

**Federal Communications Commission
Spectrum Policy Task Force**

**Report of the Spectrum Rights and
Responsibilities Working Group**

November 15, 2002

Spectrum Rights and Responsibilities Working Group

David Furth, Chair
Diane Conley
Lloyd Coward
Howard Griboff
Karl Kensinger
David Krech
Evan Kwerel
Arthur Lechtman
Sara Mechanic
Chris Murphy
Paul Murray
Bruce Romano
Priya Shrinivasan
Martha Stancill
Scot Stone
Doug Webbink
John Williams
Lori Kalani (intern)

Disclaimer

The findings and recommendations contained in this Report are those of the Spectrum Rights and Responsibilities Working Group members, and do not necessarily reflect the views of the Commission, Commission management, or the Spectrum Policy Task Force.

Table of Contents

I.	Introduction.....	1
II.	Spectrum Usage Models and Incentives for Efficient Use of Spectrum.....	2
A.	Spectrum Usage Models: Advantages and Disadvantages.....	2
1.	“Command-and-Control” Model.....	3
2.	“Exclusive Use” Model.....	6
3.	“Spectrum Commons” Model.....	8
B.	Application of the Three Models: The Story So Far	10
C.	Looking Ahead: Applying Spectrum Use Models to the Future.....	14
1.	“One Size Does Not Fit All”	14
2.	Greater Regulatory Flexibility	16
3.	Balancing Exclusive Use and Commons Models	17
a)	Factors favoring exclusive use model.....	17
b)	Factors favoring commons model	19
4.	Limited Use of Command-and-Control	20
III.	Defining Specific Rights and Obligations Within Spectrum Usage Regimes: Existing and Optimal Approaches	21
A.	Flexibility	21
B.	Regulatory Certainty.....	24
C.	Interference Standards.....	26
D.	Secondary Market Arrangements and Commission-Granted Easements	29
E.	License Terms and Term Limits on Rules	33
IV.	Other Considerations	35
A.	International Considerations	36
B.	Public Safety.....	38
C.	Spectrum Allocated for Government Use (or Shared with Non-Governmental Uses).....	40
D.	Broadcast Services	42
E.	Rural vs. Urban Areas	44
V.	Transition.....	46
A.	General Transition Considerations	48
B.	Available Transition Mechanisms	49
1.	Expanded rights “overlay” licenses combined with mandatory relocation of incumbents	50
2.	Expanded rights “overlay” licenses with grandfathering of incumbents.....	50
3.	Expanded rights “overlay” licenses combined with voluntary band- clearing/restructuring incentives for incumbents.....	50
4.	Expanded rights granted to incumbent licensees under existing licenses	51
C.	Factors Affecting the Choice of Transition Mechanism.....	51

Acknowledgements

Appendix I

I. Introduction

One of the missions of the Spectrum Policy Task Force has been to examine the types of legal rights and responsibilities the FCC assigns to licensees and other users of the spectrum it manages, and to identify alternative approaches to the definition of such rights and responsibilities that might better promote the most efficient and productive use of this spectrum. In order to acquire a fuller understanding of the issues involved, and the consequences of various approaches to defining spectrum usage rights and responsibilities, the Task Force created a Spectrum Rights and Responsibilities Working Group, which undertook several inquiries.¹

First, the Working Group examined the comments filed in response to the Public Notice issued by the Task Force on June 6, 2002.² Second, the Spectrum Policy Task Force held a Public Workshop on Spectrum Rights and Responsibilities on August 9, 2002, in which attorneys, economists, engineers, and other experts drawn from various segments of the telecommunications industry and the academic community participated.³ Panelists provided input regarding a number of topics, including theoretical spectrum rights models and their application to the practical realities of spectrum management; the advantages and disadvantages of various licensed and unlicensed models; optimal approaches to defining technical requirements; issues particular to certain services and environments, including public safety and rural areas; and mechanisms for transitioning from current spectrum usage regimes to more efficient and beneficial systems. Third, the Working Group analyzed certain frequency bands in different parts of the spectrum and different types of services that it found to be representative of the Commission's past practices with respect to establishing usage rights. The group used these analyses to: (1) understand in what circumstances and to what extent the Commission's current rules are expressions of particular regulatory models; and (2) examine how the use of these models has either promoted or deterred spectrum efficiency and the development of new technologies and services. Fourth, the Working Group reviewed numerous articles written by a variety of experts to gain further insight into how the Commission might best define spectrum rights and obligations in the future to promote the most productive use of the radiofrequencies it manages.⁴

¹ The findings and recommendations contained in this Report are those of the Spectrum Rights and Responsibilities Working Group members, and do not necessarily reflect the views of the Commission, Commission management, or the Spectrum Policy Task Force.

² The Spectrum Policy Task Force sought comment on issues related to the Commission's spectrum policies. See "Spectrum Policy Task Force Seeks Public Comment on Issues Related to Commission's Spectrum Policies," ET Docket No. 02-135, *Public Notice* (DA 02-1311) (rel. June 6, 2002). The Commission received approximately 200 comments and reply comments.

³ The Public Workshop convened on Spectrum Rights and Responsibilities (*Public Workshop on Spectrum Rights and Responsibilities*) was held on August 9, 2002. See "Spectrum Policy Task Force Announces Panelists for the August 9th Public Workshop on Spectrum Rights and Responsibilities," *Public Notice* (DA 02-1892) (rel. August 2, 2002). A transcript of the Public Workshop can be found at <<http://www.fcc.gov/sptf/files/0809fcc.pdf>>

⁴ A bibliography (with summaries) is attached as Appendix I.

This overview summarizes the Working Group’s findings, conclusions, and recommendations with respect to spectrum rights and responsibilities, based on the input received from the commenters and participants in the Public Workshop on Spectrum Rights and Responsibilities.

II. Spectrum Usage Models and Incentives for Efficient Use of Spectrum

A. Spectrum Usage Models: Advantages and Disadvantages

The Working Group examined the Commission’s spectrum policies and rules defining spectrum usage rights in relation to three general models:

- (1) “Command-and-control” model. The traditional process of spectrum management in the United States, currently used for most spectrum within the Commission’s jurisdiction, allocates and assigns frequencies to limited categories of spectrum users for specific government-defined uses. Service rules for the band specify eligibility and service restrictions, power limits, build-out requirements, and other rules.
- (2) “Exclusive use” model. A licensing model in which a licensee has exclusive and transferable rights to the use of specified spectrum within a defined geographic area, with flexible use rights that are governed primarily by technical rules to protect spectrum users against interference. Under this model, exclusive rights resemble property rights in spectrum, but this model does not imply or require creation of “full” private property rights in spectrum.
- (3) “Commons” or “open access” model. Allows unlimited numbers of unlicensed users to share frequencies, with usage rights that are governed by technical standards or etiquettes but with no right to protection from interference. Spectrum is available to all users that comply with established technical “etiquettes” or standards that set power limits and other criteria for operation of unlicensed devices to mitigate potential interference.

Commenters and participants in the Public Workshop gave significant input with respect to each of the models. Most parties provided little guidance regarding specific bands in which these models should be applied, but rather, commented at length on the general advantages and disadvantages of each model. There was not a consensus on which model is best under all conditions, though many commenters observed that the status quo – which primarily relies on the “command-and-control” model – significantly limits efficiency in many cases.

Each of these models represents an ideal. In reality, the models involve different levels of regulatory involvement, with the command-and-control model being the most proscriptive. All licensees can and should benefit from the lessons of the three basic models. In other words, for any given licensee, the Commission could adopt greater

interference protection consistent with the command-and-control model, enhanced flexibility consistent with the exclusive-use model, or enhanced access to spectrum consistent with the commons model.

1. “Command-and-Control” Model

The traditional process of spectrum management in the United States is referred to by some as the “command-and-control” model because of the strict control and oversight exercised by the government. The command-and-control model process involves four steps: allocation, adoption of service rules, assignment, and enforcement.⁵ In the allocation process, the Commission decides what types of uses it will permit in particular spectrum bands. Next, the Commission establishes service rules that specify the power limits, build-out requirements, and other rules for the service allocated in this band. The Commission then assigns licenses for use of the spectrum to specific parties through mechanisms such as first-come-first-served licensing, lotteries, comparative hearings, or auctions. Finally, the Commission enforces its allocations, service rules, and assignments against the licensees and other users of the spectrum.

The Commission’s task in applying the command-and-control model is enormous. The Commission must continually decide and revisit difficult technical questions concerning spectrum allocation, geographical coverage, system configuration, channelization, power flux density, coding, out-of-band emissions, and innumerable other technical criteria at discrete points in time.⁶ For allocations that cross international borders, the Commission must work with the National Telecommunications and Information Administration (NTIA), the Department of State, and the International Telecommunication Union (ITU) to coordinate domestic commercial proposals with government and multi-national uses. Meanwhile, rapid technological advances, changing consumer demands, and new market developments steadily erode the utility of spectrum-management decisions that the Commission made years prior to deployment.⁷

Most commenters and workshop participants stressed the costs imposed by the command-and-control approach on licensees and the public, and argued that these costs could be substantially reduced by adopting a more market-oriented approach. One of these commenters characterized the traditional policy as “ultra-conservative,” arguing that the Commission gives too much weight to the potential for interference, which burdens new entrants with restrictions and delays the introduction of new technology and competition to the public.⁸ Some questioned the Commission’s ability to allocate resources efficiently even under the best of circumstances.⁹ In addition, various parties argued that, while the Commission has a process to consider transfers and assignments,

⁵ See, e.g., Lawrence J. White, 9-Fall Media L. & Pol’y 19, 23-24 (2000).

⁶ See generally Principles for Reallocation of Spectrum to Encourage the Development of Telecommunications Technologies for the New Millennium, *Policy Statement*, 14 FCC Rcd 19868 (1999) (*Spectrum Policy Statement*).

⁷ *Spectrum Policy Statement*, 14 FCC Rcd at 19868-69, ¶¶ 1-5.

⁸ See Thomas Hazlett (Hazlett) Reply Comments at 1.

⁹ See Gerald Faulhaber and David Farber (Faulhaber and Farber) Comments at 5; see generally Hazlett Comments.

the current approach is overly burdensome and makes it difficult for spectrum to move to its highest-valued use. These commenters contended that a well-functioning market for resources offers a level of efficiency that a centralized, bureaucratic approach can never match.¹⁰

Several commenters, however, argued in favor of retaining a command-and-control approach to allocation for certain services on the grounds that more market-based alternatives, such as the exclusive use model, would undervalue or thwart the provision of some important services.¹¹ Advocates for public-safety organizations contended that the benefits from providing their services cannot be measured in economic terms – arguing that one cannot put a price on safety or human life – and that the spectrum necessary for such services should not be subject to market mechanisms.¹² Some private radio operators argued that they support the nation’s industrial and commercial infrastructure, and therefore they should not have to face the greater risk that would accompany a move away from the status quo.¹³ Radio astronomy advocates feared that an allocation mechanism that does not include a significant government role will undervalue long-term scientific research projects that may offer significant social benefits but also require dedicated spectrum bands.¹⁴ Similarly, several satellite operators argued that moving to an exclusive use model may give too little weight to the public interest benefits of serving remote and rural areas and providing an alternative communications infrastructure for use in case of disasters.¹⁵ Broadcast commenters asserted that statutory

¹⁰ See generally Faulhaber and Farber Comments; Statements of Thomas Krattenmaker and Peter Pitsch at the *Public Workshop on Spectrum Rights and Responsibilities*.

¹¹ See, e.g., Consumer Federation of America Comments at i (“The moment spectrum is auctioned, the private economic interests of the license holder comes into conflict with the citizen interest. Once the airwaves are sold-off – “propertized” or “monetized” in current jargon – the new owners will decide who gets to use it.”).

and how it is used. If you have enough money, you get to speak, if you do not, you are out of luck.”).

¹² See, e.g., Association of Public Safety Communications Officials-International (APCO) Comments at 3; Statements of Ron Haraseth and David Warner, respectively, at the August 5, 2002 Public Workshop on Spectrum Efficiency (*Public Workshop on Spectrum Efficiency*) at 70, 73; see also Satellite Industry Association (SIA) Comments at 18 (noting that “[s]everal features of satellite systems offer advantages for public safety, law enforcement and emergency response organizations.”); Bergen County Comments at 1-5 (noting that “market oriented policies are but one” consideration for the Commission in executing its statutory public interest mandate).

¹³ See, e.g., Private Radio Commenters Comments at 2 (many businesses are inherently dangerous, and the licensees cannot afford the risk of loss of critical communications services from a commercial provider); Aeronautical Radio, Inc. (ARINC) Comments at 2 (“Allocations will always be needed to provide for safety functions, especially where radio is the only means of communication.”).

¹⁴ See, e.g., National Radio Astronomy Observatory Comments.

¹⁵ See, e.g., Boeing Comments at 8, 9-10 (“it would disserve the public interest if the Commission placed its goal of spectrum efficiency above its other equally important and statutorily mandated goals and obligations”); SIA Comments at 4 (noting that the Communications Act requires the Commission “to make available, so far as possible, to all the people of the United States, a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges . . .”) (citation omitted); Statements of Michael Fitch at the *Public Workshop of Spectrum Efficiency* at 150 (“the safety implications [of spectrum used for commercial aviation and navigation] are very high”); Mobile Satellite Venture Comments at 15 (auctioning the right to flexibly use satellite spectrum would “thwart the Commission’s goals of ensuring service to rural and underserved areas and would lead to decreased spectrum efficiency and utilization”).

public interest considerations and the free over-the-air nature of broadcasting service have limited applicability to market-based spectrum licensing models.¹⁶

In other cases, parties asserted that transaction costs associated with assembling the spectrum for a communications network might make providing service prohibitively expensive. Satellite interests, for example, stated that the transaction costs of acquiring spectrum or landing rights through hundreds of seriatim rounds of competitive bidding around the globe would prevent the deployment of international satellite systems.¹⁷ Other parties asserted that specific spectrum bands are needed, and losing the rights to even a few bands could make international harmonization difficult or impossible.¹⁸ These commenters added that an exclusively market-based approach might create perverse incentives to game the international regulatory processes by encouraging nations to make disruptive “paper filings” for spectrum and orbital resources at the International Telecommunications Union.¹⁹ Accordingly, some of these commenters asserted the need for government involvement in overcoming market failures and prohibitively high transaction costs.

Finally, some have argued the physical properties of spectrum, combined with the peculiarities of network industries in general and wireless telecommunications in particular, may require a certain level of “command-and-control” in any spectrum model to avoid inefficient allocation.²⁰ This argument maintained that characteristics such as consumption externalities that require a critical mass before a technology becomes useful, high switching costs that tend to “lock in” consumers to existing technologies, and large economies of scale all increase the potential for market failure and thus necessitate a higher level of regulatory involvement.

¹⁶ See generally National Association of Broadcasters/Association for Maximum Service Television (NAB/MSTV) Joint Comments; Society of Broadcast Engineers (SBE) Comments; Association of Public Television Stations (APTS) Comments; National Public Radio (NPR) Comments.

¹⁷ See, e.g., Satellite Industry Association (SIA) Comments at 5-6, 7-8; (“Sequential auctions [in foreign countries] would necessarily follow [a U.S. auction for satellite spectrum] and would deter investment in satellite systems [not only] by raising both the cost of such systems but also by adding an additional level of uncertainty as to the overall licensing, and thus deployment, costs associated with the system.”).

¹⁸ See Statements of David Weinrich, Stephen Blust, Stephen Gillig, and Michael Fitch at *Public Workshop on Spectrum Efficiency*; Hughes Network System (Hughes) Reply Comments at 14-15.

¹⁹ See, e.g., SIA Comments at 8 (“With the advent of auctions, however, other nations may try to stake their claim to prospective auction revenues by claiming slots that U.S. systems need through ‘paper filings’ that are never actually built.”).

²⁰ See, e.g., Oz Shy, *The Economics of Network Industries*, Cambridge Univ. Press 1-6 (2001).

2. “Exclusive Use” Model

The “exclusive use” model, as discussed in this report, refers to a licensing model in which a licensee has rights that are exclusive, flexible, and transferable, and has specific responsibilities that come with this interest.²¹ Under an exclusive use model in its purest form, licensees acquire an interest in a frequency band that is similar to a fee simple interest in the spectrum, with the right granted being exclusive and perpetual, or nearly so. Few or no restrictions exist on the commodification of the spectrum, which allows for secondary market trading, with the spectrum holder’s rights transferring with the sale or lease. In short, an exclusive use model provides that the licensee obtains rights to do everything within its assigned frequencies not expressly prohibited under the license. Finally, responsibilities also accompany rights to the spectrum, including technical rules that establish power and out-of-band emission limits. These responsibilities are the flip side of rights, indicating the level of power and potential interference licensees must tolerate from other operators, which corresponds to the rights of these other parties.

Parties who advocated granting exclusive rights to licensees argue that such an approach encourages investment. They indicated that business enterprises view any potential for interference as a danger, and that incumbents are deterred from investing in new technologies if they do not have exclusive rights to spectrum and do not know who might interfere with them in the future. Some economists favored the exclusive use model because it is built on the assumption that there is scarcity in the spectrum, at least at some times and some places.²² They asserted that this scarcity may be the result of limited access, or an excess of spectrum use relative to capacity. They explained that the exclusive use model promotes economic efficiency because its key characteristics – clearly defined rights, exclusivity, flexibility and transferability – are necessary for efficiently allocating any scarce resource among competing uses.

Participants representing parties interested in trading spectrum rights noted that transferability of rights would be critical in order to achieve efficient use of the spectrum.²³ They claimed that the right to trade this resource would allow it to be moved to its highest valued use, which would help rectify the imbalance between spectrum shortages in some areas and surpluses in others. Rural carriers make similar arguments, noting that secondary markets may improve spectrum efficiency and enable providers to gain access to spectrum for use in rural markets.²⁴

Parties that opposed an exclusive use model argued that allocation based on giving exclusive interests to licensees in particular bands may not be the most efficient

²¹ The “exclusive use” model, as referenced herein, is presented as a theoretical model, as is the commons model that follows it. Their characteristics are described below. This exclusive use model is not equivalent to the many different variants of “exclusive use” licensing currently employed by the Commission in bands throughout the spectrum.

²² See, e.g., Faulhaber and Farber Comments; Hazlett Comments.

²³ See Statements of Brent Wilkins at the *Public Workshop on Spectrum Efficiency*.

²⁴ See, e.g., National Telecommunications Cooperative Association (NTCA) Comments; Rural Telecommunications Group (RTG) Comments.

policy. These parties stressed the benefits of an approach based on shared use under a commons approach, with less emphasis on a purely exclusive use model.²⁵ Other commenters argued that an exclusive use approach deters innovation because technology advances at least in part out of a need to make better use of resources, and licensees with exclusive use rights have guaranteed access to the spectrum resource. Several even challenged the assumption of scarcity, upon which the exclusive use model is built.²⁶ Some commenters further opposed any creation of a quasi-property right in spectrum, arguing that such a step would be contrary to the Communications Act, detrimental to free speech, and a threat to economic competitiveness in communications markets.²⁷

Finally, some parties raised concerns about market failure that could accompany a strict application of an exclusive use model. Some feared that such a model might encourage commercial hoarding of spectrum rights that would exclude innovative, non-profit, public-service or other uses of the spectrum that benefit society as a whole. Also, they asserted that spectrum users who require immediate, but infrequent access to spectrum, such as public safety agencies, might be unable or unwilling to pay for commercially available services that could provide the same level of reliability in times of peak demand that their current services offer.²⁸ In addition, they were concerned that spectrum users that require simultaneous operation over global geographic areas, such as satellite service providers, might not obtain internationally harmonized spectrum due to holdout by individual spectrum owners.²⁹ Additionally, they observed that spectrum users that require the simultaneous use of large segments of spectrum, such as ultra wideband (UWB), or the short-term use of portions of a wide range of spectrum, such as software-defined radio (SDR), might never overcome the transaction costs necessary to gain access to spectrum to operate.³⁰ They argue that SDR and similar technologies shrink the “frequency/time/space dimension that a user must occupy exclusively in order to communicate without interference,” which in turn creates units “so small as to make the transaction costs involved in negotiating allocation of exclusive property rights to them prohibitive.”³¹

²⁵ See, e.g., David Reed (Reed) Comments; Jon Peha (Peha) Comments; Statements of Preston Marshall at the *Public Workshop on Spectrum Efficiency*.

²⁶ See, e.g., Werbach Comments; Reed Comments.

²⁷ See, e.g., New America Foundation Reply Comments.

²⁸ See, e.g., Bergen County Comments at 3 (noting “there are a range of national policy objectives, such as public safety, that simply cannot be accomplished through a market direction” and adding that many of these objectives “will not be achieved by awaiting a market solution”); Society of Broadcast Engineers Comments at 5 (“SBE is at a loss to understand how a blanket market-driven allocations policy can do anything but cripple [Broadcast Auxiliary Service] use during emergencies”).

²⁹ See, e.g., Statements of David Weinrich, Stephen Blust, Stephen Gillig, and Michael Fitch at *Public Workshop on Spectrum Efficiency*.

³⁰ See, e.g., XtremeSpectrum at 5 (supporting a non-exclusive “regulatory scheme that welcomes low-power, non-interfering devices in spectrum already allocated for other purposes”).

³¹ See, e.g., Benkler, Yochai, “Overcoming Agoraphobia: Building the Commons of the Digitally Networked Environment,” *Harvard Journal of Law and Technology*, Vol. 11 (1998), at 322.

3. “Spectrum Commons” Model

In a spectrum commons model, spectrum is available to all users that comply with established technical “etiquettes” or standards that set power limits and other criteria for operation of unlicensed devices to mitigate potential interference. Usage rights are flexible, with minimal or no restrictions placed on the types of use of the spectrum. As is the case under the regulatory regime currently governing unlicensed Part 15 spectrum, there are no licenses³² and the primary allocation method for using the spectrum is akin to “first come, first served.”

Supporters of the commons model argued that this approach leads to greater technological innovation and spectral efficiency than exclusive access: because no spectrum is exclusively held, spectrum commons users have incentives to create spectrally efficient frequency-hopping technologies, whereas licensed spectrum typically sits idle when the license-holder is not transmitting.³³ Commons supporters also stressed that this model precludes warehousing of spectrum, which can create artificial scarcity and is a potential disadvantage of an exclusive use model. Furthermore, proponents of an open, commons approach claimed that spectrum scarcity might actually be reduced under such a regime because of the efficiency enhancing possibilities of new technologies (e.g., ad hoc networks) and the fundamentally different spectrum demands of architectures such as mesh networks.³⁴

Although there is some indication that a commons regime may not attract the same level of investment as an exclusive rights system, proponents also argued that the need for long-term capital investments in networks is reduced with this model because the innovation cycle is faster.³⁵ In addition, attracting major amounts of financing may be less of an issue for systems such as mesh networks³⁶ because capital costs are distributed among users (through smart receivers, for example) rather than being concentrated at central points of transmission as in traditional architectures. However, various parties noted that industries that do require large fixed investments might have trouble attracting capital or be hesitant to invest further because of the lack of guarantees against future interference.³⁷

Parties that opposed a spectrum commons model, however, argued that some of the supposed incentives for innovation do not work and that significant disadvantages

³² There is, however, some process for equipment certification or approval.

³³ See, e.g., Kevin Werbach (Werbach) Comments at 7 (“In a spectrum commons, every user has incentives to use spectrum wisely and intelligently, because it has no guarantee of protection against competing uses”).

³⁴ See Werbach Comments at 4; Benkler, Yochai (2002) “Some Economics of Wireless Communications,” 15 Harvard Journal of Law and Technology, forthcoming 2002-3, at 19.

³⁵ See, e.g., David Reed (Reed) Comments.

³⁶ Mesh networks are communications architectures in which each node is connected to every other node. They operate in contrast to ring networks in which every node is part of a closed loop, or point-to-multipoint networks, which rely on key transition points.

³⁷ See, e.g., Cellular Telecommunications & Internet Association (CTIA) Comments; Cingular Wireless LLC (Cingular) Comments; Sprint Corporation (Sprint) Comments.

also accompany use of this model, including: overuse, with resulting interference; service limitations due to low-power requirements and a rising noise floor; and underinvestment due to these overuse and service limitations.³⁸ These parties argued that a commons approach would result in a spectrum shortage.³⁹ They asserted that while the “tragedy of the commons”⁴⁰ could be ameliorated through rules on power levels, modulation, back-off schemes, and other approaches,⁴¹ it would remain to the extent there is too little spectrum relative to the communications demanded at a given time and place.⁴² Commenters also expressed concern that a “pure” commons model could lead to an unintelligible cacophony of mutually interfering signals. Without some type of government-imposed restrictions on the use of spectrum commons, commenters acknowledged that “a poorly designed system, although economically more feasible for some, would only lead to undue hardship[]” for other spectrum users.⁴³ Some economists also argued that many of the benefits of a commons model could be achieved via private owners who allocate their spectrum for such purposes.⁴⁴

Other commenters argued that unlicensed spectrum should not be seen as a replacement for licensed spectrum, but akin to a public park, free for anyone to use.⁴⁵ Under this approach, the Commission would use market-based mechanisms to sell exclusive use licenses, but also preserve some spectrum as an unlicensed spectrum commons for new or emerging technologies. Many commenters supporting this balanced approach also supported the allocation of additional unlicensed spectrum.⁴⁶ Other parties support maintaining a licensed regime with the right of non-interfering technologies

³⁸ See, e.g., GPS Industry Council Comments at 3 (“The primary role of the FCC should be as steward of the nation’s radiofrequency spectrum to ensure its availability for the most important and beneficial uses.”).

³⁹ See, e.g., Station Resource Group Comments at 4 (“The more speedily the Commission moves to making the spectrum a Commons, though, with all the policy shifts this implies, the more rapidly we will evolve from the current artificial scarcity construct to real scarcity. For the most part, the market is the most practical solution to a shake-out in the best interest of the public.”).

⁴⁰ The tragedy of the commons occurs when too many parties have the right to use a resource, such that the resource is overused.

⁴¹ See, e.g., Jon Peha (Peha) Comments at 6; Reed Comments.

⁴² See, e.g., Faulhaber and Farber Comments; Statement of Peter Pitsch at the *Public Workshop on Spectrum Rights and Responsibilities*.

⁴³ See Part-15.ORG Comments at 8.

⁴⁴ See, e.g., Hazlett Comments at 1-2; Faulhaber and Farber Comments.

⁴⁵ See, e.g., Hazlett Comments; Faulhaber and Farber Comments.

⁴⁶ See, e.g., New America Foundation et al. Reply Comments (asserting that over 20 commenters explicitly support additional unlicensed spectrum and only a handful actively oppose it); Consumer Electronics Association Reply Comments; Cisco Comments (advocating setting aside additional unlicensed spectrum to promote innovation in creating broadband devices, such as wireless LANs); Cingular Comments at 50-51 (supporting additional spectrum for unlicensed devices in unlicensed bands only, asserting that spectrum overlays in licensed bands cause too much interference); Citizens Media Corp/Allston-Brighton Free Radio Comments at 14 (asserting that spectral efficiency is contingent upon whether technical innovation is allowed to flourish through an increase in the amount of unlicensed spectrum or use of “holes” or underdeveloped areas in currently occupied areas of the spectrum); ShreveNet Comments at 2 (asserting that more license-exempt spectrum should be set aside for rapid expansion of wireless Internet).

(such as spread spectrum, or UWB devices) to operate within the same band, rather than allocating separate unlicensed spectrum.⁴⁷

B. Application of the Three Models: The Story So Far

In most bands, the Commission has historically used variations of the traditional command-and-control approach to defining rights, in which spectrum is allocated and assigned for specific uses that are limited, often very narrowly, by regulation. More recently, the Commission has developed rules for certain bands that approximate the exclusive rights model, and rules for other bands that approximate the commons model, but it has not applied either model to significant portions of the spectrum, and has not used either model in a pure form.

The command-and-control approach has taken different forms over time. In many cases the Commission has arrived at a regulatory structure through an ad hoc process of accretion over the years, while in other cases it has used a less ad hoc process and has adopted an overall plan for all services in a band at the same time. Moreover, some usage regimes that have command-and-control features have allowed for considerably more usage flexibility than others. And, many licensing regimes involve “exclusive use” licenses of a more restricted form than the exclusive use model involving flexible usage rights discussed in Section II.A above.

For example, in the 902-928 MHz band, a block of spectrum in which a number of licensed services as well as unlicensed users operate, the Commission has made a series of specific regulatory decisions over time that has resulted in a complex hierarchy of users subject to significant restrictions.⁴⁸ Thus, Federal Government radiolocation systems have primary rights in the band. Next in order of priority are Industrial, Scientific, and Medical (ISM) devices, and Federal Government fixed and mobile and Location and Monitoring Systems (LMS) are secondary to these uses. Licensed amateur radio operations and unlicensed Part 15 operations are secondary to all other uses of the band.

The 27.5-30.0 GHz band is another example of command-and-control regulation of a specific band, though in this instance, the Commission adopted an overall plan for all services in the band at the same time. In the 1990s, the Commission concluded that this band, then occupied by fixed point-to-point microwave service, was underutilized, and therefore adopted a band segmentation plan that provided for use of the band by Local Multipoint Distribution Service (LMDS), a terrestrial service, and certain designated satellite uplinks and feeder links. Co-frequency sharing between services or systems was allowed in band segments where the Commission and parties concluded that it was

⁴⁷ See, e.g., XtremeSpectrum Comments at 5, 10 (advocating that certain shared spectrum technologies, such as ultra-wideband, are low-power, non-interfering devices that can operate efficiently in spectrum already allocated for other purposes).

⁴⁸ See generally 47 C.F.R. Part 15 – Radio Frequency Devices; Part 18 – Industrial, Scientific, and Medical Equipment; Part 90, Subpart M – Intelligent Transportation Systems Radio Service; Part 97 – Amateur Radio Service.

technically feasible. For the remaining parts of the band the Commission created primary and secondary usage rights among the services.⁴⁹

From the Commission's experience with command-and-control regulation, it is apparent that overregulation can deter both efficiency and innovation. The highly regulated nature of certain services has tended to discourage technological change because the means of providing permissible services are narrowly defined in terms of current or outdated technology. Moreover, in cases where licensees are limited in what services they are permitted to offer, they have no incentive to seek out a higher valued use for the spectrum.

One example of restrictive regulations having such effects may be found in the 12.75-13.25 GHz band, which is shared by Broadcast Auxiliary Services (BAS), Cable Antenna Relay Service (CARS), Fixed Microwave, Geo-Stationary Orbit (GSO), and Non-Geostationary Orbit (NGSO) Fixed Satellite Service (FSS). The Commission's rules have not permitted BAS operators to use digital modulation techniques,⁵⁰ even though the broadcasting stations they serve are required to convert to digital television, thus complicating the transition to DTV and precluding other efficiencies. Other rules limit the use of the frequencies; for example, CARS licensees are permitted to transmit only video signals (not voice or data). In addition, some of the required procedures for limiting potential interference between users of the band reduce the efficiency gains that could be obtained from the use of technologically advanced real time frequency coordination devices. Limitations on licensee eligibility for BAS and CARS licenses have also contributed to the inhibition of innovation in these fixed services. Only recently has the Commission expanded eligibility for CARS licenses to include previously non-eligible multichannel video programming distributors such as private cable operators.⁵¹

The Commission has begun to move away from command-and-control to more flexible spectrum policies in recent years. In addition, the Commission has amended a variety of service rules to increase the flexibility of existing services. Among the many examples that could be cited are the Paging and Radiotelephone Services rules. Early technological and regulatory restrictions regarding the provision of one-way paging service have been eliminated and paging licensees are free to develop and implement new

⁴⁹ See, e.g., Rulemaking To Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, To Reallocate the 29.5-30.0 GHz Frequency Band, To Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services; Petitions for Reconsideration of the Denial of Applications for Waiver of the Commission's Common Carrier Point-to-Point Microwave Radio Service Rules; Suite 12 Group Petition for Pioneer Preference, CC Docket No. 92-297, *Second Report and Order, Order on Reconsideration, and Fifth Notice of Proposed Rulemaking*, 12 FCC Rcd 12545 (1997); *Third Report and Order*, 12 FCC Rcd 22310 (1997); *Third Order on Reconsideration*, 13 FCC Rcd 4856 (1998); 47 C.F.R. §§ 101.103, 101.1005.

⁵⁰ In the Matter of Revisions to Broadcast Auxiliary Service Rules in Part 74 and Conforming Technical Rules for Broadcast Auxiliary Service, Cable Television Relay Service and Fixed Services in Parts 74, 78 and 101 of the Commission's Rules, ET Docket 01-75, *Report and Order* (FCC 02-298 (rel. Nov. 13, 2002).

⁵¹ See Amendment of Eligibility Requirements in Part 78 Regarding 12 GHz Cable Television Relay Service, CS Docket No. 99-250, *Report and Order*, 17 FCC Rcd 9930 (2002).

technologies and uses, including one-way messaging, two-way messaging, mobile data, and fixed wireless services.⁵² The Commission has also amended certain Part 15 rules several times in the last fifteen years to accommodate technological developments in spread spectrum technology.⁵³ Nonetheless, broad applications of flexible rights policies have been adopted for only relatively limited portions of the spectrum.

To the extent that the Commission has adopted a flexible exclusive use approach to spectrum licensing, there is general consensus that the Commission's most successful application of this approach to date in terms of deployment of service has been broadband Personal Communications service (PCS), operating in the 1850-1910 MHz and 1930-1990 MHz bands. The PCS rules follow the exclusive use model quite closely: the Commission granted PCS licensees rights to large blocks of spectrum and allowed substantial flexibility in terms of technology and usage rights, subject only to interference parameters to protect neighboring geographic areas and adjacent spectrum blocks. There are no other users of the band other than fixed microwave incumbents, which are subject to mandatory relocation requirements. However, unlike the "pure" exclusive use model, the PCS rules do not allow for unrestricted flexibility of use, because the allocation precludes use of this spectrum for broadcasting.

While the rapid proliferation of wireless services in the PCS band is well-documented, the Commission's application of a flexible exclusive use model in some other bands (e.g., Wireless Communications Service (WCS)) has not been equally successful. Some parties have claimed that the rules governing these services are "excessively" flexible and that, as a result, manufacturers have not known what sort of equipment to build.⁵⁴ Nonetheless, this does not necessarily mean that the slower development of certain services accorded flexible rights is attributable to the flexible nature of the usage rights awarded by the Commission. In some instances, prior allocation and licensing decisions by the Commission have resulted in adjacent spectrum bands being used by dissimilar services with different spectrum usage characteristics, which in turn has created interference issues that impose practical constraints on licensees even though their licenses give them nominal flexibility. In other instances, spectrum use has been limited due to lack of market demand for service. However, even in such instances, the flexibility provided to licensees allows for more productive future spectrum use when technology and market conditions improve, without the need for additional regulatory intervention.

The Commission has also applied rules to several spectrum bands that resemble the commons model. The 2.4 GHz band (2402-2450 MHz), for example, is used on an open access, unlicensed basis by thousands of unlicensed consumer and industrial devices, including cordless phones, microwave ovens, and wireless LANs such as those

⁵² See generally 47 C.F.R. Part 22, Subpart E – Paging and Radiotelephone Service.

⁵³ See, e.g., Amendment of Part 15 of the Commission's Rules Regarding Spread Spectrum Devices, ET Docket No. 99-231, *Second Report and Order*, 17 FCC Rcd 10755 (2002).

⁵⁴ See, e.g., Motorola Comments at 9; Nokia Inc. (Nokia) Comments at 2.

using 802.11b and Bluetooth technology.⁵⁵ The proliferation of Wi-Fi and similar technologies was not anticipated when the Commission's rules for unlicensed devices were established, but the open access and technical flexibility afforded by these rules (the primary constraint being the limitation of Part 15 devices to very low power) has allowed significant market-driven innovation. The popularity of the unlicensed 2.4 GHz band makes it clear that there is demand for a commons-type usage model for some spectrum, and that this model can work for several different sorts of services. The parallel to the "pure" commons model is not perfect, however, because the types of equipment used must be registered and operate under certain rules such as those regarding primary use rights and equipment standards.

Moreover, not all unlicensed bands have been as successful as 2.4 GHz. In the unlicensed PCS band, for example, there has been very little development of unlicensed technologies, in large part because of the difficulty of establishing an effective mechanism to pay for the relocation of licensed incumbents in the band. The FCC established UTAM (Unlicensed PCS Ad Hoc Committee for 2 GHz Microwave Transition and Management) to enable the transition from use by incumbent fixed microwave licensees in the band to unlicensed use. The industry must collect money from manufacturers of unlicensed devices to compensate incumbent fixed microwave licensees for their relocation. Unlicensed PCS products must only operate at UTAM-approved customer locations until incumbents have moved out of 1910-1930 MHz. If a product moves away from its coordinated location it may not be reactivated, until UTAM verifies coordination at the new location.⁵⁶ UTAM assesses a fee on each unlicensed PCS product and directs the money toward the incumbent relocation effort (\$20 in 2001). The economic non-viability of this compensation mechanism plus the lack of development of equipment for use in the unlicensed band have combined to inhibit development of a narrowband PCS service.

An examination of the flexible exclusive use and commons models as they have been applied to date suggests that each model has led to different types of technical and economic efficiencies. In broadband PCS, for example, licensees have developed centrally managed wireless networks that cover large geographic areas and accommodate large numbers of mobile customers. The licensing of multiple users has also led to significant competitive benefits in the CMRS market. Parties that have noted the success of PCS disagree about what has driven the innovations that we have seen in that service; some think they have been driven by investments in exclusive use, while others said that they had developed because of competition. It seems likely that in fact both factors have played an important role in the development of PCS. In any event, it does not appear that flexible exclusive use models have deterred the development of technologies and service in this instance. Although some commenters argue that exclusive use will not lead to technical innovations such as Wi-Fi, the PCS rules do not preclude licensees from developing low power Wi-Fi networks if they choose to. The fact that PCS licensees have not done so to date is likely due to the fact that (1) the PCS rules provide for

⁵⁵ See generally 47 C.F.R. Part 15 – Frequency Devices; 47 C.F.R. Part 18 – Industrial, Scientific, and Medical Equipment.

⁵⁶ See 47 C.F.R. § 15.307.

flexibility and interference protection that enables licensees to develop higher-power system architectures, and (2) licensees face a higher opportunity cost with respect to their spectrum that makes such architectures a higher valued use.

In the Part 15 bands, where there are strict power limits and no interference protection, the opportunity cost of spectrum is reduced to a very low amount approaching zero,⁵⁷ which forces spectrum users to channel their investment exclusively into developing robust low power technology that can function in this environment and continue to function as the environment grows more congested. The initial technologies that evolved in these bands were low power devices such as cordless phones and garage door openers. More recently, the Part 15 bands have been host to the emergence of “smart” low power devices that can support more sophisticated applications, including peer-to-peer networking. This has resulted in a significant surge of economic investment in these bands. However, the commons model may not offer sufficient certainty or reliability for other types of spectrum uses. For example, services requiring large upfront capital investments or users promising a certain standard of service to paid subscribers may not wish to take the risk of not knowing exactly where, when, and next to whom on the spectrum they can operate. Therefore, it is unlikely that a uniform approach to spectrum management can meet the very different needs of all spectrum users.

C. Looking Ahead: Applying Spectrum Use Models to the Future

1. “One Size Does Not Fit All”

The Working Group looked at the question of which of the above-described spectrum use models the Commission should use in the future and what the appropriate mix might be. While the Commission’s experience with existing bands provides some important lessons about the costs and benefits of various models that have been applied, it would not be reasonable to conclude from this experience that there is one particular regulatory model that should be applied uniformly to all bands or all services. It is also notable that, with few exceptions, participants in the Public Workshop agreed with the principle that in spectrum policy, “one size does not fit all.”⁵⁸ Thus, while there was a split among commenters and panelists who advocated an exclusive use regime and those who advocated a commons regime, most commenters and panelists appeared to support the proposition that there is a place in the Commission’s spectrum policy for both models. Some also asserted that the two can be complementary, and that grants of

⁵⁷ The opportunity cost for using Part 15 spectrum is not actually zero because, although there is no interference protection and no limit on entry, any user can choose to use some part or all of a particular band for many different uses. Thus, for example, an individual user of Part 15 devices may not be limited in the number of Wi-Fi devices he or she may install in his/her home, but this individual may find that other devices operating on the same band (*e.g.*, portable phones) may not function properly. The opportunity cost, while small, of using the WiFi devices is the inability to use a portable phone, even though users of the same frequencies a block away have no impact on the individual.

⁵⁸ See, *e.g.*, Statements of David Siddall and Michael Kurtis, respectively, at the *Public Workshop on Spectrum Rights and Responsibilities* at 119, 169; Motorola Comments at 8; Information Technology Industry Council Comments at 3.

exclusive primary rights need not constrain the development of innovative unlicensed technologies.

Commenters suggested that the FCC should seek to find a balance between a commons model, which would allow for unlicensed innovation and enable ad hoc open networks systems, and an exclusive use model, which would give licensees sufficient predictability to stimulate long-term capital investments. Commenters also urged the Commission to consider variations and gradations of each model. For example, a number of commenters suggested that granting flexible exclusive use rights to spectrum users did not preclude the Commission from imposing some regulatory limitations on use, analogous to zoning restrictions that are placed on property owners by local governments. Any service not included in the rights granted to the licensee would have to be considered through a zoning-like hearing in which all interested parties could comment. Such a model would in fact be a type of limited exclusive use model. A different variation of a limited exclusive use model would be one in which the licensee has exclusive rights to provide any service on its assigned frequencies but other users are granted easements to use those frequencies on a non-interference basis. Certain commenters, however, were opposed to the creation of property rights, and particularly the idea of rights in fee simple, in spectrum.

Participants in the Public Workshop focused a good deal of attention on how different rights models would affect emerging “smart radio” technologies, such as Software Defined Radio (SDR). They noted that SDR will be in the marketplace soon and that there are significant advantages from using SDR.⁵⁹ One panelist indicated that the FCC needs to come up with mechanisms for accommodating SDR and suggested that it needs to consider the practicality of not only creating more commons but also of setting up a simultaneous exchange for trading.⁶⁰ Another panelist observed that as communications ranges get shorter and shorter in terms of distance (for example, with developments such as Wi-Fi), the commons model becomes more appropriate because it entails fewer regulatory requirements and allows parties to focus on technical solutions for the delivery of data.

There was broad support among proponents of unlicensed spectrum use for permitting greater access to unused portions of licensed bands, even including broadcast, by smart radios on a non-interference basis. However, as indicated above, advocates of exclusive use models and incumbent licensees expressed skepticism about such an approach. It was also pointed out that the Commission needs to be pragmatic in permitting frequency agile radios too much access to licensed bands because licensed users should be expected to implement new technologies and thereby reduce the gaps available for frequency agile radios to use.

The issue of congestion was also raised in connection with unlicensed use, and, as with many other matters, there was disagreement regarding whether such congestion is

⁵⁹ See, e.g., Statement of Bruce Fette at the *Public Workshop on Spectrum Rights and Responsibilities* at 49, 67, 78; Hyres Comments at 4; Motorola Comments at 14-15.

⁶⁰ See Statement of Peter Pitsch at the *Public Workshop on Spectrum Rights and Responsibilities* at 90.

“real” or an artifact of regulation.⁶¹ Thus, one panelist stated that the FCC needs to ensure that swaths of unlicensed spectrum do not become paralyzed by congestion, and one party that filed comments on the Public Notice indicated that all use of unlicensed spectrum should be regulated to provide clear rules regarding an access etiquette, maximum power levels, and/or duty cycle restrictions, among other technical considerations.⁶² However, one panelist asserted that there was no real congestion in unlicensed spectrum, only congestion caused by regulatory limits.⁶³

While considerable emphasis was placed on promoting innovation through an expansion of unlicensed uses, at least one panelist argued that licensing is of critical importance for the opposite reason, i.e., ensuring consumers that their equipment will continue to work with existing infrastructure.⁶⁴ Many agreed that this is the Commission’s role, but some also indicated that this goal can be achieved through the use of band managers.⁶⁵ Certain panelists also argued that the market should decide which equipment is maintained as viable, that the obsolescence of some existing equipment is an indication of progress, and that the overall benefit to consumers of rival systems battling in the marketplace outweighs the negative impact on those who are stranded with obsolete equipment.⁶⁶

Finally, although participants in the Public Workshop generally subscribed to the principle of “one size does not fit all,” and appeared to agree that there is a place for different spectrum usage models, they did not supply many specifics as to how much spectrum should be designated for exclusive use relative to shared or unlicensed uses.

The Working Group agrees with the consensus view expressed by participants in this process that “one size does not fit all” in spectrum policy. We also believe that there is considerable room to move from the largely *ad hoc* approach to spectrum rights that has evolved historically to a much smaller set of basic spectrum rights models that can be applied more consistently and comprehensively across the radio spectrum as a whole.

2. Greater Regulatory Flexibility

In general, as the comments suggest, we recommend that the Commission base its spectrum policy on a balance of the three basic spectrum rights models outlined in Section II.A above: an exclusive use approach, a commons approach, and a command-and-control approach. We further recommend that the Commission fundamentally alter the existing balance among these models – which is dominated by legacy command-and-

⁶¹ See Statement of Peter Pitsch at the *Public Workshop on Spectrum Rights and Responsibilities* at 42.

⁶² See Statement of Tom Hazlett at the *Public Workshop on Spectrum Rights and Responsibilities* at 185.

⁶³ See Statement of David Reed at the *Public Workshop on Spectrum Rights and Responsibilities* at 178, 204.

⁶⁴ See Statement of Gee Rittenhouse at the *Public Workshop on Spectrum Rights and Responsibilities* at 69.

⁶⁵ See, e.g., Statement of Tom Hazlett at the *Public Workshop on Spectrum Rights and Responsibilities* at 186.

⁶⁶ See, e.g., Statement of Tom Hazlett at the *Public Workshop on Spectrum Rights and Responsibilities* at 187.

control regulation – by expanding the use of both the exclusive use and commons models throughout the radio spectrum, and limiting the use of the command-and-control model to those instances where there are compelling public policy reasons to continue using it.

Ultimately, wherever there are competing uses for a resource – that is, wherever there is scarcity – some mechanism must exist for allocating that resource. A mechanism based on markets, such as an exclusive use model, will be most efficient in most cases. However, reasonable restrictions or rules will be necessary to overcome specific market failures. Government may wish to employ such powers as eminent domain to acquire appropriate bands for public safety use, for example. Similarly, government may wish to promote the important efficiency and innovation benefits of a spectrum commons by allocating spectrum bands for shared use, much as it allocates land to public parks. Finally, for the reasons stated above, the command-and-control model should be reserved only for cases of significant market failure.

Thus, to the extent feasible, more spectrum should be identified for both licensed and unlicensed uses under flexible rules, and existing spectrum that is subject to more restrictive command-and-control regulation should be transitioned to these models to the greatest extent possible, as discussed below. If this approach is consistently applied to Commission spectrum policy decisions, it has the potential to significantly reduce the artificial scarcity of spectrum that currently exists as a result of barriers to access. This will have the beneficial effect of reducing the cost of obtaining exclusive spectrum rights where an exclusive use approach is used, and will also help to alleviate congestion of spectrum that is made available on a commons basis, thus mitigating (though not eliminating) the risk of the tragedy of the commons.

3. Balancing Exclusive Use and Commons Models

The recommendation to move towards greater reliance on exclusive use and commons models requires that the Commission also determine the appropriate balance between these two models. There are a number of variables that may be relevant to this determination with respect to any particular band, but the Working Group believes that the key factors to be considered are (1) spectrum scarcity and (2) transaction costs associated with moving spectrum from less efficient to more efficient use. By “spectrum scarcity,” we mean the degree to which competing demands to use particular spectrum exceed the supply of spectrum available. By “transaction costs,” we mean the expenditure of time and resources required for a potential spectrum user to obtain the spectrum access rights necessary to its proposed spectrum use.

a) Factors favoring exclusive use model

In general, where spectrum scarcity is high and the transaction costs of transferring or dividing rights to the spectrum are low, these factors tend to favor application of the exclusive use model. The exclusive use model is appropriate because it gives the most incentives to efficiently use scarce spectrum. Where rights and responsibilities are clearly defined and effectively enforced, the characteristics of this

model— *e.g.*, exclusivity, flexibility, and transferability – help move resources to their highest valued use. When transaction costs are not so high as to impede the transfer of spectrum among alternative users, the exclusive use model allows market mechanisms to determine the most efficient allocation of the scarce resource by providing a clear framework for the assignment and negotiation of spectrum usage rights between spectrum users.

Where both spectrum scarcity and transaction costs are high, the exclusive use model still may be most appropriate, though this situation is less clear. The presence of high transaction costs means that some transfers of spectrum will not occur, and some valuable uses therefore will not appear in the market. However, wherever scarcity exists, there will be competing claims to the resource, and the exclusive use model is most effective at balancing these competing claims. Moreover, the greater the scarcity, the greater will be the incentive for parties to find ways to overcome these high transaction costs. In contrast, a spectrum commons would not be effective in cases of high scarcity, despite its merits at addressing high transaction costs.

These variables suggest that in the lower portion of the radio spectrum, particularly bands below 5 GHz, the Commission should focus primarily, though not exclusively, on using the exclusive use model. The propagation characteristics in this portion of the spectrum (which can support a wide variety of high- and low-power, fixed and mobile uses), combined with the high level of incumbent use (including government as well as non-government uses), result in a large number of competing demands for this spectrum relative to the amount of spectrum available. These factors tend to weigh in favor of an exclusive use approach with flexible rules because it provides a mechanism for spectrum users to choose among the full range of technically feasible spectrum use options based on market forces.

Application of the exclusive use model to these bands, however, does not necessarily mean that all possible usage rights associated with particular spectrum must be invested in the licensee. For example, with private property in land, it is difficult, if not impossible, for the government to build a highway if it must negotiate with individual property owners without eminent domain powers. Similarly with spectrum, it may be prohibitively burdensome for some potential spectrum users, *e.g.*, those with technologies like UWB that operate across a wide range of spectrum, to negotiate for spectrum access with each licensee in each band and in each geographic area that would be used. Where the presence of many spectrum license holders with exclusive use rights makes it difficult to pursue economically efficient projects because of the high transaction costs associated with negotiating spectrum access with each licensee, the potential exists to create a “tragedy of the anticommons.”⁶⁷ To reduce this potential, the government may create access rights for some types of spectrum uses even in spectrum that is otherwise licensed

⁶⁷ Heller, Michael (1998) “The Tragedy of the Anticommons: Property in the Transition from Marx to Markets,” 111 Harvard Law Review, 621, 622-25. The tragedy of the commons may occur when many parties have property-like rights for small slivers of spectrum so that a party wanting to use a block of spectrum may find it costly and complicated to negotiate with many separate holders of spectrum usage rights. In such a case, the spectrum may go unused and thus become a wasted resource.

on an exclusive basis. Options for creating such access rights in an exclusive use model are presented in Section III.D below in the discussion of secondary markets and government-granted easements.

b) Factors favoring commons model

Conversely, in spectrum bands where spectrum scarcity is low and the transaction costs of transferring or dividing rights to the spectrum are high, these factors tend to favor application of the commons model. The commons model is most appropriate because it helps give access to the spectrum to users who otherwise would be deterred by these substantial negotiations costs. The commons approach makes this increased access possible by replacing the negotiation of formal leasing and sale contracts between users and rights holders with an agreement by the user to abide by certain user protocols and etiquette. This promotes efficiency through spectrum sharing; commons users generally operate at low power for a short time in limited areas, which allows multiple users to operate on the same spectrum. The commons approach also promotes technological innovation by providing a spectrum environment in which to develop new technologies.

Where both spectrum scarcity and transaction costs are low, the commons model again may be the most appropriate, though this situation is less clear. Under these circumstances, the presence of low transaction costs would add to the efficiency-creating characteristics of the commons. On the other hand, it also is possible that the exclusive use model would provide comparable benefits, such as in instances in which the price will be close to zero if spectrum is abundant and/or the burden of negotiating with rights holders will also be low. With low transaction costs as well as low price, interested users should have unrestricted access to the spectrum they need.

An important caveat must accompany any recommendation for a commons model: If scarcity appears in particular spectrum bands in the future, then a commons model may no longer be appropriate for these bands. This approach is only efficient when there is little or no scarcity, since with a commons there is no price mechanism to use as a tool for allocating scarce resources among competing users. The “price” of spectrum is essentially zero. With free access, however, comes the risk of interference and over-saturation, the classic problems of the “tragedy of the commons.” These problems can be overcome to some extent through regulatory guidance, requirements such as power and emission limits, and sharing etiquettes. But where actual spectrum scarcity exists, the tragedy of the commons may be unavoidable because there are insufficient incentives to avoid overuse. Therefore, a spectrum commons approach may be useful for some, but not all, of the available spectrum.

The variables described above tend to tilt in favor of expanded use of the commons model in higher spectrum bands, particularly above 40 GHz, based on the physical characteristics of the spectrum itself. In these bands, the propagation characteristics of spectrum preclude many of the applications that are possible in lower bands (e.g., mobile service, broadcasting), and instead favor short-distance line-of-sight operation using narrow transmission beams. Thus, these bands are well-suited to

accommodate multiple devices operating within a small area without interference. Moreover, administering these uses on an individualized licensed basis would involve very high transaction costs. Thus, the commons model may have broader applicability in this portion of the spectrum.

This does not, however, mean that only higher band spectrum should be subject to a commons approach. As many commenters point out, there is also value in having some lower band spectrum dedicated for commons use, much as there is benefit in having some land that could be developed commercially dedicated entirely to public use, such as parks. The record shows that the Commission's dedication of some lower band spectrum to unlicensed uses, e.g., 2.4 GHz, is yielding significant technological and economic benefits in the form of low-power short-distance communications and emerging mesh network technologies that should be further encouraged. We therefore recommend that the commons model continue to be used selectively in other lower spectrum bands if feasible.

We do not advocate the wholesale conversion of all spectrum to a commons approach as some commenters appear to advocate. Although the commons model is in many ways a highly deregulatory "Darwinian" approach, as its proponents point out, productive use of spectrum commons by unlicensed devices, particularly in lower spectrum bands, typically requires significant regulatory limitations on device transmitter power that preclude many other technically and economically feasible spectrum uses that rely on higher-power signal propagation over longer distances, or that require greater protection from interference. In addition, some commons proponents themselves state that setting aside additional spectrum for use on a commons basis is not essential to the continued success of unlicensed technology because the technological capability exists to prevent congestion from occurring in existing unlicensed bands. Furthermore, supporters of mesh network architectures argue that this technology actually *expands* the capacity of the spectrum proportionately to demand.⁶⁸

To the extent that new technologies are capable of operating on a non-interference basis with licensed uses, the proposal to create easements "underneath" exclusive use licenses would provide additional capacity to some types of users who otherwise would operate in spectrum devoted to commons use.

4. Limited Use of Command-and-Control

With respect to the command-and-control model, as noted above, the Working Group recognizes that continued use of this approach may be required in situations where prescribing spectrum use by regulation is necessary to accomplish compelling public interest objectives. However, such objectives should be carefully defined, and the amount of spectrum subject to a command-and-control regime should be limited to the minimum amount necessary to ensure that those objectives are achieved. Many spectrum users will claim that they warrant special consideration and thus deserve exemption from

⁶⁸ See Benkler, Yochai (2002) "Some Economics of Wireless Communications," 15 Harvard Journal of Law and Technology, forthcoming 2002-3, at 18.

any reform of their service allocation rules. It is therefore critical to distinguish between special interest and the public interest, establishing a high bar for any service to clear prior to receiving an exemption.

In general, command-and-control regulation should be reserved only for spectrum uses that provide clear non-market public interest benefits. For example, radio astronomy may need to have dedicated, protected spectrum bands for the foreseeable future, due to its highly sensitive applications and the fact that its benefits accrue to society as a whole and only over the long run. Public safety and critical infrastructure may also require dedicated spectrum at particular times to ensure priority access for emergency communications. Other examples where limited use of command-and-control may be justified include spectrum uses that require regulatory prescription to avoid market failure (e.g., satellite allocations to ensure global harmonization of satellite frequency bands) or that have a non-market dependent public interest basis articulated in the Communications Act (e.g., broadcasting). Some of these instances are discussed in greater detail in Section IV below.

Subject to these exceptions, the Commission should eschew command-and-control regulation, and legacy command-and-control bands should be transitioned to more flexible rules and uses to the maximum extent possible (whether under the exclusive rights or commons model). The Working Group's recommendations with respect to transition mechanisms are discussed in greater detail in Section V below.

III. Defining Specific Rights and Obligations Within Spectrum Usage Regimes: Existing and Optimal Approaches

A. Flexibility

A theme implicit in much of the discussion in the Public Workshop and submitted comments was the tension between licensees' desire for certainty on the one hand and flexibility on the other. It was often unclear exactly what type of flexibility parties wanted, but most agreed on general principles, such as (1) rules should be flexible enough to accommodate future uses and have just enough technical features to define rights; and (2) increased flexibility is good, but interference criteria have to be clear. Flexibility in three areas was discussed: service or use flexibility, such as would enable licensees to move their spectrum into higher valued uses; technical flexibility that would allow service providers to determine how best to combine inputs (e.g., using the newest or most cost effective technology); and the flexibility to subdivide, lease or transfer spectrum rights to others, so that compatible users are more likely to have access to the spectrum they need.⁶⁹

The Working Group also posed the question of whether the Commission should develop more market-oriented spectrum rules that provide licensees with greater flexibility, and, if so, in which bands or services and how. The Working Group also

⁶⁹ See, e.g., Information Technology Industry Council Comments at 8; Peha Comments at 2; CDMA Development Group Comments at 3-5; New America Foundation et al. Reply Comments at 11.

asked whether some limitations should be imposed on particular bands or services in order to achieve public interest objectives that would not be met under a purely market-based approach.

There was general agreement that more spectrum should be subject to market forces in order to encourage innovation and enhance productivity through creative transactions with minimal transaction costs. For example, such a system would facilitate the introduction of broadband technologies by standardizing rules across spectrum blocks and making it easier to coordinate use with multiple licensees. Some argued that the Commission should analyze carefully why it is not generally in the public interest to give all licensees much more flexibility. At the very least, instances in which flexible rules are not adopted should be the exception rather than the rule, should be tailored to meet specifically defined public interest goals, and should be applied to the least amount of spectrum necessary to achieve those goals.

Commenters state that in order to avoid uncertainty regarding the scope of flexibility afforded by our rules, the rules should be presumptively written (or re-written as necessary) to define spectrum rights in terms of spectrum uses that are excluded, prohibited, or limited. Thus, the Commission's approach should be that licensees and unlicensed users be allowed to do anything not explicitly prohibited by the rules, rather than the presumption being that anything not affirmatively authorized needs a rule change or waiver before it can be done.

Commenters and participants expressed broad support for both the development of secondary markets and greater implementation of the band manager concept.⁷⁰

While the majority of commenters favored extending the current system of auctioning spectrum rights valid for a number of years with a presumption of renewal, several parties recommended that the government instead lease spectrum for shorter periods, and that leases be renewable.⁷¹ It was suggested that a market would develop in lease rights, so that prices would accurately reflect short-term spectrum values in a way that auctions for essentially perpetual rights cannot do. Such a system would set a lower barrier to entry than certain auctions, and would make it quicker and easier to reclaim unused spectrum than current procedures permit. It was further argued that user fees are a means of making licensees bear the opportunity costs of inefficiency and of enabling the Treasury to receive revenue long-term instead of just at the time of initial license assignment. It was also acknowledged, however, that the FCC might face difficulties similar to those it has encountered with installment payments if it were to rely on periodic lease payments, rather than lump sum payments for spectrum licenses.

⁷⁰ See, e.g., Cisco Comments at 9; Statement of Peter Pitsch at the *Public Workshop on Spectrum Rights and Responsibilities*; Statements of Mark Crosby and Nancy Jesuale at the *Public Workshop on Interference Protection*.

⁷¹ See, e.g., Statements of Michael Calabrese and Larry Miller at the *Public Workshop on Spectrum Rights and Responsibilities*; New America Foundation et al. Comments at 16-17; Wayne Longman (Longman) Comments and Reply Comments.

Some parties suggested that the FCC should extend flexibility as far as letting private parties develop interference standards, with the FCC functioning in the role of mediator.⁷² Other panelists indicated, however, that many carriers may prefer that the Commission establish more universal standards so that more equipment is manufactured under those criteria.⁷³ Certain panelists also stated that as new technologies such as SDR evolve, there should be less need for a fixed standard because it will be easier to adjust to technology changes through software, as opposed to having to redesign hardware.⁷⁴

Various parties indicated that a purely flexible/market-oriented approach may not be appropriate for public safety and other critical infrastructure users. They contended that market-based sharing regimes might pose problems for such entities, which are required to meet strict regulations with absolute reliability.⁷⁵ They also asserted that it may be more beneficial for these entities to operate their own systems in order to comfortably be assured of meeting these standards. It was pointed out many times that a pure market mechanism disadvantages those providing public services. While the highest and best commercial uses may adequately be measured in market terms, several commenters asserted that the market fails to value public services appropriately.⁷⁶ These public goods include public safety communications systems (police, fire, rescue, disaster coordination, etc.), and less visible uses such as radio astronomy.⁷⁷ Specific use allocations may still be necessary in these cases, although no more spectrum than necessary should be devoted to such regulated use. Such dedicated spectrum needs may be reduced if public service providers are allowed to lease part of their requirements on an as-needed basis. Public safety is discussed in more detail below.

Another situation in which the market fails to take important considerations into account is when domestic spectrum uses must be compatible with international uses, either for technical reasons, or in order to conform to international agreements. A number of commenters pointed out the importance of respecting those demands.⁷⁸ Much of the discussion was in the context of developing global satellite systems, and the solution was generally assumed to be an arrangement of special allocations. But in keeping with the general interest in more flexibility, the Commission should also explore an approach in which spectrum would be made available for satellite, terrestrial, or combined use at the option of the user.

⁷² See, e.g., Ericsson Inc. (Ericsson) Comments at 5-6.

⁷³ See, e.g., Statement of Michael Kurtis at the *Public Workshop on Spectrum Rights and Responsibilities*; Peha Comments at 4.

⁷⁴ Statement of Ray Pickholtz at the *Public Workshop of Interference Protection* at 124. See also Old Colorado Communications Comments at 3-4; License Exempt Alliance Comments at 5.

⁷⁵ See, e.g., New York State Office for Technology Comments at 11; Private Radio Commenters Reply Comments at 3-4.

⁷⁶ See, e.g., Statements of Jennifer Warren and Joe Gatusso at the *Public Workshop on Spectrum Rights and Responsibilities*; AT&T Wireless Comments at 8-9; NPR Comments at 4-12.

⁷⁷ See, e.g., NPR Comments at 4-12; Barnaby Rickett Comments at 2; Nickolaus Leggett Comments at 5-6.

⁷⁸ See, e.g., SIA Comments at 7; Hughes Network Systems Comments at 10-14; New York State Office for Technology Comments at 11-12; Motorola Comments at 25-26.

Conclusions/recommendations. The Working Group generally agrees with commenters and workshop participants that, within “basic” parameters, spectrum users should be given maximum possible flexibility to:

- Choose the services they provide on their spectrum;
- Determine the technology that is most appropriate for providing those services; and
- Transfer, subdivide, or lease their spectrum rights.

In addition:

- Rules generally should be written so as to permit anything not expressly prohibited; and
- Exceptions to flexible rights licensing models should permit command-and-control restrictions only where absolutely necessary and involving the least amount of spectrum needed to accomplish public interest goals.

B. Regulatory Certainty

While participants were vocal about their desire for more flexible rights, they were equally interested in firmness and clarity in the rules they are required to follow.⁷⁹ Discussions at times seemed paradoxical, with commenters apparently requesting both more definite and more flexible rules, but an overarching principle eventually emerged: providers of wireless services want clear rules governing their interactions with the FCC and other spectrum users, but the freedom to operate as they please within those boundaries. In other words, they want certainty of access to a clearly specified bundle of spectrum use rights with firmly defined limits on how much interference they have to accept and can produce, but flexibility in their operations within those parameters.

As in the discussions about flexibility, the commenters requesting more certainty were not always talking about exactly the same types of certainty. While most agreed that the Commission’s rules are not sufficiently clear, the examples they provided varied greatly. Some pointed out that rights which are not exhaustively defined create “grey areas” that can lead to conflict. With site-based licenses, for example, the question of who should have access to the white space surrounding a licensed site is often a source of dissension. Others argued for more clarity in the rules on the grounds that equipment manufacturers do not know what sort of equipment to build if service rules are not clearly defined.

Advocates of the exclusive use model argued that instability in the usage rights of licensees discourages investment, and further contended that “exclusive” rights are not meaningful when the Commission, after licensing, can tell a licensee that a new service may operate on the same frequencies, through overlay or underlay licensing. Thus, they maintained that the rules should explicitly prohibit other users from interfering with incumbent systems.⁸⁰ Proponents of commons-like approaches disagreed with the

⁷⁹ See generally Sprint Comments at 4; Statement of Steve Sharkey at the *Public Workshop on Spectrum Rights and Responsibilities*.

⁸⁰ See, e.g., AT&T Wireless Comments at 14-15; Sprint Reply Comments at 7-8.

proposition that exclusive rights are necessary to investment, pointing out that uncertainty can inspire innovation and the development of such devices as frequency agile radios.⁸¹

The suggestions that received the most attention were those dealing with interference rights, which many parties asserted are important to define⁸² Specific suggestions dealt with different aspects of interference, among them the need to clarify the definition of “harmful interference” currently used by the Commission; how to define the maximum level of “noise” that licensees must accept; and the rules on how to resolve issues that arise when an incumbent’s service is impaired by a new user operating within its rights.⁸³ Several participants noted that the need to consider these points is well illustrated by Nextel’s conversion of SMR service to a cellular-type service, an unintended consequence of which was interference with adjacent public safety licensees.⁸⁴ If the rights of the new service had been defined more clearly at the outset, the problems may have been avoided. In general, prospectively defining these rights is useful for avoiding subsequent problems with incumbents, but unfortunately that is not always possible. Transitional issues are discussed below.

Commenters frequently pointed out a need for more objective measures of interference.⁸⁵ Defining measures and setting them at an appropriate level will require the Commission to have a better grasp of the science involved prior to making rules, and to anticipate better the consequences of different uses. This means that more engineers should be involved in the rulemaking process.

Based on the many comments received and heard, the following basic spectrum rights parameters must be clearly defined for both licensed and unlicensed uses:

1. Authorized frequency and bandwidth;
2. Geographic scope of right to operate;
3. Maximum RF output, both in-band and out-of-band; and
4. Interference protection, i.e. maximum level of noise/interference that spectrum user must accept from other RF sources.

Parties often cited broadband PCS as an example of how flexible service and technical rules can coexist with clearly defined spectrum rights and responsibilities.⁸⁶ In that regime, geographic licenses for a particular frequency and bandwidth carry a

⁸¹ See, e.g., Statements of Bruce Fette and David Reed at the *Public Workshop on Spectrum Rights and Responsibilities*.

⁸² See, e.g., Statements of Victor Tawil and Peter Pitsch at the *Public Workshop on Spectrum Rights and Responsibilities*; Part 15 Organization Comments at 5; CTIA Comments at iii, 12.

⁸³ See, e.g., Statement of Steve Sharkey at the *Public Workshop on Spectrum Rights and Responsibilities*; Coleman Bazelon (Bazelon) Comments at 2-3.

⁸⁴ See, e.g., Statements of Andrew Clegg and Nancy Jesuale at the *Public Workshop on Interference Protection*.

⁸⁵ See, e.g., Sprint Comments at 13; Statement of Dewayne Hendricks at the *Unlicensed Spectrum and Experimental Licenses Public Workshop*, held at the Commission on August 1, 2002.

⁸⁶ See Statements of David Siddall and Michael Kurtis at the *Public Workshop on Spectrum Rights and Responsibilities*; Sprint Comments at 2-3.

construction requirement and a renewal expectancy, which give licensees the certainty they need to make major investments while still giving the Commission the ability to reclaim the spectrum if the licensee acts improperly. The PCS rules include maximum output levels at the geographic and spectrum borders of each licensed spectrum block, so that each licensee knows in advance the maximum output that it can produce and is required to accept from co-channel and adjacent channel PCS licensees. This approach also provides a clear common framework from which adjacent and co-channel licensees can negotiate alternative consensual arrangements. Some suggested that this approach can work for almost any technology.

The issue of enforcement also arose in connection with the clarification of rights, with various panelists arguing that the FCC must do a better job of enforcing licensee rights or else the licensee really does not have those rights.⁸⁷ Indeed, the point was made repeatedly that the success of any rights regime depends on the enforcement of the rights. It was suggested that the FCC needs a plan to speed up the resolution of interference complaints, and that better enforcement could be achieved by increasing technical expertise at the Commission.⁸⁸

Conclusions/recommendations. In sum, the Working Group generally agrees that with regard to regulatory certainty:

- Rights should be clearly and exhaustively defined;
- Basic parameters to be determined are frequency, bandwidth and geographic scope, and how much interference a licensee is allowed to impose on others and how much he must accept; and
- Once identified and assigned, rights should be protected through adequate enforcement efforts, and should not easily be modified.

C. Interference Standards

Issues concerning interference were among the most widely discussed by commenters and by participants in the Public Workshop. The specifics of appropriate types of interference parameters and interference protection schemes, and appropriate levels of desired and undesired signals and how to best measure them, are discussed elsewhere in the reports of other Working Groups. Here we discuss the impact of various approaches on licensee rights and responsibilities.

The most common theme expressed was that as services proliferate and more people try to do more things with spectrum in the future, the most fundamental spectrum management problems will likely relate to interference. As discussed above, it was noted that too often the interference caused to adjacent channel licensees is not factored in when a new service is authorized. Another concern expressed was the preclusive effect of many licensees/operations in the absence of predefined protections for future spectrum users.

⁸⁷ See, e.g., Statements of Victor Tawil and David Wye at the *Public Workshop on Spectrum Rights and Responsibilities*; Bazelon Comments at 2.

⁸⁸ See, e.g., Bazelon Comments at 2-3.

Several parties also pointed out that the Commission's most difficult, controversial, and unsatisfactorily resolved cases have resulted from situations in which the extent of an incumbent's spectrum rights and interference rights, and its limitation on impacting other bands or users, were not clearly understood by the incumbent, by a new service provider, and even by this Commission.

Several parties argued that the current definition of interference is too vague and subjective, while others preferred to retain the flexibility of interpretation that it allows.⁸⁹ Various parties stressed the need for regulatory certainty, both in terms of what kinds of signals they would be permitted to transmit, within their bands and into other bands, and what kinds of undesired signals they should plan to tolerate as worst case from in-band operations (e.g., "underlay") and out-of-band operations.⁹⁰ To achieve this certainty, they maintain, requires some objective technical standards that are concretely measurable and predictable.

Participants that remarked on this issue generally suggested that the Commission should take into account frequency/bandwidth, power, co-channel and adjacent channel operations, out-of-band emissions, background noise, and perhaps geographic location and scope. A few parties insisted that the Commission must field test its assumptions when determining interference consequences of its technical determination.⁹¹

Despite a desire for certainty regarding the operating environment that they could create and in which they would be required to perform, parties also expressed a compelling desire for flexibility. There was some discussion of whether licensees' permissible operations should be defined in terms of "inputs" – permissible tower height and transmission power – or in terms of "outputs" – how much signal strength results on particular frequencies at particular locations. Parameters based on the latter considerations would provide licensees with greater flexibility in determining their system architecture to meet customer density, geographic location and scope, and cost considerations, while maintaining what should be the Commission's most basic regulatory concern: the extent to which they impact the service of other licensees and operations.

Any setting of such standards, of course, reduces the Commission's flexibility in responding to changing technology and changing customer and public needs. Nonetheless, the degree of certainty that can be provided for both incumbent licensees and potential new entrants and the increased opportunity for new entrants and services outweigh this concern. This concern is further diminished if the Commission undertakes

⁸⁹ See, e.g., American Radio Relay League Comments at 10; Private Radio Commenters Comments at 15-19; Hughes Comments at 10.

⁹⁰ See, e.g., Telecommunications Industry Association (TIA) Comments at 6; Information Technology Industry Council Comments at 9; CTIA Comments at iii, 12; Bazon Comments at 2; AT&T Wireless Comments at 14; Consumer Electronics Association at 6-7.

⁹¹ See, e.g., CTIA Comments.

periodic review of its technical parameters, as further discussed below in the section regarding license terms and term limits on rules.

Various panelists agreed that it is critical to distinguish interference from competition. Several complained that incumbent licensees claim that a new service will cause “interference” when their primary concern is direct or indirect competition provided by the new entrant. One participant specifically remarked that regardless of whether the standard is “harmful interference” or “meaningful interference,” the analysis will depend on one’s point of view, *i.e.*, whether one is an incumbent or a new entrant. New entrants often complain that incumbents have no incentive to produce robust systems that are less affected by potential interference and, in fact, have a disincentive to do so if the Commission continues to protect legacy equipment that is not designed to operate in a spectrally efficient manner.

At least one party proposed that the Commission let the courts determine what constitutes harmful interference when parties have a conflict.⁹² However, the more objective standards for determining interference that we expect to develop would appear to obviate the basis for such a proposal.

One idea that participants raised was that the Commission define the amount of interference that a user can create and must accept, and let industry set standards within those parameters. Participants also suggested that the Commission should allow the private sector to develop interference standards and present them to the FCC, which would then be responsible for enforcement. The Commission has often been guided by or given deference to industry-developed standards, and will continue to do so when the participants reasonably represent all affected and potentially affected interests. Sometimes, however, industry groups may not adequately account for the interests of other affected entities, such as those developing new technologies and nascent providers of future services.

While there also was some call for receiver standards, these proposals appeared to result primarily from concerns about the vulnerability of many receivers designed by incumbent licensees in the context of our current interference rules. We believe that if the interference environment in which receivers must operate is adequately specified in advance, licensees and receiver manufacturers would face strong economic incentives to design equipment that will not be susceptible to potential interference. In most cases it is best left to licensees and equipment designers and manufacturers to determine how best to design equipment to operate in this environment, and to make the various economic evaluations and trade-offs involved in such determinations. The Commission should carefully consider, however, whether it might be appropriate to mandate receiver performance for consumer goods whose design and manufacture are not controlled by a licensee.

⁹² See David Rhodes Comments at 4.

Conclusions/recommendations. Given these considerations, the Working Group concludes and recommends as follows:

- The current definitions and rules for controlling interference do not always provide licensees with adequate notice regarding possible changes to the electromagnetic environment in which they may be required to operate in the future;
- Inadequately defined interference rights can lead to extensive adversarial contests regarding the rights of incumbents when new services are proposed;
- If the Commission determines to specify the maximum level of undesired signal to which licensees will be subjected, licensees and equipment manufacturers can design systems that will provide for additional future uses by other users of the same spectrum and of adjacent spectrum;
- Interference standards based on outputs provide desired flexibility while protecting the reasonable expectations of licensed and authorized service providers and the public; and
- While there may be some situations in which it would be appropriate for the Commission to establish receiver performance requirements, in most cases licensees and manufacturers should retain that responsibility, assuming that they know in advance what their expected interference environment will be.

D. Secondary Market Arrangements and Commission-Granted Easements

Commenters and Public Workshop participants suggested that the Commission needs to look for ways to improve access to licensed spectrum by new entrants, and that technological advances using devices such as frequency-agile radios have increased the potential for spectrum to accommodate multiple non-interfering uses.⁹³ Many strongly advocated that the Commission move forward with its pending proceeding on secondary markets.⁹⁴

Commenters generally suggested two alternative approaches to facilitate access. Many advocated expanded use of a variety of market arrangements, including secondary markets involving the lease of spectrum usage rights.⁹⁵ Under this approach, licensees would hold the rights associated with determining which potential entrants could have access to the spectrum and under what conditions. Others advocated allowing open access on a non-interfering basis through expanded use of easements.⁹⁶ In the latter case, the Commission, and not the licensee, would establish conditions for user access to the spectrum. There was significant disagreement among commenters on how to balance

⁹³ See, e.g., Statements of David Farber at the *Public Workshop on Spectrum Rights and Responsibilities* at 61, 77.

⁹⁴ See, e.g., Sprint Comments at 9; Cantor Fitzgerald Comments at 3; AT&T Wireless Comments at 12; Winstar Comments at 3. See generally Promoting Efficient Use Of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, WT Docket No. 00-230, *Notice of Proposed Rulemaking*, 15 FCC Rcd 24203 (2000).

⁹⁵ See Sprint Comments at 9; AT&T Wireless Comments at 12; Winstar Comments at 3.

⁹⁶ See Statement of David Reed at the *Public Workshop on Spectrum Efficiency* at 60; Statements of Gerald Faulhaber at the *Public Workshop on Spectrum Efficiency* at 144, 222.

these approaches. However, it should be noted that the two approaches are not necessarily mutually exclusive, and in fact could both be applied to the same block of spectrum.

Proponents of secondary market arrangements asserted that the market can solve these types of access problems if licensees have flexibility and exclusive rights.⁹⁷ Incumbents could determine, through privately negotiated agreements, how other parties could use some fraction of the spectrum bandwidth or some portion of the geographic area covered by the license for some period of time, which could be for a few seconds or minutes or for years. Many secondary markets proponents were also skeptical of the easement approach, arguing that (1) “non-interfering” operation tends to work better in theory than in practice, and (2) even where spectrum is otherwise not being used by the licensee, creating easements for third party access without the licensee’s consent could lead to squatter’s rights problems.⁹⁸ Several commenters also were particularly adamant that the Commission not grant any easement rights that would affect exclusive use licenses that had already been granted by the Commission, contending that incumbent licensees have already built out their systems and made other technical decisions in reliance on there being no easement rights to third parties that could possibly create harmful interference.⁹⁹

Proponents of easements asserted that the market would not facilitate, and might even inhibit, access by the very technology that is revolutionizing efficient spectrum use, i.e., smart, frequency-agile devices. They pointed out that the Commission currently allows unlicensed Part 15 low power devices including ultra wide band (UWB) devices to operate in certain portions of the spectrum in which incumbent licensees operate without the users of those devices obtaining permission from the licensee. The FCC could also allow “opportunistic” devices to search across licensed spectrum and then to operate in licensed but unused spectrum without permission of the licensee, as long as those devices did not cause interference to incumbent licensees and instantly ceased transmitting whenever a licensee wished to use the spectrum. Easement proponents contended that exclusive rights holders will look for ways to block access by such devices to protect their investment, and that the only way to open spectrum to new uses is to vastly expand the use of the easement model from its currently limited form. They also contended that new technology is sufficiently sophisticated to overcome concerns regarding interference.¹⁰⁰

The Working Group believes that there is room to expand our use of *both* market arrangements such as secondary markets and the easements models. The Commission has already taken steps to initiate and expand secondary markets, but this model has so far been applied on a limited basis only. This is partly due to statutory issues, but also results from usage rights in existing spectrum not being well-defined (as discussed in

⁹⁷ See generally Cantor Fitzgerald Comments at 3-4.

⁹⁸ See, e.g., Statement of Peter Pitsch at the *Public Workshop on Spectrum Rights and Responsibilities* at 68-69.

⁹⁹ See, e.g., AT&T Wireless Comments at 14; Sprint Comments at 4.

¹⁰⁰ See, e.g., Hypres Comments at 4.

prior sections). Allowing a variety of market arrangements so that licensees would be able to authorize others to make use of unused portions of their licensed spectrum could lead to substantially greater access to and use of the spectrum. The Commission has used an easement approach in cases such as UWB, but this is still a very limited application compared to the kind of easement access that some commenters advocate. Both low power underlay easement rights operating below the noise temperature and easement rights that would allow the use of non-interfering opportunistic devices in some situations could be expanded.

New technology has transformed the access issue by making certain types of access possible that were not technologically feasible in the past. We must therefore develop access models that take the potential of this new technology into account. We agree with commenters that the secondary markets model and the easements model each offer certain distinct advantages as well as disadvantages, but conclude that neither model should be adopted to the exclusion of the other.

Secondary markets model. The secondary markets model takes advantage of the flexibility and adaptability of the market to solve access problems. Because licensees have economic incentives to use spectrum in ways that will yield the highest return to them, they will often find it advantageous to allow others to use unused portions of their spectrum if they are adequately compensated. Because licensees have a strong incentive to obtain the highest possible return on all their “assets” including their spectrum, we do not agree with those who contend that making an exclusive licensee the access “gatekeeper” (i.e., requiring potential spectrum users to obtain licensee consent) will inhibit access by new technology. In fact, exclusive licensees will often wish to encourage and even develop new technologies in order to provide new services, serve more customers, etc.

If the rights afforded to licensees are sufficiently well-defined and flexible, and the secondary market mechanism is fast and efficient with low transactions costs, licensees will have ample incentive to negotiate with potential secondary users for access. As long as the transaction costs of those negotiations are not too high, then many licensees will find it in their self interest to allow access by secondary users. It is also important to realize that a secondary markets approach doesn’t necessarily need to rely on individual negotiations with each licensee: band managers and other intermediaries such as clearinghouses can facilitate transactions. Thus, even if many individual transactions are necessary in order for secondary markets to work, organizations are likely to develop to handle those transactions just as American Society of Composers, Authors and Publishers (ASCAP) and Broadcast Music, Inc. (BMI) were developed to handle the negotiations between holders of copyrighted music and the thousands of radio stations and other organizations wishing to play that music. On the other hand, there may be instances where secondary markets work less well, such as in cases in which they impose such significant transaction costs on parties that negotiations will not occur. In that case, an easements model may be appropriate.

Easements model. By definition, the easements model appears to allow for highly efficient and low-cost access to spectrum, since a government agency establishes overall rules and protocols under which any user would be allowed access to the spectrum. Negotiations with individual licensees is not required. As a number of commenters suggested, the easements model bears greater consideration than in the past because the increased sophistication of technology allows for the possibility of enhanced spectrum use by third parties on a non-interfering basis with the licensee.¹⁰¹ While it is true that potential interference problems between licensees and easement users may arise in an easement model, presumably those problems can be resolved through technical protocols and coordination. Moreover, the concern about overcrowding and the tragedy of the commons is greatly reduced when easements are applied to high frequencies and the power levels in devices are limited so that potentially interfering signals only travel relatively short distances and thus the number of potentially interfering devices is limited.

At the same time, however, the easement model inherently limits the flexibility afforded to the licensee to some degree, and relies on government to define the scope of the easement. For example, currently all Part 15 devices are limited to very low power levels in order to minimize the possibility of interference. If opportunistic devices are to be authorized in the future, there will have to be regulations or protocols to ensure that they listen before they transmit and that they do not transmit when to do so would cause interference to an incumbent licensee. In addition, there is the concern that once unlicensed entities begin to operate in an easement and then later create interference to the incumbent licensee, it may be difficult legally or politically to shut down those unlicensed operations. Thus the potential for squatters is another potential downside of the easement model that must be addressed.

Balancing the two approaches. In seeking to balance the two approaches, we generally conclude that rights of licensed incumbent users should be limited to some extent to create “easements” for non-interfering uses below a defined interference temperature. There may also be some limited situations in which it would be desirable to establish easements for higher power opportunistic devices, but only in circumstances where the transaction costs associated with negotiating with incumbents for access to the spectrum would otherwise be unreasonable.

To the extent that efficient market mechanisms can be developed that would allow market arrangements at reasonable transactions costs, however, then they should be left under the control of incumbent licensees. That would be true of both individually negotiated secondary market uses and opportunistic uses of licensed spectrum. Opportunistic uses of spectrum may become feasible (especially by using technical solutions such as agile-frequency-hopping radios, software defined radios and adaptive antennas) at reasonable transaction costs. If such uses become feasible either through direct negotiations with incumbents or perhaps through royalty or rent mechanisms administered by private band managers or clearinghouses, the right of access should

¹⁰¹ See, e.g., Statements of Jennifer Warren and David Wye, respectively, at the *Public Workshop on Spectrum Rights and Responsibilities* at 253, 255.

remain within the control of the licensed user rather than be the subject of an FCC dedicated and mandated easement.

Using this balanced approach, certain technologies should probably be allowed access to spectrum “holes” primarily on a secondary markets basis, while others may be more amenable to access via easements. The easement model appears particularly suitable for underlay technologies that operate at very low power (i.e., below the “interference temperature”¹⁰²), provided that the technical boundaries of the easement are well-defined.

Conclusions/recommendations. In order to evaluate the options involving secondary markets and easements, the Working Group recommends to the Spectrum Policy Task Force that the Commission obtain more information from the public (e.g., through an NOI) on:

- Developing further analysis to distinguish those situations in which government granted easements may be appropriate compared to situations in which various secondary market arrangements between licensees and other users are appropriate; and
- Analyzing the ability of new technologies (smart frequency-agile radios, software defined radios, adaptive antennas, spread spectrum etc.) to operate, even at higher power levels, without causing harmful interference.

Other actions that the Working Group recommends include the following Commission actions:

- Move forward with the existing “Secondary Markets” proceeding;¹⁰³
- Address underlay/easement rights in transition bands on a going-forward basis;
- In new allocations and assignments, consider including low power easements or underlay rights based on the “interference temperature” concept;
- Clearly define access rights for opportunistic devices, whether based on secondary market uses, easements, or a combination of the two.

E. License Terms and Term Limits on Rules

Participants in the Public Workshop, as well as parties that commented on the Public Notice, provided input regarding how long spectrum license terms should be, as well as whether it would be useful to set some sort of term limits on Commission rules so that rules would automatically be revisited periodically. A few parties suggested various alternatives for providing periodic modifications in our technical rules in order to demand increasing spectrum efficiency from licensees as technology advances.¹⁰⁴

¹⁰² “Interference temperature” measures the RF power available at the receiving antenna per unit bandwidth and is a measure of the “noise” in a particular band and location.

¹⁰³ Promoting Efficient Use Of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, WT Docket No. 00-230, *Notice of Proposed Rulemaking*, 15 FCC Rcd 24203 (2000).

¹⁰⁴ See, e.g., New America Foundation et al. Comments at 14; Consumer Federation of America Comments at 30-31.

License terms in various services differ. For instance, the term of wireless telecommunications licenses is generally ten years, while broadcast licenses have a term of eight years and CARS licenses are awarded for a maximum of five years. Satellite licenses have in the past generally been awarded for ten years, but in February of this year the Commission adopted rules allowing it to issue such licenses with 15-year license terms.

The practice of adopting individual rules with predetermined sunset dates has long been used by the Commission in cases where it finds that a rule would outlive its usefulness if allowed to remain indefinitely. Under the Telecommunications Act of 1996, the Commission is also required to determine in every even-numbered year whether any regulation is no longer necessary in the public interest as the result of meaningful economic competition between service providers, and to modify or repeal such regulation. The Commission has undertaken numerous proceedings to streamline its rules pursuant to this requirement.

With respect to license terms, certain public interest organizations argued that the FCC should, in keeping with the fact that the airwaves are a public asset owned collectively by all Americans, establish relatively short license terms. They argued that the Commission should not lengthen license terms or otherwise undermine the government's ability to reorder spectrum rights and responsibilities as technologies and social needs change. Incumbent licensees, on the other hand, argued in this and other fora that consistency and certainty are necessary to warrant significant investment, and most seemed to assume that the current level of license renewal expectancy would remain an integral part of our licensing scheme.

Commenting on the idea of term limits or sunsets for Commission rules, one panelist said that different bands would require different term limits and that it is impossible to determine what they should be (that is, how quickly technology will change in each band), so the Commission is better off with rules of infinite duration but a reservation of power to intervene in the event of a market failure.

We believe that a predictable and structured format and timetable for implementing rule changes that will periodically increase the efficiency of spectrum usage is imperative. At this point, it is not apparent that it matters whether such changes are implemented as a function of periodic license renewal considerations or as a function of periodic service rules review. What does matter is that the timing of such potential changes is both reasonable and predictable, and that the extent of change within any period of years is limited in some manner.

One proposal made at the Public Workshop was that all licenses should be subject to a re-evaluation period that enables the Commission to prevent old technologies from occupying spectrum in virtual perpetuity, but is scheduled sufficiently into the future that it does not threaten the stability of licensees' business plans. We continue to believe that a level of certainty regarding one's ability to continue to occupy spectrum at particular

locations, at least for some foreseeable period, is an essential prerequisite to investment, particularly in services requiring significant infrastructure installation and lead time. A periodic adjustment of operating parameters or requirements, however, need not deter investment if limited to predictable and reasonable outlines. While potentially disruptive, periodic revision of operating parameters and protections is a necessary means to continue to mine the spectrum with increasing efficiency as technology develops, to the extent such efforts are economically viable. Any such assessment would include, of course, an assessment of the economic/societal value of the new or increased service capability being accommodated versus the costs to incumbent licensees and to the public. This applies to “commons” spectrum and exclusively used spectrum, including easements, with respect to both internal operations and effects on geographic and spectral neighbors.

Any evaluation of such periodic adjustments should be on a predictable schedule, and any implementation of resulting new rules should be on a schedule that is predetermined by rule. For instance, no change in technical parameters, such as an increase in noise floor or in emission masks or in edge of territory field strength, could be introduced in a particular service until at least three years after a determination is made to implement such a change. While some new technologies may develop suddenly, and could sometimes be delayed by a guaranteed transition period, the uncertain cost of this risk is outweighed by the need to provide some level of certainty to develop and implement known technologies and services. We do not propose that the timetable should be the same for all services and spectrum bands, but can vary with both service provider and customer investment requirements, apparent public expectations, and anticipated speed of technological development. This is one way in which to ensure continued innovation and continually increasing efficiency in the use of spectrum.

Conclusions/recommendations. In sum, the Working Group proposes:

- A periodic adjustment in technical requirements is imperative in order to continue to make increasing use of spectrum; and
- Such adjustments must be predictable in both time and scope (although it is probably not significant whether such adjustments are effectuated in the context of service rules or periodic license renewals).

IV. Other Considerations

While significant debate exists over the merits of the exclusive use model versus the commons model, as noted above, the command-and-control approach may be more appropriate for some allocations and services, such as those having elements that may be given too little weight in the market. Examples include satellite, public safety, spectrum shared with the federal government, broadcast, and rural services. Moreover, each service has distinct reasons why it may be more appropriately dealt with in a command-and-control framework.

For example, satellite services require significant negotiations over spectrum that must be harmonized across many countries. Significant transaction costs accompany

these efforts, and it may not be economically feasible to pursue alternative spectrum bands. Most notably, the benefits of such harmonized spectrum accrue to spectrum users and society as a whole, not just to satellite services, while the costs are incurred by satellite services alone. This type of public benefit with a cost concentrated on one party or industry appears to be a classic market failure problem that can be addressed via certain regulatory interventions, such as government-mandated spectrum allocations.

Public safety, which uses spectrum as an input, is another commonly cited example of a service that may be given too little weight in the market. In this case, however, the potential problem may be distinct from that associated with satellite services. As opposed to satellite services, which may need particular bands of spectrum set aside for global harmonization, it may be possible to address concerns related to public safety with less intrusive regulation, including some market-oriented policies.

Other spectrum allocation decisions have traditionally reflected considerations that may not be fully accommodated in an exclusively market-based approach. For example, a significant amount of spectrum is allocated to (and shared between) both Federal Government and non-Federal Government users. In addition, broadcasters traditionally have faced a set of rules that represent their unique history and services. Similarly, rural interests have unique needs that may be costly to meet, and there is strong support for public policy that will address these needs. Similarly, radio astronomy has particular spectrum needs and can provide important but very long-term benefits which market mechanisms may not fully reflect.

A. International Considerations

A number of parties stressed that the United States should make a better effort to harmonize its spectrum management policies and allocations with those of the rest of the world, when possible.¹⁰⁵ According to these commenters, to the extent domestic policies and allocations complement international decisions, U.S. consumers and businesses will reap important benefits such as more international roaming and better economies of scale with regard to equipment manufacturing. Commenters also pointed out that while the satellite, maritime, aeronautical, public safety and radio astronomy services have long required and benefited from extensive international coordination, terrestrial services like third generation wireless and radio local area network (e.g., Wi-Fi) services are also becoming increasingly ubiquitous requiring the same level of international coordination.¹⁰⁶

The commenters explained that the United States needs to eliminate any credibility concerns that are raised when it advocates for an international allocation only

¹⁰⁵ See, e.g., CTIA Comments at 15-16; Association of American Railroads Comments at 25; SIA Comments at 20; Information Technology Industry Council at 5; AT&T Wireless Comments at 20; Nokia Comments at 4; Motorola Comments at 25-26.

¹⁰⁶ See, e.g., Wireless Ethernet Compatibility Alliance Comments at 5-7.

to later allocate the same spectrum for different uses domestically.¹⁰⁷ Various parties asserted that the United States should formulate more effective and forward-looking international positions to take to the International Telecommunication Union's (ITU) World Radiocommunication Conferences (WRC) through the regional Organization of American States (OAS) telecommunications process administered by CITEL.¹⁰⁸ It was suggested that the Commission make it a priority to advocate for an increase in the speed and efficiency of the ITU spectrum decision-making process.¹⁰⁹ It was also suggested that the United States appoint a professional WRC ambassador to provide continuity of expertise between and for WRCs.¹¹⁰

Other parties commented on the importance of the Commission considering how spectrum-based services are affected by spectrum use models. It was stated, for example, that the Commission should take account of the effect that interference caused by licensees offering newly flexible services would have on existing cross-border interference agreements with Canada and Mexico.¹¹¹ Commenters asserted that a broader regional perspective on spectrum management by the Commission could speed deployment of services to U.S. consumers by resolving cross-border coordination and regional policy issues earlier.¹¹²

Conclusions/recommendations. International considerations must be taken into account in two ways:

- First, because regional and world-wide harmonization of band use can have significant advantages both in terms of truly ubiquitous services and economies of scale, in developing domestic spectrum policies and allocations, the Commission should always carefully consider the potential impact on international objectives.
- Second, U.S. consumers could benefit from improved spectrum management coordination with our regional neighbors, especially Canada and Mexico.

¹⁰⁷ See, e.g., Statement of Jennifer Warren at the *Public Workshop on Spectrum Rights and Responsibilities* at 243.

¹⁰⁸ See, e.g., ArrayComm Comments at 6-8; Sky Tower Comments at 11 (identifying backward-looking preparatory process for international meetings and claiming that "new technologies are often shut-out altogether or compromises are reached causing a proposal for a new technology to be considered on less desirable frequencies, of limited bandwidth, and/or with severe interference criteria that make deployment of the new technology much more difficult").

¹⁰⁹ See SIA Comments at 19; Winstar Comments at 4.

¹¹⁰ See CTIA Comments at 15-16.

¹¹¹ See, e.g., Dominion Comments at 9; New York State Office of Technology Comments at 11-12.

¹¹² See, e.g., Longman Comments at 27; Winstar Comments at 4; New York State Office of Technology Comments at 11-12.

B. Public Safety

The Working Group sought information regarding what spectrum use models the Commission should use to ensure the provision of public safety services and other public service uses of spectrum.

A number of commenters and participants in Public Workshop who addressed this issue opposed applying an exclusive use model to public safety.¹¹³ Although they recognized the need to encourage efficiency on the part of public safety providers, many agreed that it is not appropriate to make them compete for spectrum against entities that measure spectrum value monetarily. These parties agreed that there is a fundamental difference between commercial systems and public safety systems, which have different funding mechanisms, are inherently slow-moving and budget-constrained, and need very reliable communications rather than cutting-edge equipment. In addition, they cited public safety's need for longer equipment cycles (e.g., 25-year cycles). For these and other reasons, they indicated that a commercial model has limited applicability to public safety.¹¹⁴ One participant also added that making state and local government users acquire spectrum in the marketplace would in effect impose a federal tax on such entities. The principal concern expressed by government and public safety spectrum users was that they not be required to compete with commercial users for spectrum.¹¹⁵ Some of the same concerns were expressed with respect to non-public safety licensees whose operations nonetheless impact public safety, such as critical infrastructure industries (e.g., electric utilities).¹¹⁶

Not all commenters or participants in the Public Workshop thought, however, that it is necessarily a bad idea to require government entities to compete with commercial entities for spectrum. Martin Cave, the one non-American who participated in the August 9 Public Workshop, stated that he had recently recommended different regimes for public safety and non-public safety entities in Great Britain, but only because he did not think his audience was ready yet for competition between government and commercial entities. He indicated that he hopes to move to such a competitive regime in 10 to 15 years.¹¹⁷ Another panelist advocated spectrum fees for state and local governments, saying that such fees would encourage efficiency and that governments will not spend the money for more efficient equipment unless they are compelled to do so by the FCC.¹¹⁸

When asked whether public safety and other public service uses of spectrum can be combined with commercial uses through sharing or other mechanisms, certain commenters indicated that such a combination is not advisable, again stressing the

¹¹³ See, e.g., David Staelin Comments at 1; Longman Comments at 14.

¹¹⁴ See, e.g., APCO Comments at 3; Marsalis Comments at 5.

¹¹⁵ See American Association of Railroads Comments at 21-22; BellSouth Comments at 1-2.

¹¹⁶ See, e.g., American Petroleum Institute (API) Comments at 13; Exelon Comments at 3.

¹¹⁷ See *Public Workshop on Spectrum Rights and Responsibilities*.

¹¹⁸ See *Public Workshop on Spectrum Rights and Responsibilities*.

different needs of public safety and commercial entities.¹¹⁹ Parties with a particular interest in public safety also stated that the Commission should not try to set uniform interference standards across all bands because of public safety services' inability to tolerate interference.¹²⁰ Certain parties suggested that the FCC consider segregating public safety bands (and related rules) from other bands.¹²¹ One commenter proposed the relocation of public safety to its own contiguous spectrum and that this relocation be paid for by auctioning licenses for current public safety spectrum at 400, 500, and 800 MHz.¹²²

One panelist advocated allowing unlicensed users to operate in bands used by public safety at the end of a 10-year grace period.¹²³ He and at least one other panelist noted that some public safety entities are moving to commercial spectrum (for example, operating in the 2.4 GHz band) because that is where the newer, cheaper equipment is. Nonetheless, other panelists opposed allowing unlicensed underlays on public safety channels because of the potentially dire consequences of interference with public safety operations.¹²⁴

One panelist noted that public safety agencies are becoming more innovative through creative licensing schemes, such as forming partnerships between state and local agencies and utilities and federal agencies. By sharing costs and spectrum with others, public safety entities are able to obtain more technologically advanced wide-area systems than they could afford on their own.¹²⁵

Conclusions/recommendations.

- Spectrum that is currently set aside for public safety and critical infrastructure use should remain so. Going forward, the Commission should set aside no more additional spectrum than is necessary to achieve goals related to public safety and critical infrastructure services.
- There is considerable potential for market-oriented policies to help rather than burden public safety, and that would allow for more efficient use of spectrum to meet both public safety and commercial spectrum needs. The Commission should explore mechanisms for meeting public safety needs other than simply through dedication of spectrum on a command-and-control basis.
- Public safety users should have flexibility to lease spectrum capacity that is available during lower-use periods to commercial users with a “take-back” mechanism when public safety use increases. Public safety use of spectrum typically is highly variable, with periods of low traffic and occasional usage

¹¹⁹ See, e.g., Private Radio Commenters Comments at 3; New York State Office of Technology Comments at 9-11.

¹²⁰ See, e.g., TIA Comments at 6; MAP/NAF Reply Comments at 7.

¹²¹ See, e.g., CTIA Comments at 13-15; Bergen County Comments at 6-7.

¹²² See Bergen County Comments at 6-7.

¹²³ See *Public Workshop on Spectrum Rights and Responsibilities*.

¹²⁴ See *Public Workshop on Spectrum Rights and Responsibilities*.

¹²⁵ See United Telecom Council (UTC) Comments at 4-5; Proxim Comments at 5 (“Market-oriented spectrum policies do not mean ‘taking away’ from government or public safety spectrum users. Rather this approach means giving such entities flexibility to monetize such assets as they best see fit to achieve their missions.”).

that “spike” during certain times of the day or week during emergencies. Accordingly, there is benefit to be gained from permitting public safety entities to lease some of their spectrum capacity to commercial users during low-use periods under an arrangement whereby the spectrum can be reclaimed immediately when needed for public safety use. The potential for this type of shared use will increase as smart transmitters and receivers are developed that can be shut down immediately upon command.

- For major regional or national emergencies, additional public safety spectrum needs potentially could be addressed through enhanced easement rights to non-public safety spectrum. In extraordinary national or regional emergencies (e.g., terrorist attack, major natural disaster), public safety may require access to spectrum resources significantly beyond the amount of spectrum required to handle their normal emergency workload. Because of the extraordinary nature of these events, permanent dedication of spectrum to public safety to meet these contingencies is likely to be highly inefficient. An alternative would be to address these needs through an “easement” mechanism that would enable public safety users to operate on non-public safety spectrum in such extraordinary emergencies, but to revert to operations on public safety spectrum when the emergency subsided.

C. Spectrum Allocated for Government Use (or Shared with Non-Governmental Uses)

Federal users of spectrum, like public safety users, need spectrum to provide many critical services such as national defense. By law, NTIA and the FCC share responsibility for management of the spectrum, with NTIA responsible for spectrum allocated for government operations and the FCC responsible for spectrum allocated for non-government operations. As government and non-government needs and concerns are often quite different, this separation provides an appropriate expertise and advocacy.

A few participants argued, however, that long-range planning has been impeded by the split in responsibilities between the FCC and NTIA. They claimed that the bifurcated management process results in the absence of a comprehensive national spectrum policy, a dearth of spectrum for numerous services that in turn drives up the cost of spectrum at auction, and inadequate harmonization of spectrum use with other parts of the world. Some commenters specifically argued for better coordination with NTIA and the removal of barriers between government and non-government spectrum.¹²⁶ Several participants noted a loss of efficiency and the slowness to react that results from this shared responsibility. They pointed out significant sources of conflict that arise from operations in adjacent bands exclusively allotted to Federal and non-Federal use, where spurious or harmonic emissions impact adjacent bands, and from operations in shared bands.

There are various policy options that potentially could address these problems. For instance, more Federal users could be required to share frequencies with each other

¹²⁶ See, e.g., Longman Comments at 25-26 and Reply Comments at 4; Nokia Comments at 2-3.

instead of with non-Federal users, and more non-Federal users to share spectrum with each other rather than with Federal users. Conflict would also be reduced if there was less interleaving between Federal and non-Federal allocations. This would reduce the occasions requiring coordination and agreement between the agencies. However, only a modest level of improvement could be so achieved. The reason for the development of extensive blocks of shared spectrum is the complementary nature of many Federal and non-Federal uses, in location, architecture, and nature of use. The greatest efficiency may come from accommodating complementary services wherever possible.

Significantly, the FCC and NTIA should coordinate, to the extent possible, the policy prerogatives resulting from this Task Force, particularly as regards interference, licensee rights and responsibilities, and periodic reassessments of efficiency, and adopt them to the fullest extent possible. The effects of any FCC actions in these regards will be severely limited if non-Federal users are hamstrung by legacy rules that are overly protective, in light of new technology, of shared and adjacent channel Federal users. For instance, a FCC policy of requiring periodic increases in equipment capability such as transmission innocuousness or receiver selectivity or discrimination will be significantly diminished if Federal users in spectrum that is impacted by non-Federal users are not migrating to similarly enhanced equipment. The Commission and NTIA should work together to minimize the indirect, as well as the direct, impact of inefficient Federal uses on non-Federal uses and the citizenry at large, and to adopt those principles and policies that they agree will lead to increasing efficiency of use of the spectrum while preserving other significant Federal interests of security and reliability. Where there is a divergence of financial incentives or means, improved relocation/compensation legislation and rules should be adopted to facilitate migration of Federal users to new spectrum or to new equipment where economically justified.

The Commission should also explore whether certain secondary market mechanisms can promote efficiency by Federal users of spectrum. For instance, such mechanisms could give the Federal government the right to lease to commercial users while maintaining priority in use. Significantly, technology has advanced to provide the option of strict priorities of service and high degrees of security and reliability, thus greatly enhancing the utility of non-Federal spectrum for many Federal uses. To the extent such arrangements are utilized, the Federal government might be able to enjoy significant cost savings, both direct and indirect, by reducing the amount of spectrum encumbered to only that used in space, time, and specific frequency. Additionally, such Federal uses would necessarily keep pace with advancements in technology.

Conclusions/recommendations. The Working Group recommends to the Spectrum Policy Task Force that the Commission work closely with NTIA to consider the following issues:

- Whether the amount of spectrum shared between the Federal Government and Non-Federal users can be reduced and whether there could be increased coordination with respect to interference, spectrum rights and responsibilities, and periodic reassessment of spectrum use.

- Whether Federal users should be allowed to engage in secondary market transactions with non-Federal users, perhaps while retaining priority in access.
- How to improve coordination in adopting technical standards and policies for both Federal and non-Federal spectrum and services.
- Whether to create a third-party board of scientific experts that can be consulted to arbitrate, on either a binding or non-binding basis, conflicts that arise from a disagreement in engineering opinions that cannot be resolved to the mutual satisfaction of both agencies.

D. Broadcast Services

The Commission has traditionally allocated spectrum specifically for broadcast use, based on statutory public interest considerations and the free over-the-air nature of broadcast service. Many commenters argued that these characteristics distinguish broadcasting from other market-based uses of spectrum, and that the Commission should therefore continue to dedicate some spectrum specifically for broadcast use on a command-and-control basis.¹²⁷ One commenter analogized the setting aside of spectrum for public service use by broadcasters to setting aside space for public parks, libraries, museums, and other public facilities and institutions.¹²⁸ Another commenter stressed the importance of setting aside spectrum for non-commercial educational broadcasting, noting that “[s]ince 1952, Congress . . . has consistently supported the policy goal of a reserved space in the spectrum for noncommercial educational purposes through federal financing and access to multiple distribution platforms.”¹²⁹

Other parties, however, contended that the continued dedication of spectrum for broadcasting, and particularly for commercial broadcasting, is increasingly anachronistic as the public gains access to alternative sources of programming and information from cable television, satellite services, the Internet, and other outlets.¹³⁰ These parties argued that the original rationale for command-and-control regulation of broadcasting, which is based on spectrum scarcity, is undermined by the proliferation of digital technology that has vastly increased the actual and potential efficiency of spectrum use to meet consumer needs.

The Working Group concludes that for the time being, there are valid reasons to continue applying the “command-and-control” model to existing broadcast spectrum, although there are also alternatives that should be considered for introducing greater flexibility into broadcast spectrum regulation in the short term, and transitioning away from the command-and-control model, with limited exceptions, over the long term.

¹²⁷ See generally NAB/MSTV Joint Comments; SBE Comments; APTS Comments; NPR Comments.

¹²⁸ See NPR Comments.

¹²⁹ See APTS Comments at 4 n.11 (citing Educational Television Facilities Act of 1962, Public Broadcasting Act of 1967, Public Telecommunications Act of 1978, Public Telecommunications Act of 1992, Cable Television Consumer Protection Act of 1992, Telecommunications Act of 1996, and Satellite Home Viewer Improvement Act of 1999).

¹³⁰ See, e.g., *Public Workshop on Spectrum Rights and Responsibilities*.

Broadcasting has consistently been a central focus of Congress and the Communications Act, which regulates broadcast content and behavior by placing certain public interest obligations on broadcast licensees. These include requirements that broadcasters provide “reasonable access” to candidates for federal elective office and afford “equal opportunities” to candidates for any public office,¹³¹ children’s educational programming requirements,¹³² restrictions on airing of indecent programming,¹³³ and provisions relating to the rating of video programming,¹³⁴ equal employment opportunities rules,¹³⁵ and other “behavioral” rules that mandate accountability.¹³⁶ While not exhaustive, this list demonstrates that “command-and-control” regulation of broadcasting has a significant statutory basis.

In addition to the statutory public interest obligations on broadcasters, there are other characteristics of broadcasting that potentially affect broadcast spectrum policy considerations.¹³⁷ Broadcast service is traditionally not subscriber-based – it is a “universal” service that is widely accessible to the general public.¹³⁸ In addition, localism and diversity of ownership are two important public interest objectives that have been associated with broadcasting to a greater degree than other spectrum uses.¹³⁹ Finally, the broadcaster’s relative lack of control over its signal reception equipment is another component that differentiates broadcast from its wireless counterparts.¹⁴⁰ In cellular or PCS systems, for example, licensees have the ability to replace or modify the equipment used by their customers, whereas in broadcasting, consumers and third party manufacturers play the primary role in the replacement of receivers. This affects the rapidity with which technological advances in equipment can be introduced into the marketplace and assimilated by consumers – a factor that has affected the pace of the DTV transition.

The transition of broadcast to a digital world, which is already under way, should help to alleviate concerns regarding inefficient and inflexible use of broadcast spectrum. As broadcasters convert to digital, some broadcast spectrum can be recovered for reallocation and reassignment to more flexible uses, as in the case of the 700 MHz band. The Commission has also allowed for some flexible use of broadcast spectrum,¹⁴¹ and

¹³¹ See 47 U.S.C. § 312(a)(7), 47 C.F.R. § 73.1944 (reasonable access); 47 U.S.C. § 315, 47 C.F.R. § 73.1941 (equal opportunities).

¹³² 47 U.S.C. § 303(b), 47 C.F.R. §§ 73.671, 73.673, 73.3526.

¹³³ 18 U.S.C. § 1464; 47 U.S.C. § 303, 47 C.F.R. § 73.3999.

¹³⁴ 47 U.S.C. § 303(w).

¹³⁵ 47 C.F.R. § 73.2080.

¹³⁶ 47 C.F.R. § 73.4280.

¹³⁷ See generally NAB/MSTV Joint Comments; APTS Comments; NPR Comments; SBE Comments.

¹³⁸ But see 47 C.F.R. §§ 73.641-73.644.

¹³⁹ See NPR Comments.

¹⁴⁰ See Statement of Victor Tawil at the *Public Workshop on Spectrum Rights and Responsibilities* at 90-94.

¹⁴¹ Broadcast spectrum can be used for ancillary or supplementary services that do not interfere with the primary broadcast signal, e.g., through use or leasing of the vertical blanking interval to provide telecommunications services. See 47 C.F.R. § 73.646. In the digital context, broadcasters may provide ancillary and supplementary services such as subscription television programming, computer software distribution, data transmission, teletext, interactive services, and audio signals so long as such services do

should consider additional ways to allow greater flexibility consistent with broadcasters continuing to meet their core public interest responsibilities. In addition, the Commission should consider whether it is feasible to make “white space” in the broadcast bands available for other uses.

Over the longer term, the Commission should periodically reevaluate its broadcast spectrum policies to determine whether they remain necessary to accomplish the public interest objectives they are intended to promote. In particular, such reevaluation should consider the extent to which the public interest benefits provided by dedication of spectrum to broadcasting under a command-and-control regime can be provided through the application of more flexible, market-oriented spectrum policies. It is likely that there will be a continued need to set aside some spectrum for non-market based broadcast uses, such as non-commercial and educational broadcasting. But assuming that technological advances continue to occur and that scarcity of access to spectrum resources decreases, it is equally likely that the continued application of command-and-control policies to commercial broadcasting can be substantially relaxed, or may not be needed at all, to ensure the public availability of the information and programming provided by commercial broadcasting outlets.

Conclusions/recommendations:

- For the time being, broadcast spectrum should continue to be subject to the command-and-control model due to the public interest obligations placed on broadcasters and the free over-the-air nature of broadcast service.
- The ongoing transition to digital television, upon completion, will allow for more efficient and flexible use of broadcast spectrum. The Commission has allowed for some flexible use of broadcast spectrum and, over time, should continue to consider ways to increase flexibility and encourage additional introduction of efficient technology for broadcasting.

E. Rural vs. Urban Areas

The Working Group addressed the issue of whether the Commission’s approach to spectrum management should vary in different portions of the spectrum, in different geographic areas, or for different types of uses. Many commenters focused considerable discussion on the issue of rural areas, where spectrum is almost uniformly uncongested even in the most heavily used bands below 3 GHz.¹⁴² Although some parties indicated that the Commission should not adopt different spectrum allocation and assignment policies for different portions of the spectrum or different geographic regions, there is some support in the record for applying different rules to spectrum usage in urban and

not interfere with the required provision of free over-the-air programming. *See* In the matter of Advanced Television Systems and Their Impact upon the Existing Television Broadcast Service, *Fifth Report and Order*, 12 FCC Rcd 12810 (1997) at ¶ 29 (citations omitted). *See also* 47 U.S.C. § 336.

¹⁴² *See, e.g.*, AT&T Wireless Comments; Blooston, Mordkofsky, Dickens, Duffy & Prendergast (Blooston) Comments; RTG Comments; Cantor Fitzgerald Comments; Internet Technology Consultants Comments; Longman Comments; Schafer Comments; Midcoast Internet Solutions Comments; NTCA Comments; Rural Cellular Association (RCA) Comments; Williams Comments; Matanuska Telephone Association Comments; Leggett Comments; Part-15 Organization Comments; Michener Comments.

rural areas, and it was generally recognized that the economic and technical considerations in rural areas can be different than in urban areas.¹⁴³

Access to spectrum. Many advocates for rural interests asserted that rural carriers have difficulty gaining access to rural spectrum, even though it is not scarce. Specifically, rural carriers indicated that the Commission's tendency to adopt large geographic service areas that include both urban and rural areas prevents rural carriers from competing at auction for an entire license area.¹⁴⁴ In addition, rural carriers commented that the Commission's partitioning and disaggregation rules do not benefit rural providers because they must incur significant transaction costs by negotiating access to rural spectrum with multiple large carriers that may opt to retain such spectrum for future use. It was further stated that impediments to secondary markets arrangements that would enable providers to gain access to spectrum, and the Commission's build-out rules, which require coverage on a population basis, result in hoarding of rural spectrum and contribute to build-out only in urban areas.¹⁴⁵

Interference and other technical considerations. Commenters also discussed whether there should be different interference standards for rural and urban areas. Certain parties advocated different permissible power levels for rural areas on the theory that where there is less congestion, higher permissible power levels would allow for fuller usage of spectrum.¹⁴⁶ Others objected to this idea, arguing that having different rural and urban regimes is impractical because it is not a simple matter to define urban versus rural, as many areas fall somewhere in between and problems may arise when formerly rural areas undergo development.¹⁴⁷ Thus, there was a difference of opinion as to whether different technical rules for rural areas are feasible or desirable. For instance, one participant in the Public Workshop indicated that unusual rural conditions have been dealt with satisfactorily through the waiver process,¹⁴⁸ and another thought that it will be possible in the future for transmitters to determine if they are operating in a rural or urban area and adjust power accordingly.¹⁴⁹

Conclusions/Recommendations. The Working Group recommends to the Spectrum Policy Task Force as follows:

- The Commission should explore the option of taking different approaches with regard to rural and urban spectrum, while recognizing, that the distinction between high- and low-congestion areas does not necessarily

¹⁴³ See generally Blooston Comments; RTG Comments; RCA Comments; NTCA Comments.

¹⁴⁴ See, e.g., Blooston Comments at 4-5; RTG Comments at 3-6; NTCA Comments at 4; RCA Comments at 4; Matanuska Comments at 3.

¹⁴⁵ See, e.g., Blooston Comments at 5-6; RTG Comments at 6-8; NTCA Comments at 3, 6; RCA Comments at 5; Matanuska Comments at 3-4.

¹⁴⁶ See, e.g., ITC Comments at 1; Longman Comments at 12-13; Schafer Comments at 4-5; Williams Comments at 1; Part 15-Organization Comments at 6; Michener Comments at 1.

¹⁴⁷ See, e.g., AT&T Wireless Comments at 11-12; Leggett Comments at 5.

¹⁴⁸ See Statement of Larry Miller at the *Public Workshop on Spectrum Rights and Responsibilities*.

¹⁴⁹ See Statement of Steve Stroh at the *Public Workshop on Spectrum Rights and Responsibilities*.

require non-uniform rules where the rules do not artificially cause spectrum congestion or constrain the use of uncongested spectrum.

- When licensing by geographic area, the Commission should explore using licensing areas that distinguish between rural and urban areas, so that rural bidders can bid directly for rural spectrum without having to bid against entities seeking urban spectrum; it should note, however, that new, rural licensing areas may not be the optimal solution for all bands because it would significantly increase the number of overall licenses and drive up the administrative and transaction costs of aggregation.
- To improve rural providers' ability to gain access to spectrum, the Commission should promote the development of an efficient and flexible secondary markets regime that, in addition to partitioning, facilitates the leasing of spectrum usage rights in rural areas.
- The Commission should consider expanding "easements" on licensed spectrum (as discussed above) in rural areas to allow access, on a non-interference basis, by other spectrum users.
- In general, interference and other technical rules should be calibrated to situations where spectrum is likely to be in the greatest demand and the most congested, *i.e.* urban areas. Thus, the rights of spectrum users to emit RF energy and the obligation to accept interference from others should be set at levels suitable for such areas, as this will increase spectrum efficiency.
- While interference rules should not necessarily prevent licensees from operating at higher power on a non-interference basis in less congested areas, licensees should not have expanded interference protection rights or reduced obligations to avoid interference under the rules. Thus, if two spectrum users come into conflict in an otherwise uncongested area, the "default" rules would prevail and be the basis for any negotiations between them.
- The Commission should explore setting technical rules for unlicensed spectrum that allow for higher-power operation in less populated areas, as power limits may be less necessary in low-population areas where fewer devices operate and interference is less likely.

V. Transition

As discussed above, this report recommends that the Commission move towards assigning flexible usage rights in spectrum within its jurisdiction, whether under an exclusive rights or a commons model. However, the practical reality is that most spectrum within the Commission's jurisdiction is already occupied by incumbent spectrum users. Moreover, most of these incumbents are governed by legacy command-and-control regulations that substantially limit allowable uses of the spectrum. Therefore, successful implementation of the recommendations in this report requires the Commission to consider how to migrate away from these restrictive legacy licensing regimes to more flexible rights models that create opportunities for new, more efficient and beneficial uses. Specifically, the Commission must determine which bands should be transitioned to expanded flexible rights models and how the transition should be accomplished.

Several parties discussed methods that the Commission might employ to determine which bands should be transitioned to more flexible rights models. Certain parties indicated that the Commission should inventory spectrum needs on a regular basis to forecast demand, and that it should work to identify inefficiently used spectrum.¹⁵⁰ As discussed above, several parties made the point that there is a large amount of significantly underutilized spectrum.¹⁵¹ Some parties suggested setting up an independent review commission to find blocks of inefficiently used spectrum (e.g., a mechanism similar to the Base Realignment and Closure Commission process as a means of facilitating reallocation decisions and overcoming any political difficulties), or drawing upon independent consulting firms or technical advisory committees to develop technical analyses for reallocation decisions.¹⁵² Some commenters suggested that the Commission should develop a rigorous cost-benefit analysis to be completed with any reallocation decision, examining both technical and financial ramifications.¹⁵³ And, as discussed above, several commenters suggested that special considerations should be given when determining whether and how to transition certain bands of spectrum, such as those used for public safety or broadcasting, to an expanded flexible rights model.

There also was considerable discussion about whether the Commission should reallocate and assign the underutilized legacy spectrum to new licensees or, instead, simply expand the rights of incumbents to use the spectrum in more flexible ways. Several commenters proposed that the Commission reallocate and reassign underutilized spectrum to more flexible use through an auction process.¹⁵⁴ These commenters objected to granting expanded flexibility to incumbents on the grounds that such a course would serve to prop up faltering businesses and might give incumbents, most of whom did not obtain their spectrum through auction, an inequitable windfall. For instance, some incumbent wireless service licensees objected to granting other incumbent licensees the flexibility to provide commercial mobile services even though they had not competed at auction.¹⁵⁵ These commenters claimed that this policy would create less of an incentive for them to invest in their networks. In addition, several commenters contended that a substantial grant of flexibility was equivalent to assigning a new license, and that the Commission is required to make such new licenses available through a competitive bidding process.¹⁵⁶

Other commenters, however, contended that granting expanded rights to incumbents would be the best means of transitioning spectrum to the most efficient uses, maintaining that the benefits to be reaped from allowing spectrum to be put to its highest and best use immediately – in the form of new services and spectral efficiency – would

¹⁵⁰ See, e.g., Motorola Comments at 2-4.

¹⁵¹ See, e.g., Cantor Fitzgerald Comments at 3.

¹⁵² See, e.g., CTIA Comments at 3-10.

¹⁵³ See, e.g., CTIA Comments at 3-6.

¹⁵⁴ See, e.g., AT&T Wireless Comments at 8.

¹⁵⁵ See, e.g., CTIA Comments at 6-9.

¹⁵⁶ See, e.g., New America Foundation et al. Comments at 11-14; AT&T Wireless Comments at 5-8; CTIA Comments.

outweigh the costs of windfalls to incumbents.¹⁵⁷ For instance, MSS providers stated that efficiency gains would follow from a policy that allowed them to conduct terrestrial mobile operations in spectrum that MSS would otherwise render useless for traditional terrestrial mobile purposes.¹⁵⁸ They asserted that granting regulatory flexibility may lower costs and eliminate inefficiencies by allowing MSS operators to extend their addressable markets to urban and suburban areas, increase the number of subscribers by offering a ubiquitous and previously unavailable mobile service, and lower costs by increasing the number of handsets produced.

To the extent that the Commission determined that the appropriate avenue would be to clear a band of incumbents and reallocate it to more flexible use, several parties recommended that the Commission create a “trust fund” from auction proceeds in order to pay for relocation costs involved in the band clearing.¹⁵⁹ In addition, some commenters advocated using incentives, such as user fees, to encourage licensees to more efficiently use spectrum that was underutilized.¹⁶⁰

As also discussed above, various parties focused on the need for long-term planning on the part of the Commission.¹⁶¹ For instance, parties suggested that the Commission should devise a comprehensive spectrum management plan for the next several years by anticipating future rulemakings. As noted above, a three- and ten-year plan were suggested.¹⁶² Another commenter proposed that the Commission take a 20-year view to assist investment, spur innovation, and focus on ways to transition bands to digital technologies. Among the other ideas suggested was that of using the expiration of licenses as a time to transition to new spectrum management approaches.¹⁶³

A. General Transition Considerations

In determining whether and how to transition legacy command-and-control bands to more flexible rights models, the Commission should focus first on initiating transition in those bands where additional flexibility will provide the greatest benefits at the least cost. In general, the greatest benefits will be realized in those bands in which the current regulatory regime has led to significant underutilization or inefficient use of the spectrum. However, the Commission must also weigh the potential cost of transition, both in terms of its impact on incumbents and on the public. Assessing these potential costs and benefits, the Working Group concludes that there are some spectrum bands in which introducing fundamental regulatory changes in the near term may not be necessary, appropriate, or practical. These include:

- Bands licensed under flexible use rules or currently allocated for such use;
- Bands dedicated for use by unlicensed devices;

¹⁵⁷ See, e.g., Mobile Satellite Ventures Comments at 8.

¹⁵⁸ See, e.g., Mobile Satellite Ventures Comments at 14.

¹⁵⁹ See, e.g., TIA Comments at 7; Nokia Comments at 3.

¹⁶⁰ See, e.g., Comsearch Comments at 6.

¹⁶¹ See generally Nokia Comments at 2; TIA Comments at 4-6.

¹⁶² See CTIA Comments at 15-16.

¹⁶³ See Consumer Federation of America Comments at 30-31.

- Public safety spectrum;
- Broadcast spectrum, including DTV spectrum that is subject to ongoing rulemakings;
- Spectrum bands currently shared with the Federal Government; and
- Bands licensed on a shared or non-exclusive basis.

In bands that fall outside these categories, however, the Working Group recommends that the Commission initiate proceedings to begin the transition of its spectrum regulations to allow more flexible uses. Moreover, in the long term, the Commission should consider transitioning to a flexible rights model in all bands throughout the spectrum where such action would further the Commission's spectrum policy goals.

B. Available Transition Mechanisms

Once the Commission identifies particular bands that are suitable for transition, it will need to identify appropriate transition mechanisms. Historically, the Commission has used a number of different transitional mechanisms to move spectrum from narrowly-defined legacy uses to more flexible new uses. In addition, other mechanisms that have not previously been used are also available. Generally, the core issue for all of these transition mechanisms is the treatment of incumbents: Do they remain in the band or are they cleared or relocated? If incumbents are cleared or relocated out of the band, what mechanisms are used? If incumbents remain in the band, does the Commission grant them expanded rights outright or does it use a new licensing vehicle to award expanded rights?

Transition options generally fall into the following categories, though variations and combinations of each are also possible: (1) reallocating a particular band to the flexible rights model, with assignment of the expanded rights to new licensees and the mandatory relocation of incumbents to other bands; (2) allowing incumbents to remain as licensees for those portions in a band that they currently occupy, while assigning "overlay" licenses for additional rights and/or unoccupied "white space" not assigned to incumbents; (3) reallocating and assigning spectrum to new licensees under the flexible rights model, and using voluntary market-based band-restructuring incentives, such as a two-sided auction, to encourage incumbents to clear or restructure the band; or (4) granting expanded, flexible rights to the incumbent licensees already occupying the band. Each of these options is discussed in general below.

1. Expanded rights “overlay” licenses combined with mandatory relocation of incumbents

Under this option, the Commission reallocates a particular band of spectrum to allow for more flexible uses, grants the expanded usage rights under new licenses (generally via auctions) and requires incumbent licensees and the services they provide to clear the band and either cease operating or relocate to other bands. The Commission has used this option in several instances, including broadband PCS.

There are several variations of this option, depending on the conditions that must be met in order for mandatory relocation of incumbents to occur. Under one approach (which was used for broadband PCS), new spectrum licenses are issued under flexible rules while incumbents are required to clear, relocate, or retune to alternative bands by a specified date. In addition, the new licensees may be required to pay the costs of relocating incumbents. Under a more conditional approach (which was adopted for 700 MHz DTV spectrum), incumbents are required to clear or relocate only if and when certain external conditions are met, such that there is no fixed time frame for clearing and relocation. Under this approach, while new licensees are not required to pay the costs of clearing and relocating incumbents, they may pay for voluntary early clearing by incumbents.

2. Expanded rights “overlay” licenses with grandfathering of incumbents

Under this option, the Commission grants expanded usage rights under new licenses, which are “overlaid” on top of the incumbent licenses. Incumbents retain their existing rights (including interference and renewal rights) on a grandfathered basis, and are not subject to mandatory band-clearing or relocation.

This overlay option has been used in services such as paging and SMR where the Commission is converting from site-based to geographic-area licensing, there is unlicensed “white space” (geographic areas where incumbents are not currently authorized), and incumbent and potential new uses are generally compatible. Under this option, incumbents can only acquire expanded rights, including the ability to expand their systems beyond their existing site-based contours, by obtaining overlay licenses. Alternatively, new overlay licensees must protect incumbents’ existing systems unless they buy the incumbents out.

3. Expanded rights “overlay” licenses combined with voluntary band-clearing/restructuring incentives for incumbents

Under this option, the Commission reallocates restricted spectrum to more flexible use, grants the expanded usage rights under new licenses, and establishes a simultaneous market-based exchange mechanism to encourage voluntary band-clearing or restructuring of the band by incumbents. This mechanism is designed to create incentives for incumbents either to relinquish their licenses and clear the band for new

users or to exchange their restricted-use licenses for the expanded rights available under the new license.

The Commission has not employed this option to date, but a number of potential mechanisms have been proposed that could facilitate this type of exchange. For instance, one mechanism that has been suggested is a “two-sided” auction, in which the Commission would auction expanded usage rights to spectrum under new licenses, and incumbents would voluntarily make their spectrum rights in the band available for auction at the same time.¹⁶⁴ Under this approach, incumbents would be eligible to participate in the auction for expanded rights only if they offered their own spectrum licenses for sale in the same auction. Moreover, incumbents would be allowed to “bid” on their own spectrum in addition to spectrum offered by other incumbents and by the FCC. Incumbents who chose not to offer their licenses would retain their incumbent rights, but would not be granted expanded rights. This mechanism provides several incentives to incumbents to offer their spectrum rights for possible exchange. First, if incumbents voluntarily participate, they would immediately have their licenses converted to expanded flexible rights licenses, thus increasing the value of their spectrum usage rights. In addition, incumbents would not be forced to sell their spectrum usage rights to others, although they would face the opportunity cost of not doing so. Finally, incumbents would be able to keep any proceeds from the sale of their rights to others, and could, as well, potentially obtain rights to relocate to other parts of the auctioned band (or other bands altogether) that might be more advantageous to them.

4. Expanded rights granted to incumbent licensees under existing licenses

Under this option, the Commission grants expanded flexible rights directly to incumbents through modification of their existing licenses. Potential new entrants are not able to bid for or otherwise obtain these expanded rights, except by acquiring the licenses from incumbents through the secondary market. This option has been used by the Commission in several bands. For example, in the CMRS Flexibility proceeding, the Commission granted CMRS providers the right to provide fixed in addition to mobile services under their existing licenses.

C. Factors Affecting the Choice of Transition Mechanism

The Commission must consider a number of factors when deciding which transition mechanisms to implement. These factors may vary significantly from band to band, suggesting possible advantages to taking different approaches in different bands.

¹⁶⁴ See Evan Kwerel and John Williams, “A Proposal For a Rapid Transition to Market Allocation of Spectrum,” OPP Working Paper 38 (November 2002).

Major factors in the Commission's evaluation of options include:

- The restrictive nature of licensee rights currently afforded incumbents in the band when compared with the flexibility that would be gained by transitioning to an expanded flexible rights model;
- The types of services currently offered in the band and the potential consumer impact of transitioning to an expanded flexible rights model of licensing;
- The number of incumbents in the band;
- The likelihood that expanded flexibility would lead to rapid changes in the use of the band or instead would have only a gradual impact on existing systems and uses;
- The practical effect on incumbent systems of providing expanded flexibility under a new licensing model (e.g., the potential for new users to co-exist in the band with incumbents);
- The nature and extent of investments made by incumbents in their acquisition of licenses and the building of systems, including whether incumbents have had the opportunity to recoup their investments; and
- The time and transaction costs associated with developing and implementing any particular transition mechanism in a particular band or bands, compared to other transition mechanisms.

New licensing with mandatory relocation. As a preliminary matter, consideration of this option depends on the availability of alternative spectrum that would be suitable for use by incumbent licensees required to relocate. Assuming that alternative spectrum is available, this option may be preferred in cases where band-clearing is likely to be critical because of the technical incompatibility between existing uses by incumbents and prospective uses. However, it is important that the benefits to be obtained through mandatory band-clearing outweigh the costs and time required to complete the relocation of incumbents, and that the relocation be consistent with the Commission's broader spectrum goals for the relocation band.

In order to ensure maximum efficiency gains in the near term and avoid holdout problems, it is preferable under this option for there to be a fixed timetable for mandatory relocation. Furthermore, this option is likely to work best when there are market incentives for new licensees and incumbents to negotiate voluntary relocation agreements, although it may also be appropriate to develop mandatory compensation mechanisms in the event that the voluntary ones prove inadequate.

New licensing with incumbent overlay. The "overlay option" generally requires the presence of a significant amount of unlicensed "white space" that would lend itself to an overlay licensing scheme. This option also is likely to work best where there is a limited need to relocate incumbents to other bands and where incumbents have incentives to acquire rights to the surrounding white space, e.g., in bands that are being converted from site-based to geographic area licensing and where incumbent uses and potential new uses are generally compatible. In considering use of this option, the Commission needs to assess the degree of risk that incumbents will hold out against transitioning to more

flexible use, which could hinder the Commission's goal of enabling more efficient use of the spectrum.

New licensing with voluntary band-clearing/restructuring. This option has potential advantages when (1) the new flexible rights regime being implemented represents a significant increase in flexibility over the legacy rules, and (2) this expanded flexibility is likely to lead to rapid changes in the market value and the actual use of the spectrum. In such cases, a simultaneous exchange mechanism may be the fastest and most efficient means of enabling incumbents and potential new spectrum users to restructure and reassign spectrum rights within the band to facilitate new uses. In determining whether to employ this option, the Commission should compare the administrative costs and efficiency of implementing a simultaneous exchange mechanism with that of employing other transition options, particularly the option of granting expanded rights to incumbents discussed below.

Expanded rights granted to incumbents. This option has potential advantages where the practical impact of granting incumbents additional flexibility is limited or is likely to be gradual rather than immediate, in which case it is likely that the operation of secondary markets over time can effectively distribute these flexible rights so that efficiency gains can be achieved. As a practical matter, this option also requires that there be no "white space," i.e., that all spectrum in the band be previously assigned to incumbents (to avoid ambiguity as to who is entitled to additional rights). While granting incumbent licensees additional flexibility may allow for more immediate expansion of the availability of flexible rights licensing models, it also may raise equity issues relating to possible windfalls or unjust enrichment. The larger issue is whether such a policy would encourage parties to make future bids on presumably low-cost spectrum that is allocated for low-value uses and that has no flexibility, then petition for an expansion of those rights after acquiring the license. Accordingly, in considering this option, these equity issues will need to be balanced against the potential gains in administrative efficiency and the potential public benefits of providing additional flexibility to incumbents in the band.

Conclusions/recommendations. The Working Group recommends that the Commission undertake the following:

- Identify encumbered bands licensed under legacy command-and-control regimes that are suitable for transitioning to expanded flexible rights licensing models within the next five years –
 - Set a goal of identifying 100 megahertz of spectrum below 3 GHz for this transition phase.
 - Develop processes for determining which bands provide greatest opportunity for improving efficient use through adoption of expanded flexible rights licensing schemes.
 - Look for band "defragmentation" opportunities (i.e., consolidating narrowband spectrum "slices").

- Choose appropriate transition mechanisms for the different bands being transitioned –
 - Look for bands in which to test different transition mechanisms.
 - Promote policy and legislative changes to facilitate the conducting of two-sided auctions.
 - Encourage migration of compatible technologies into common band groupings.

Acknowledgements

The Spectrum Rights and Responsibilities Working Group wishes to thank the participants at the Public Workshop on Spectrum Rights and Responsibilities held on August 9, 2002. We are grateful for the many suggestions and insights which they shared with us. We would also like to thank the many Commission Staff members in addition to the members of our working group who helped to improve the quality of this report.

Appendix I

Bibliography (with Summaries)

1. M. Calabrese, “**Battle Over the Airwaves; Principles for Spectrum Policy Reform,**” New America Foundation, Sept. 2001.

http://www.newamerica.net/Download_Docs/pdfs/Pub_File_610_1.pdf

The focus of this article is a discussion of the principles that Calabrese believes should guide spectrum policy reform. Four principles Calabrese considers to be important are: (1) the airwaves are a public asset owned in common by all Americans; (2) all commercial licensees should pay a market-based rent for the use of spectrum; (3) rigid zoning of the airwaves should be replaced by more flexible, market-driven allocation process; (4) revenue from licensing spectrum should be reinvested in new public assets that benefit all Americans and be used to update our educational technology and public media for the digital age. Calabrese suggests that the immediate problem the FCC faces is the shortage of spectrum caused by the rapid diffusion of wireless communications. The short-term issue is how to reallocate spectrum from existing licensees (who pay nothing) to emerging technologies (particularly wireless broadband services) that promise both higher value-added services and the payment of substantial public auction revenue. Therefore, Calabrese suggests that auctions should occur as soon as possible. Calabrese claims that the longer-term challenge is to modernize spectrum policy in a way that combines more flexible and market-oriented allocation rules with a level playing field that requires all commercial users to pay a market rate to rent space on the public airwaves. Charging all commercial licensees would result in more efficient use of spectrum as well as in the formation of a private secondary market. Calabrese also believes that the public should maintain control of spectrum and that licenses should be for strictly-defined periods. He suggests a transition method which: (1) sets a date when incumbent licenses will be auctioned rather than automatically renewed; (2) imposes an airway “right of way” fee similar to a franchise fee typically paid by cable companies to local governments for terrestrial rights of way; (3) combines the future auction date with escalating interim fees. Calabrese also suggests that lease fees could be an option where auctions are not practical (e.g. for small business users and public sector users).

2. R. Carlberg, “**The Persistence of the *Dirigiste* Model: Wireless Spectrum Allocation in Europe, *a la Francaise*,**” 54 Fed. Comm. L.J. 129 (2001).

<http://www.law.indiana.edu/fclj/pubs/v54/no1/Carlberg.pdf>

Carlberg examines spectrum allocation for 3G mobile wireless networks in the European Union. He claims that the EC committed itself to a schizophrenic policy when it allowed member states to devise their own methods of allocating frequency spectrum. In particular, Carlberg criticizes the French *dirigiste* policies where *dirigisme* refers to the central government’s role in directing the French economy. He claims that the EC has erred in two crucial aspects of its spectrum policy. It imposed short-term deadlines and pushed for the speedy creation of a 3G market. This may have the effect of an over-commitment of resources by telecom firms and financial institutions to a market where demand is only speculative. In addition, the EC yielded to countries like France that wanted to maintain substantial control over the selection of the license and near-managerial control over the future market. Therefore, the EC did not require free market auctions for 3G licenses, thus undercutting the EC’s policy of market liberalization and of greater competition among European firms.

3. R.H. Coase, **“The Federal Communications Commission,”** 2 J.L. & Econ. 1 (1959).

Coase begins this article with an overview of the development of government regulation of spectrum in the United States. He then discusses the debate over whether the FCC’s consideration of programming content when granting licenses is in violation of the First Amendment to the Constitution which protects the freedom of the press. Finally, Coase discusses the system used by the FCC (prior to 1960) to allocate spectrum and whether or not spectrum should be treated as private property. Coase argues that licensees should have to pay for spectrum use and states that the aim of regulation should be to maximize output as opposed to minimizing interference. Coase argues that it is not necessarily optimal to completely eliminate interference, but that any gain resulting in interference should more than offset the harm it produces. He also makes an argument for the use of property rights but also notes that when large numbers of people are involved, the argument for the institution of property rights becomes weaker and that for general regulations becomes stronger. He suggests that only practical experience can answer the question of how far delimitation of rights should come about as a result of strict regulation and how far as a result of transactions on the market.

4. R.H. Coase, **“The Nature of the Firm,”** 4 *Economica* 398 (1937).

Coase was responsible for the initial development of the theory of the firm which he describes in this very influential paper. A firm can be defined as a group of people who have organized themselves for the purpose of transforming inputs into outputs. Coase develops a theory explaining why these firms exist. That is, why do people organize in this fashion? Why, if the market is the most efficient way of allocating resources, do producers of different inputs (e.g. owners of capital and workers with various skills) allow decision-making to be centralized? If a market is better at allocating resources than a central planner then why is the creation of a firm necessary? Within the firm, individual bargains between the various co-operating factors of production are eliminated and for a market transaction is substituted an administrative decision. Coase notes that production could possibly be carried out in a completely decentralized way by means of contracts between individuals. But, if the costs of these transactions are very high or if short term contracts would be unsatisfactory, firms will emerge to organize what would otherwise have been market transactions. The limit to the size of the firm is set where its costs of organizing a transaction become equal to the cost of carrying it out through the market. These transaction costs determine what the firm buys, produces, and sells. Coase notes that a firm will tend to be larger: (1) the less the costs of organizing and the slower these costs rise with an increase in the transactions organized; (2) the less likely the entrepreneur is to make mistakes and the smaller the increase in mistakes with an increase in the transactions organized; (3) the greater the lowering in the supply price of factors of production to firms of larger size; (4) the smaller the spatial distribution of the transactions organized and the dissimilarities of these transactions; (5) when inventions such as the telephone reduce the costs of organizing spatially.

5. R.H. Coase, **“The Problem of Social Cost,”** 3 J.L. & Econ. 1 (1960).

This very influential paper laid the groundwork for the development of the Coase Theorem (for which the economist, Joseph E. Stiglitz, coined the term). The Coase theorem asserts that an optimal allocation of resources can always be achieved through market forces, irrespective of the

legal liability assignment, if information is perfect and transactions are costless.¹⁶⁵ Coase first advanced the proposition on which this theorem is based in “The Federal Communications Commission”¹⁶⁶ and develops it in more depth here. In this article, Coase examines the actions of businesses that have harmful effects on others and examines how the assignment of property rights can potentially mitigate these harmful effects. He also discusses the merits of and costs to government regulation. Coase shows that if an initial delineation of property rights is established, the ultimate allocation of resources which maximizes the value of production is independent of the legal position if the pricing system is assumed to work without cost. In reality the pricing system does not work without cost. There are transaction costs to carrying out market transactions which may prevent many transactions that otherwise would have been carried out. These costs include the costs of negotiating, drawing up contracts, and enforcing these contracts. When transaction costs are taken into consideration, the initial delimitation of rights does have an effect on efficiency and the allocation of resources. In a situation in which there exist high transaction costs, direct government regulation may be necessary. Instead of instituting a legal system of rights which can be modified by transactions on the market, the government may impose regulations which state what people must or must not do and which must be obeyed. But there are costs to government regulation as well which include: (1) bad decisions made regarding restrictive and zoning regulations; (2) political pressures; (3) operating without any competitive check. Government regulation is useful when a large number of people would need to be involved with the bargaining in a market system because the costs of handling the problem through the market or a firm would be high in this situation. Coase argues that when considering regulation, the government must decide whether the gain from preventing the harm is greater than the loss which could be suffered elsewhere as a result of stopping the action which produced the harm.

6. P. Cramton, E. Kwerel, and J. Williams, “**Efficient Relocation of Spectrum Incumbents,**” 41 J.L. & Econ. 647 (1998). <http://www.market-design.com/files/98jle-efficient-relocation.pdf>

The authors examine the relative efficiencies of alternative rules for relocating spectrum incumbents. They compare two alternative types of property rights, the “right to stay” and the “right to move.” Under the right to stay rule, an incumbent is free to use the spectrum according to the terms of the existing license. Under the right to move rule, the entrant can unilaterally move the incumbent. There are two versions of the right to move rule: the right to move with compensation to the incumbent and the right to move without compensation. The authors find that giving the new entrant the right to move the incumbent with compensation can reduce negotiation costs and promote efficiency when there is private information about spectrum values but good public information about the cost of relocating the incumbent. They also note that adopting an efficient relocation rule is especially important in a setting like PCS, where the reallocation brings much needed competition.

7. R. Crandall, J. Eisenach, J. Gattuso, T. Hazlett, P.W. Huber, G.A. Keyworth II, T.M. Lenard, W.C. Myers, P. Pitsch, K. Robinson, G. Sidak, and A. Thierer, “**Privatizing the Electromagnetic Spectrum,**” *Future Insight* 3.1, May 1996.

The authors give some very specific recommendations for managing spectrum policy so a somewhat longer summary is presented here. The authors state that the overarching goal should

¹⁶⁵ Jean Tirole, The Theory of Industrial Organization, The MIT Press, 1995, p. 113.

¹⁶⁶ R.H. Coase, “The Federal Communications Commission,” 2 J.L. & Econ. 1 (1959).

be to maximize the value of spectrum to the American people. The current system is government-run and centrally managed but the authors believe that the best means of achieving efficient use of the spectrum is to rely principally on market forces. They state three problems with the current system: (1) the FCC lacks the information necessary to make efficient decisions; (2) the process has been used by special interests to delay competition and innovation; (3) the current system has held fallow or underutilized a substantial portion of the spectrum for government purposes.

The authors recommend that within its explicit or implied service area and spectrum block, a licensee should be given: (1) service and technical flexibility; (2) freedom to resell or sublease; (3) freedom to pick regulatory classification. Specifically, the authors recommend that the FCC prepare an overlay system of licenses that would permit the exhaustive assignment of the 402 MHz of spectrum allocated for television broadcasting services. In order to do this the FCC should create licenses of 20 MHz and no smaller than the relevant ADI and assign overlay licenses using simultaneous multiple round auctions. The authors believe that the FCC should permit aggregation of overlay licenses, subject only to competitive considerations and that existing TV broadcast licensees be given flexibility in use. The authors recommend that currently unassigned spectrum be made available in an efficient manner and that the new assignments should be: (1) exclusive; (2) have the same marketplace freedoms as existing licensees; (3) assigned through simultaneous multiple round auctions where there are mutually exclusive applicants. Existing licensees in these bands would be protected and would gain flexibility in use and the FCC would define interference radiation limits between new licensees. The FCC should maximize the value of the spectrum licenses by auctioning broad, low-frequency bands of contiguous spectrum that are not fully assigned.

Similar incentive-based reforms are recommended for the spectrum used by the federal government and public safety community. The authors recommend that: (1) any state may assume responsibility for managing the spectrum currently allocated to public safety uses within its state boundaries provided it notifies the FCC of its plans; (2) any state government assuming spectrum management for public safety frequencies may grant licensees the same flexibility in use available to private FCC licensees; (3) interference disputes between states be resolved at the FCC; (4) within one year the federal government make an additional 20% of its exclusive or shared spectrum below 5 GHz available to the FCC for allocation to private sector licensees using auctions. After two years, the FCC should prepare a cost-benefit report on the effects of implementing proposed legislation which would include: (1) an estimate of the change in costs of accessing spectrum; (2) the net economic and social benefits accruing from more flexible use of spectrum; (3) the impact on low power users; (4) a discussion of how reforms affected the international allocation of spectrum, the setting of technical standards, the development of new uses of the spectrum, the availability of advertiser-supported programming, and the use of spectrum by the federal government and public safety community.

8. A. De Vany, **“Implementing a Market-Based Spectrum Policy,”** 41 J.L. & Econ. 627 (1998).

De Vany contends that the block allocation method results in a great portion of the spectrum going unused and, since it fixes technical standards for each block, technological innovation is prevented. De Vany believes that spectrum should be unbundled from broadcast and transmission facilities and that the “commoditization” of spectrum will facilitate standardization, price discovery, and open access to diverse users. He believes that a liquid secondary spectrum market will lower transactions and entry cost, making telecommunications

markets contestable. De Vany contends that unbundled spectrum property rights, commoditization, and open markets will give the public access to this public resource. He suggests that the government hold 2-sided simultaneous auctions with package bidding for interdependent licenses which differ in frequency and scope. This, De Vany believes, would result in voluntary spectrum clearing and reallocation. De Vany notes that if the government wants to raise revenue as well, the government could retain the difference between the bid and offer prices. The present broadcast standard of licenses should be restated in terms of the spectrum dimensions as they were in the WCS licenses and rights should be defined with respect to transmitters.

9. A. De Vany, R.D. Eckert, C.J. Meyers, D.J. O’Hara, and R.C. Scott, “A Property System for Market Allocation of the Electromagnetic Spectrum: A Legal-Economic-Engineering Study,” 21 Stan. L. Rev. 1499 (1969).

The authors give some very specific recommendations for managing spectrum policy, defining property rights, and defining the statutory rules so a somewhat longer summary is presented here. The authors believe that the goal for spectrum policy should be to maximize the social value of production from the use of spectrum. In order to do that they believe that property rights need to be established and that the rule for choosing among definitions of property rights should be to reduce the costs of exchange and enforcement relative to the value of the rights. The authors recommend that rights should be defined with respect to transmitter owners (because the authors believe that if rights were given to owners of receivers there would be high exchange and enforcement costs) and for frequencies between 50 and 1000 MHz. Rights should be specified in terms of time, area, and frequencies.

The time rights should be defined as rights to use spectrum for 24 hours per day in perpetuity and these rights should be transferable and divisible. The area rights should be defined in terms of the following three properties: (1) the exclusive right to originate radiation subject to the constraint that the field strength achieved by this radiation does not exceed a specified limit expressed in volts per meter outside his area; (2) the right to be free, above the same field strength, from radiation originating in any other area; (3) straight-line boundaries. Note that there will be an area (low quality service strip) between two licensees’ areas where interference will be a problem. The width of this strip is greater for transmissions at lower frequencies. Therefore, the lower frequencies could be used for transmitters serving large areas, while higher frequencies could serve smaller areas. The frequency rights should be defined in terms of the following three properties: (1) the rights apply to a band of frequencies bounded by upper and lower limits; (2) the exclusive right to originate radiation, subject to the constraint that the field strength achieved in any other unit band of frequencies not exceed a certain limit; (3) the right to be free, above the same limit, from radiation originated by other sources assigned to a different band of frequencies. Note that there would be protection from multipath propagation from other users. Since there would be economic incentives to limit the height of the antenna, there should be no explicit restrictions on antenna height.

The authors give detailed recommendations with respect to formulation of the statutory rules regarding spectrum rights. The rules should state that the general purpose of the property system is to create property interests in a designated portion of the spectrum in order to promote market allocation of this resource. The rules should include a definition of the basic property interest in the spectrum and authority should be delegated to a federal agency to create licenses for sale to the public. The statute should state that licenses are private property and fully transferable and specifically state: (1) license owners may agree to changes in the boundaries of

the license areas; (2) license owners may transfer their rights to radiate on a time basis, by the hour, day, month, or year or by any other denomination of time; (3) license owners may agree to an increase or decrease of signal field-strength limits; (4) license owners may transfer all or any part of the band assigned to them; (5) license owners may transfer all or any portion of their geographical areas of operation; (6) there shall be no restrictions, either in the license owner's certificate of ownership or by regulatory order, on transmitter power, or on antenna location and height. The authors believe that there should be a strict liability standard and that any unauthorized operator of radiation within an assigned license is guilty of a breach of duty and can be shut down. Injunctions should be granted as a matter of right to any complainant who establishes that his rights have been violated. The statute should specifically bar the acquisition of prescriptive rights in the spectrum and there should not be criminal penalties.

The authors also recommend that the statute stipulate the time duration of the rights created (the authors recommend creation of perpetual rights). If the rights are not defined as perpetual, the auction for re-lease of the license at the end of the lease term should be set for a time somewhat earlier than the expiration of the term. The lease arrangement might be accompanied by a system of rental payments instead of a lump sum payment but the government should be able to terminate the lease and re-lease the license if payments are not met. When transfers create multiple subdivisions of license areas a strict priority rule coupled with an expanded third-party-beneficiary doctrine will serve to allocate liability efficiently. The liability of transferees for rental payments could be dealt with by the adoption of rules similar to landlord and tenant law. The authors recommend that the statute require all agreements by license owners relating to the use of the spectrum be recorded in a central registry. Penalties should be assessed for noncompliance with the registration requirement, and unrecorded transfers should be voidable at the instance of subsequent purchasers. The authors believe that enforcement should be left to the federal and state courts. Other questions not addressed here could be resolved under state law.

The government could experiment with small portions of the spectrum to allow the opportunity to evaluate the above proposals. The authors recommend the following experiments: (1) in spectrum in which VHF and UHF television operates, auction off the unassigned channels to other radio services; (2) clear voice and UHF-television channels; (3) vest FM rights (fully transferable and divisible license rights would replace input specifications); (4) pack FM stations into the 94- to 108-MHz bands to free up spectrum for auction.

10. A. De Vany, "**Property Rights in the Electromagnetic Spectrum,**" Palgrave Dictionary of Economics and Law p. 167.

This article argues that the decades old systems of spectrum management in use around the world must be replaced by more open access to and flexible use of the spectrum resource. The author originally proposed a detailed model for privatization of spectrum in 1969. The article posits that the concept of property rights is the central issue in spectrum management. Privatization of spectrum would require a well-defined physical space broken down into time, area and spectrum bandwidth. Owners would be free to do with their spectrum as they desired. This type of system would drastically reduce transaction costs and get spectrum out to the public much faster.

11. H. Demsetz, “**Toward a Theory of Property Rights,**” *American Economic Review*, 1967, pp. 347-359.

Demsetz’s goal was to fashion some of the elements of an economic theory of property rights. Demsetz explains that property rights specify how persons may be benefited and harmed, and, therefore, who must pay whom to modify the actions taken by persons. He believes that the disadvantage of communal property is that the effects of a person’s activities on his neighbors and on subsequent generations are not fully taken into account. The advantage of private property is that the concentration of benefits and costs on owners creates incentives to utilize resources more efficiently and to achieve a greater internalization of externalities. Demsetz mentions three broad principles governing development of property rights in communities oriented to private property: (1) an increase in the number of owners is an increase in the communality of property and leads, generally, to an increase in the cost of internalizing; (2) if there are many externalities, a buy-out may be cheaper than contractual agreements; (3) the greater the diseconomies of scale to land ownership the more will contractual arrangement be used by the interacting neighbors to settle differences. Demsetz also notes that the emergence of property rights can best be understood by their association with the emergence of new or different beneficial and harmful effects (e.g. new technologies).

12. W.L. Fishman, “**Property Rights, Reliance, and Retroactivity Under the Communications Act of 1934,**” 50 Fed. Comm. L.J. 1 (1997).
<http://www.law.indiana.edu/fclj/pubs/v50/no1/fishman.html>

Fishman focuses on legal interpretations of the rights of spectrum licensees and explores the question of what is meant when we say that government preserves its (assumed) right to regulate spectrum by law. Fishman notes that although FCC approval is required for the transfer of control of the licensee or assignment of the license, it is reasonably clear (and the courts have recognized) that FCC licenses have some, albeit limited, attributes of property. Also, although the FCC discourages speculation in unbuilt facilities, the sale of bare licenses resulting in a profit has been allowed in the past. Fishman believes that a contractual provision for reversion but subject to FCC approval would be consistent with law. In addition, the creation of a security interest, albeit limited to the proceeds of an FCC-approved sale, should be deemed valid and enforceable. Fishman notes that detrimental reliance in some circumstances is a workable substitute for property rights and that considerations of justifiable reliance appear to have had at least some force in past court cases. Past court cases demonstrate that FCC licensees have the right to be treated equitably by the FCC (even though property rights are limited) and that the FCC can’t disregard a licensee’s reliance on prior policy. The courts won’t automatically defer to FCC conclusions when there are claims of detrimental reliance. Fishman suggests proposing that property rights as normally understood are not a necessary precondition to careful judicial review of agency policy changes. He believes that detrimental reliance may represent a recognizable and legitimate basis on which to seek relief even when, in the classical sense, there are no property rights as such.

13. B.C. Fritts, “**Private Property, Economic Efficiency, and Spectrum Policy in the Wake of the C Block Auction,**” 51 Fed. Comm. L.J. 849 (1999).
<http://law.indiana.edu/fclj/pubs/v51/no3/FritMac9.PDF>

Fritts examines the C block auction, which took place in 1995, discusses what went wrong, and suggests remedies. He mentions six factors which contributed to the failure of the C block auctions to efficiently distribute spectrum: (1) the C block licensees were mostly

newcomers to the industry and they didn't have the infrastructure necessary to make efficient use of the spectrum; (2) the lenient terms of the license drove up the bids (higher than their market value); (3) newcomers and new technology made it difficult to determine the optimal bid; (4) most C block bidders failed to arrange adequate financing before the auction took place; (5) special payment plans for small businesses contributed to inefficient allocation; (6) too many goals were given to the FCC and efficiency was not primary. Fritts notes that the auction rules were clear and objective and were not the cause of the problems discussed above. Instead, the problems stemmed from the policy underlying the rules of the auction.

Fritts believes that the primary focus of the FCC should be the efficient distribution of property rights in spectrum. These property rights should include the right to use the spectrum in whatever manner the owner deems to be in his or her best interest. Fritts believes that spectrum should be distributed to those that value it most and that there should be sufficient competition in the market to ensure accurate prices. The FCC should avoid dramatic changes in rules so that companies can count on regulatory law to be predictable. The only goals of the FCC should be to conduct auctions in an efficient manner and grant winners an ownership interest equivalent to private property that will then be enforced by the FCC. Fritts thinks that the best and most efficient means of distributing spectrum is to hold an auction where payment is required shortly after the winning bid is selected. The design of spectrum auctions should: (1) allow for license aggregation and the prevention of collusion in the bidding process; (2) not allow bidding credits; (3) not allow installment plans. In addition, diversity and increasing revenue for the government should not be significant goals.

14. T.W. Hazlett, "Assigning Property Rights to Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?" 41(2) J.L. & Econ. 529 (1998).
<http://www.journals.uchicago.edu/JLE/abstracts/412haz.html>

Hazlett discusses the development of the system for broadcast license assignments in the United States. According to him, the system for license assignment that developed was neither irrational nor a "accident of history." Hazlett argues that political motivations resulted in the "giveaway" of licenses for a long time in the United States. Zero-priced licenses gave regulators much power to influence broadcast content which would not have been feasible or legal under a market-based allocation scheme and Hazlett argues that there is a clear link between method of assignment and licensee performance. Hazlett believes that the special interest of regulators in influencing broadcasting content, the limits placed on explicit program regulation by the U.S. Constitution, and the agency problem embedded in central planning explain the political stability of economically inefficient licensing methods. Hazlett also illustrates how the increase in the relative economic performance of nonbroadcast wireless services explains recent reforms in spectrum policy.

15. T.W. Hazlett, "The Rationality of U.S. Regulation of the Broadcast Spectrum," 33 Journal of Law and Economics 133 (1990).
<http://www.aei.org/ra/rahaz110.pdf>

This paper reviews Hazlett's interpretation of the early history of the use and regulation of the spectrum in the 1910s, 1920s and 1930s including passage of the Radio Act of 1912, actions by Commerce Secretary Herbert Hoover, the establishment of the Federal Radio Commission in 1927 and the Communications Act establishing the FCC in 1934. According to Hazlett, early problems with interference and "chaos of the ether" imply that there was a need to define spectrum rights but do not imply that there is (or was) a need for the government to assign

spectrum rights. In the 1920s it would have been possible to develop a system of exclusive, transferable property rights in the spectrum and it could have been done under the common law rather than through a Federal regulatory agency. Hazlett asserts that in the 1920s major existing broadcasters desired federal regulation as a method of restraining competition and preserving their existing economic rents.

16. T.W. Hazlett, “The Wireless Craze, The Unlimited Bandwidth Myth, The Spectrum Auction Faux Pas, and the Punchline to Ronald Coase’s ‘Big Joke:’ an Essay on Airwave Allocation Policy,” 15 Harvard Journal of Law and Technology (Spring 2001). http://www.aei.brookings.org/publications/working/working_01_02.pdf

In this long article (205 pages in the working paper format), Hazlett argues strongly for establishing spectrum private property rights. Hazlett asserts that FCC top down regulation (i.e. block allocations), involves a variety of non-market failures because the FCC lacks the information that competitive markets can provide, receives its information from interested parties and not from the general public, and because incumbents have incentives to favor underutilization of spectrum in order to minimize interference to them and to exclude competitive entry. (He points out that it is not economically efficient to minimize interference, but rather we should want an optimal level of interference). In his review of FCC history, he provides examples of how incumbent licenses blocked or tried to block the introduction of FM radio broadcasting, CATV, DARS, LPTV, ultra-wideband systems, software defined radio, etc. Radio license auctions work well because they reduce delays in licensing, increase the efficiency of license distribution, make it easier to aggregate licenses, reduce rent seeking behavior of applicants and help build the intellectual case for liberalization of the licensing process. However, high license auction prices and revenue can be a sign of policy failure, not success, because they suggest that access to the spectrum has been artificially restricted in order to maximize revenues or rents.

There are, potentially, serious problems with spectrum commons, because there is likely to be congestion and thus a tragedy of the commons, just as there is on the Internet. In both cases the problem is that a price should be put on congestion. In the unlicensed bands, the FCC is likely to impose either too strict or not strict enough restrictions (e.g. power limits that are too low or too high). An advantage of unlicensed operations is that entry by spectrum users is not constrained by the barriers to entry of the FCC allocation and licensing process. It may be possible to consider three classes of unlicensed bands: (a) bands generally allocated to unlicensed use and controlled by a band manager; (b) localized unlicensed low power use bands; and (c) long distance low power unlicensed use bands.

With regard to the future of spectrum regulation, Hazlett offers small, medium and large reform proposals. Small reforms include: (1) establishment of a spectrum registry which would indicate occupied and unoccupied spectrum, intensity of traffic, etc.; (2) privatization of public safety communications so that public safety agencies would have title to the spectrum they own; (3) creation of a federal spectrum budget to show costs and benefits of spectrum used by each government agency. Medium reforms include: (4) establishment of exhaustive overlayrights in the TV bands so that every channel in every market would be used. Also, grant existing wireless licensees complete flexibility. (5) Granting of underlay rights and allow UWB and don't allow incumbent operators to block UWB by claiming interference problems. Large reforms include: (6) Abolishing the FCC and replacing it with a Spectrum Court; (7) granting de novo entrants a presumptive right to use unoccupied frequencies; (8) allowing unregulated low power local area wireless devices; (9) Granting complete flexibility to existing licensees; (10) abandoning administrative license authorizations and replacing them with pure interference adjudications

through a Spectrum Court; (11) Recasting competition or antitrust policy to take into account spectrum ownership in evaluating market concentration; and (12) making clear that Congress, rather than a regulatory agency, should impose taxes and subsidies related to spectrum utilization.

17. T.W. Hazlett and B.E.L. Boliek, “**Use of Designated Entity Procedures in Assigning Wireless Licenses,**” 51 Federal Communications Law Journal 639 (1999). <http://www.aei.org/ra/rahazl9905.pdf>

There was a significant loss in consumer surplus, i.e. so called “deadweightloss,” due to the use of subsidies to designated entities in the PCS C block auction and the Regional narrowband PCS auction. The use of the designated entities led to a delay in the provision of service to consumers, slowed the entry of viable competitors and reduced the amount of money initially payable to the Treasury for the auction by allowing payment spread over a number of years with a below market rate of interest on the future payments. On the other hand, Hazlett and Bolick also suggest that because of the subsidies available to designated entities, they may well have bid up auction prices to higher levels than would have happened without their designated entity status.

18. T.W. Hazlett, “**Spectrum Flash Dance: Eli Noam's Proposal for ‘Open Access’ to Radio Waves,**” 41 J.L. & Econ. 805 (1998).

This article challenges Eli Noam’s property rights article, “Spectrum Auctions: Yesterday’s Hearsay, Today’s Orthodox, Tomorrow’s Anachronism,” published concurrently in *The Journal of Law and Economics* (Oct. 1998). The article does so on the grounds that the Noam article (i.e., analogizing spread spectrum technology or an “open spectrum access” model for overall spectrum allocation to the Internet packet switching) confuses defects in the auction allocation regime with the innovative mechanism of auctioning assignments by failing to appreciate the efficiencies gained by auctions and not defining useful remedies for the problems. The author argues that the spectrum was originally regulated, starting in 1927 under the Radio Act, not because of chaos and lawlessness, as is the popular belief, but that the general application of the common law “right of user” or “trespassing” solution to the commons problem was to preempt development of such a general legal regime in favor of political control in the form of a statutory solution promoting the “public interest.” The article challenges Noam’s assertion that auctions were favored as a method for raising revenues, auctions as barriers to entry and property rights as free speech infringement. The article suggests that Noam analogy to Internet packet switching is misguided and that a better analogy would be competing tollways, where access providers charge competitive rates for the use of the road. The article concludes by criticizing Noam’s opposition to large spectrum auctions in favor of micro-auctions and contends that Noam overstates the current state of technologic development and its ability to arrange frictionless traffic. The article states that Noam’s clearinghouse approach would likely overdivide the spectrum creating significant transaction costs to reassemble long-term rights.

19. J.A. Hausman, “**Valuing the Effect of Regulation on New Services in Telecommunications,**” *Brookings papers on Economic Activity, Microeconomics*, 1997, pp. 1-38. <http://www.nextera.com/pdf/ValuingTheEffectOfRegulation.pdf>

This article estimates that cost of regulatory delay in the provision of new services, including voice messaging, and cellular telephone. Using assumptions and estimates about consumer demand, pricing and welfare loss, they estimate losses of about \$1.27 billion per year in

consumer welfare for voice messaging and about \$50 billion per year in consumer welfare loss for cellular telephone due to regulatory delay in authorizing these new services.

20. R.E. Hundt and G.L. Rosston, “**Spectrum Flexibility Will Promote Competition and the Public Interest,**” IEEE Communications Magazine, December, 1995, pp. 2-5.

The true significance of the PCS auctions was not that they raised \$7.7 billion for the treasury but that they led to the creation of 3 large wireless communication firms. What led to the large wireless investment boom was that the Commission allowed flexibility in the use of that spectrum. Spectrum flexibility includes both service and technical flexibility. We need to stop over-regulating commercial uses of licenses. Interference restrictions are similar to land zoning restrictions. The FCC should set initial interference restrictions and then allow licenses to negotiate interference agreements between themselves. Restrictions on allowable uses inhibit competition, and cause delay in providing innovative services. Allowing flexibility means that license will have incentives to invest in technology to increase competition, to take advantage of any innovations they develop and they will not need to reveal their ideas in advance to the FCC and thus to competitors.

However, full flexibility may allow some market failures and thus may not always be appropriate. The FCC should intervene to constrain technical flexibility so many unlicensed low power devices can operate without causing interference, to ensure sufficient educational children’s television programming, to coordinate cross-border satellite operations, and to decide whether too much or too little over-the-air television broadcasting is available in specific markets compared to other uses of the spectrum. There may be other social goals where flexibility will either help or hinder the accomplishment of those goals such as minority and female ownership of businesses, provision of rural telephone services, public interest obligations of broadcasters.

With respect to transitional issues, some believe that efficiency must be balanced against equity. However, if a company obtains a windfall due to flexibility, it is because it has provided a more attractive service to consumers. Also, the Commission’s public interest mandate should be to maximize competition, not protect incumbents from competition. Flexibility may cause some customers to be stranded without a service provider, but overall it is likely to increase choices for consumers.

All future spectrum allocations should provide service and technology flexibility. All remaining spectrum should be exhaustively licensed using overlays. In general, users should be given exclusive rights. Spectrum rights should be transferable. Finally, service and technical restrictions on existing licensees should be reduced.

21. H.J. Krent and N.S. Zeppos, “**Monitoring Government Disposition of Assets: Fashioning Regulatory Substitutes for Market Controls,**” 52 Vanderbilt Law Review 1705 (1999). <http://law.vanderbilt.edu/lawreview/vol526/zeppos.pdf>

Most of this article discusses the sale or lease of Government assets other than the frequency spectrum or radio licenses. Government sales and leases of public assets such as oil rights, public land and mineral rights, and even rights to use the electromagnetic spectrum, timber sales, and the disposition of real estate have generally been deplorable and sold at a fraction of the market price. Methods should be used, with legislative changes where necessary, to allow the government to maximize its return on assets sold or leased. However, the disposition of assets

can serve other goals such as helping to ensure that the public receives the best service from the private use of the asset, or programmatic goals such as giving licenses to broadcasting stations that best service the public interest, or it can serve distributional goals such as helping disadvantaged individuals, or social goals such as preserving a valued way of life, etc. The Administrative Procedure Act excludes from its provisions federal agency decisions involving the distribution of public property.

The author's recommendations for reform include: all public property disposition processes should be subject to notice and comment rulemaking. Judicial review should continue to play an important role. Greater OMB review and/or Congressional review may be appropriate. The process of selling, leasing and giving away public property should be more open and transparent.

22. E.R. Kwerel and J.R. Williams, "**Changing channels: Voluntary Reallocation of UHF Television Spectrum,**" Office of Plans and Policy Working Paper No. 27 (November 1992). http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp27.pdf

Kwerel and Williams argue that the voluntary reallocation of a single UHF channel in Los Angeles from television broadcasting to use as a third cellular system would increase social welfare by \$1.0 billion. Because the social value of a broadcasting service may exceed its private value, the FCC may need to estimate whether it is desirable to allow such a shift. However, subject to such a benefit-cost analysis, one voluntary reallocation should be allowed in every TV market and perhaps with respect to other spectrum uses as well. In their calculation, they estimate the amount of spectrum that could be freed up by such a move, the social cost of reducing the number of TV signals by one in LA, and then compare that with the social benefit from the reduced cellular prices that would likely take place from allowing a third cellular competitor in LA. Much of the paper is devoted to alternative calculations of the costs and benefits of such a voluntary relocation. As the value of over-the-air broadcasting diminishes compared to additional forms of personal communications, a properly supervised voluntary reallocation policy for other non-TV uses might have substantial benefits. Licenses for new services could be issued in a band before the incumbent users left the band and new licensees could negotiate with incumbents for access to additional spectrum.

23. J.R. Minasian, "**Property Rights in Radiation: An Alternative Approach to Radio Frequency Allocation,**" 18(1) J.L. & Econ. 221 (1975).

This article is based on a 1963 paper co-authored by Minasian, R.H. Coase and W. Meckling. While consistent with Coase's economics papers, it also addresses technological aspects of defining auctionable spectrum licenses.

The current institutional arrangement for spectrum allocation (1975, pre-auction) cannot provide the information needed to guide resources into their highest valued use, and gives users no incentive to economize on scarce resources. However, property rights can be defined in such a way as to bring about technically efficient use and form the basis for exchange in a market setting. A set of property rights in spectrum would incorporate the following:

1. Emission rights – The right to operate on a particular bandwidth at a specific time and place, at a power level specified at its boundaries. In addition, the amount of spurious radiation emitted would be limited.
2. Admission rights – The rightholder has the right to exclude others from using that spectrum.
3. Use – The rightholder is free to choose among legal uses.

4. Transferability – Emission and admission rights would be transferable at the discretion of the rightholder.

Minasian also considers whether the inherent variability in radiation outputs and the techniques used for enforcement are consistent with a system of private property rights and a market mechanism, and concludes that such a system would actually result in greater technical efficiency.

Regardless of the initial distribution method, the market will eventually reallocate the rights to their most valuable use. Initial distribution should take political expediency into account, and to the extent possible, minimize the transactions costs of further redistribution.

When increases in value accrue to the owner of the spectrum, there are incentives to innovate and update technology. “Like” services will tend to cluster together because the value of their rights will be greater. The public sector can exercise rights of eminent domain to repurchase spectrum if there is a strong need. Monopoly will be discouraged if the monopolist is not given the resource free of charge.

Any freedom to relax the current system of rigid input controls will improve technical efficiency.

24. E. Noam, “**Beyond Spectrum Auctions: Taking the Next Step to Open Spectrum Access,**” *Telecommunications Policy*, Vol. 21, No. 5, Elsevier Science 1997, pp. 461-475.

Noam advocates a new post-auction paradigm for spectrum which he calls “open access,” which will soon be made possible by new technologies. Users can enter spectrum without an exclusive use license by buying access tokens, the price of which varies with congestion.

Licensing imposes restrictions on free speech, and to the extent technology makes a less restrictive regime possible, the government is obliged to move toward allowing greater freedoms.

Auctions of exclusive use licenses have other drawbacks. They are primarily a revenue tool of the federal government, and therefore, revenue needs will determine auction policy. They are used to fund current consumption at the expense of long run asset management. Social values are not reflected in auction bids. Auctions are a barrier to entry and encourage bidding consortia and an oligopolistic market structure.

The proposed open access system is not currently possible, although some parts are feasible. Packets of transmitted information would carry with them electronic tokens, which would be transferred (i.e., paid) at various tollgates and access points. Spot and futures markets in access tokens would exist. Such a system would convert upfront fixed costs to marginal costs, reduce barriers to entry and encourage competition. The current unlicensed system is similar in terms of non-exclusive access, but because it relies on etiquette to manage congestion, it cannot guarantee access when demand is high.

25. E. Noam, “**Taking the Next Step Beyond Spectrum Auctions: Open Spectrum Access,**” *IEEE Communications Magazine* (December 1995), pp. 66-73.
<http://www.columbia.edu/dlc/wp/citi/citinoam21.html>

Auctions are preferable to the spectrum allocation systems of the past, but they may not be the best system for the future. This paper makes essentially the same arguments for an open access system as #23, above. In addition, Noam makes the following points:

- Some argue that without exclusive spectrum licensing, there may be less investment, but the certainty of licensing should be balanced with the enhanced competitive environment of an open access system.
- Investment takes place in other industries without ownership of all of the inputs. Certainty of supply can be addressed through the development of futures markets.
- Couching the discussion in terms of property rights is not helpful, since transferable frequency access is just as much a property right as is fee simple ownership.
- Auction winners are unlikely to become good managers of an open system because they will have interest in deterring competitors. The relatively small pieces they own will limit the benefits of frequency agility.
- Noam makes clear that he departs from Paul Baran and George Gilder in advocating the use of a price mechanism to manage scarcity. They would rely on technology alone.

26. G. Robinson, “**Spectrum Property Law 101,**” 41 *J.L. & Econ.* 609 (1998).
<http://www.journals.uchicago.edu/JLE/abstracts/412rob.html>

Robinson expands on a paper by Shelanski and Huber (#32, below) who show that, in practical terms if not in theory, spectrum licensees already are in possession of most of the essential characteristics of property: the rights to exclude, transfer, and use, and a renewal expectancy, which protects “investment-backed expectations.” Robinson points out that as long as public interest obligations are upheld, licenses cannot fully be treated as property and, therefore, cannot freely be traded. This prevents efficiency enhancing reallocations. Significant public interest obligations are still maintained only in broadcasting, although even there they are largely symbolic. Broadcasters have a strong interest in maintaining their public interest obligations, which although trivial in practice, have allowed them to make lucrative deals for spectrum access.

27. G.L. Rosston, “**The Long and Winding Road: The FCC Paves the Path with Good Intentions,**” Stanford Inst. For Econ. Policy Research (2001).
http://www.calit2.net/events/2002/Spectrum/presentations/Long_Winding_Road4-20-02.pdf

Although the FCC has indicated its intention to move to a more market-based system of spectrum allocation, a number of recent examples indicate that market failure exceptions are more frequently the rule. The Commission should immediately make the move to a true market system by selling flexible license rights to spectrum which has been held back for various reasons. Incumbent interests and political interests are two major roadblocks to increasing the usable amount of spectrum. Rosston illustrates his point with the following case studies:

- **700 MHz Guard Band**-- Many politically motivated restrictions on use and technology may result in managers being unable to use the band profitably and efficiently, which will likely prompt them to petition the FCC for more flexible use.

- **Satellite and Terrestrial Uses** – Rosston points to the DBS/Northpoint case, and petitions for terrestrial rights in the 2 GHz Band and for terrestrial repeaters by XM Radio as situations in which the FCC failed to define license rights fully ahead of time.
- **DBS Satellites** – A prohibition against allowing Canadian DBS providers to serve US customers exacerbates an already concentrated US DBS market.
- **CARS Band**– A very narrow definition of who may operate in the 12 GHz CARS band has prompted a proposal to expand the definition slightly. It would be more efficient to open the band to more flexible use.

In order to facilitate getting unused spectrum rights out into the market, Rosston proposes a licensing “nomination” process. Parties identifying rights they are interested in would submit a nomination to the FCC. Nominations would be kept secret during the filing window. If no other party submitted a mutually exclusive nomination, the applicant would be granted a license for that right. An auction would be held to resolve competing applications.

In addition, the interference responsibilities of licensees should be clarified and defined in terms of emissions rather than inputs. Secondary trades should be allowed to take place efficiently. Spread spectrum technologies should be allowed to operate “under” other licensees, if possible.

28. G.L. Rosston and J. Steinberg, “Using Market-Based Spectrum Policy to Promote the Public Interest,” 50 Fed. Comm. L.J. 1 (1997).

Rosston and Steinberg propose a set of principles to guide the FCC in its mission to maximize the public interest value of the spectrum. Because the Commission cannot fully know or predict how much consumers value different services or what technologies are practical or possible, it must leave these decisions on how best to use the spectrum to a decentralized marketplace. It should make available to the market the rights to as much spectrum as possible with as few restrictions as possible on how it can be used. In order to minimize transactions costs, the FCC should initially configure licenses optimally for the services they will most likely be used for, but it should permit aggregations and disaggregations as necessary. It should weigh the benefits of unlicensed uses of spectrum with the cost of keeping those bands out of exclusive use. The FCC should promote a competitive industry, and be prepared to intervene when there is market power.

The Commission should permit maximum flexibility of four types: in service use, in technology and equipment, in bandwidth and geographic scope, and in implementation (when and where licensees build out). In general, technical and use flexibility should be limited only by interference concerns.

When the market fails, such as in providing the socially optimal amount of public goods, the FCC may need to dedicate spectrum to those uses. In many cases, however, the government can provide subsidies to facilitate spectrum license purchases by the providers of those public services. Public interest considerations may also prompt some restrictions on services, such as requiring broadcasters to provide children’s TV programming, but the requirements should be as flexible as possible.

In most cases, competitive bidding is the fastest means of putting the spectrum into the hands of those who will put it to its most valuable use. In other cases, the Commission should

seek to use fees approximating opportunity costs as a means of allocating scarce spectrum among competing users.

The Commission should promote certainty about the conditions of spectrum use licenses by providing flexibility upfront, so that licensees do not need to petition for changes. A reasonable expectation of renewal will encourage investment. If public interest considerations require that the FCC reallocate spectrum, incumbents should be fairly and efficiently compensated.

The U.S. should help promote global networks by cooperating and coordinating with international interests.

29. H. Shelanski, “Competition and Deployment of New Technology in U.S. Telecommunications,” 2000 U. Chi. Legal F. 85 (2000).

Shelanski examines how the introduction of new technology in U.S. telecommunications has historically been related to market structure. Theoretical and empirical evidence on the relationship between firm size and innovation in the general economy is ambiguous. With respect to industry concentration, there is suggestive evidence firms in neither very competitive nor very concentrated industries are more innovative. He examines ten cases of new technology development in the telecommunications sector.

While innovation occurred under varying market structures, the deployment times were fastest when firms were in the most competitive environments. Shelanski draws the policy implication that while there may be cases in which there are tradeoffs between innovation and competition, the presumption should be in favor of preserving competition.

30. H. Shelanski, “Regulating at the Technological Edge: New Challenges for the FCC,” 2000 L. Rev. Mich. St. U. Det. C.L. 3 (2000).
http://www.dcl.edu/lawrev/2000-1/Shelanski_Revision.htm

This speech makes general points about how the FCC ‘s regulatory policy should facilitate competition and foster innovation, and promote access to new technology.

31. H. Shelanski, “The Bending Line Between Conventional ‘Broadcast’ and Wireless ‘Carriage’,” 97 Colum. L. Rev. 1048 (1997).

By permitting Direct Broadcast Satellite (DBS) operators to deliver wireless services and programming, without requiring the public interest obligations traditionally carried by broadcasters, the FCC has blurred the traditional distinction between broadcasters and wireless carriers.

32. H. Shelanski, “The Speed Gap: Broadband Infrastructure and Electronic Commerce,” 14 Berkeley Tech. L.J. 721 (1999).

The growth of electronic commerce will depend in large part on the capability of broadband and its availability to residential consumers. However, regulation of advanced services may slow the deployment of broadband and adversely affect prices faced by consumers.

33. H. Shelanski and P. Huber, “Administrative Creation of Property Rights to Radio Spectrum,” 41 J.L. & Econ. 581 (1998).

<http://www.journals.uchicago.edu/JLE/abstracts/412she.html>

Although the Communications Act of 1934 expressly prohibits private ownership of spectrum, the FCC since the 1970’s effectively has been increasing the property rights that spectrum licensees hold. This has been accomplished through substantive and procedural regulatory reform of both the transmission and reception ends of licensee rights. The FCC has increased the renewal expectancy and lowered the cost of renewing licenses. It has reduced the ban on trafficking from 3 years to one year, and reduced the criteria that must be considered in allowing transfers. Broadcasters are allowed more leeway over public interest concerns in leasing or subdividing their airtime. The FCC has given providers more freedom over what use is made of their spectrum, especially in exempting DBS and other subscription services from broadcaster public interest responsibilities. At least in part, this deregulation represents an ideological shift that occurred during the 1980’s. Limited degrees of use flexibility are now permitted. The FCC has moved away from strict content regulation of broadcasters, although it retains some influence.

While these reforms generally involve giving licensees more control over the transmission side of spectrum communications, a complete bundle of rights would involve licensees controlling how their signals are received, as well. Broadcasters traditionally have had little power to protect their programs from unauthorized commercial retransmission, but in recent years the courts, the FCC and Congress have moved in the direction of granting broadcasters more rights in that area.

34. H. Shelanski and P. Klein, “Empirical Research in Transaction Cost Economics: A Review and Assessment,” 11 J.L. Econ. & Org. 335 (1995).

Transactions costs economics (TCE) deals with how trading partners utilize contracts or governance arrangements to protect their interests in exchange relationships. For example, partners investing in a specific asset may want to merge in order to align their interests in using the asset – i.e., through vertical or horizontal integration. Implicit in TCE is the idea that observed institutional arrangements have come about as the result of minimizing some set of transactions costs among parties. Shelanski and Klein examine some of the theoretical implications of TCE and empirical studies which attempt to validate them.

In general, these studies attempt to explain a governance structure for a particular industry as a function of such features as asset specificity, uncertainty about the relationship, the complexity of the transaction and the frequency of trade. The authors look at a large number of studies which focus on both formal and informal contracting arrangements and conclude that overall, there is quite strong evidence that transactions costs arguments are important in explaining the nature of these relationships.

35. J.H. Snider, “Who Owns the Airwaves? Four Theories of Spectrum Property Rights,” New America Foundation, April 2002.

Snider emphasizes that policy analysts should lay out all valid policy considerations, regardless of political considerations. He believes that policy analysts should clearly distinguish between what are political and public policy issues relating to the allocation of spectrum. Towards this goal, Snider discusses four theories of spectrum property rights as they would apply to local TV broadcasters. The License Theory suggests that since license terms are currently

limited (eight-year term for broadcasters), all broadcast spectrum could eventually be returned to the public and reallocated with no special compensation to the broadcasters. The Service Theory would allow broadcasters to provide the same service (e.g. the provision of one standard definition analog TV signal) as technology changes but would force the broadcasters to return excess spectrum resulting from improvements in technology. The Spectrum Theory holds that incumbents have full rights in perpetuity to their spectrum, including all residual rights, where the term residual means all rights to provide services not explicitly granted in the license. The Lebensraum Theory holds that incumbents have full rights not only to their licensed spectrum, but to the guard bands surrounding the spectrum that protects their signals from interference.

36. P. Spiller and C. Cardillo, “Towards a Property Rights Approach to Communications Spectrum,” 16 Yale J. of Reg. 1 (1999).

Spiller advocates a property rights approach to spectrum usage and advocates the development of a market for unrestricted tradable permits in spectrum. To implement this policy, Spiller believes that Congress should enact legislation mandating that the FCC grant full property rights for spectrum usage. Subsequently, the judicial branch would be responsible for enforcement with regard to potential interference problems. Spiller describes the structural foundation which he believes would allow for a market in tradable spectrum permits. The licensee would be granted the right to use the spectrum for any service that he chooses and the right would be defined in terms of usage or outputs. That is, the licensee would be granted the right to transmit over a particular band and over a particular geographic location. This property right would assume a maximum field strength at the boundary of the coverage area and maximum levels of out-of-band emissions. Included is a right to a minimal acceptable signal to noise ratio as long as the right holder maintains a minimum field strength. Additionally, the right would be transferable as well as partitionable.

Spiller’s paper also includes a review of New Zealand’s and Guatemala’s experiences with spectrum property rights. New Zealand’s 1989 Radiocommunications Act authorized the Ministry of Commerce to introduce tradable spectrum rights. New Zealand’s experience thus far does not appear to be very successful as only a small amount of spectrum has been sold to individuals and much of the spectrum is not being used. Spiller believes that New Zealand’s lack of success has three possible explanations. There may be a lack of demand for spectrum due to New Zealand’s low population density. Additionally, the system was only implemented in certain limited bands. Finally, there were problems with the second-price auction process that was implemented. Unlike New Zealand, Guatemala was able to successfully implement a total property rights approach to spectrum utilization. Spiller believes that the situation in Guatemala more closely reflects the potential success that the U.S. would experience if a property rights approach were to be implemented.

37. T. M. Valletti, “**Spectrum Trading**,” *Telecommunications Policy*, 2001.
<http://www.ms.ic.ac.uk/tommaso/spectrumtrading.pdf>

Valletti’s paper is based partly on work done for OFTEL, the UK radiocommunications regulator, and focuses on UK and other European spectrum management regimes. His primary point is that it is inefficient to rigidly define spectrum allocations, even if spectrum is efficiently assigned within those allocations. He recommends a system of spectrum trading in which fully flexible transferable rights are given or sold to licensees, who may then trade them. The regulator will have a role in correcting market failures, but the presumption should be that the market will resolve problems unless it is demonstrated otherwise. The government role may include arbitrating interference disputes, enforcing antitrust laws (although concentration should be less of a problem when inputs of spectrum for an industry are not fixed by rigid allocation), and licensing low power equipment for open access spectrum. Social objectives should be dealt with using bidding credits, including for the military, broadcasting and public service.

38. J.M. Ward, “**Secondary Markets In Spectrum**,”¹⁰ *CommLaw Conspectus* 103 (2001).

The author contends that there is a spectrum drought that will impact the market. The author explains that auctions only ensure that spectrum is put to its highest valued use at the time of the initial assignment and that post-auction efficiencies are being evaluated in the Commission’s secondary markets proceeding. He says that spectrum leasing has been a tremendous success, but that it is hampered by cumbersome regulations resulting in uncertainty. He hopes that eventually secondary markets will evolve into spot markets or exchanges where spectrum is bought and sold. The article analyzes the current Commission rulemaking on secondary markets and predicts the Commission’s likely course of action and suggests regulatory and statutory changes to prepare for new technologies and markets. The author concludes that the Commission’s secondary market proposal clings too closely to its administrative control over spectrum by requiring licensees to retain control over their spectrum, even though they may not have operational control. The author believes that this model is a disincentive to leasing and that, instead, the Commission should forebear from enforcing the traditional control standards and assign responsibility for leased spectrum to the entity operating in it.

39. D.W. Webbink, “**Frequency Spectrum Deregulation Alternatives**,” OPP Working Paper No. 2 (Oct. 1980).
http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp2.pdf

The author describes the concepts of “spectrum deregulation” or “spectrum economics” as terms that encompass not only auctions and fees but also less reliance on government decision making and greater freedom for the licensee. The paper also describes the frequency management system, problems associated with the existing system, deregulatory proposals, and objections that have been raised. The paper concludes by the author listing the most important proposals: (1) free license transferability, (2) limiting petitions to deny, (3) allowance of license sharing and resale, (4) allowance of greater technical flexibility, (5) greater service flexibility, (6) clear but limited property rights, and (7) reduction in the number of classes of allocations. The paper also concludes by listing the most important but controversial changes: use of auctions and lotteries instead of comparative hearings and repeal of distinctions between broadcasting, common carrier and private radio systems. The author notes that the most difficult proposal to implement would be the institution of spectrum fees.

40. J.A. Eisenach and R.J. May, eds. “**‘Propertyzing’ The Electromagnetic Spectrum: Why It’s Important, and How to Begin,**” Communications Deregulation and FCC Reform: What Comes Next? The Progress & Freedom Foundation (2001) (reprinted in 9 Media Law & Policy 19 (2000)).

The paper advocates changing the stewardship model of government regulation of spectrum use to one of full ownership of spectrum by the government and the private sector. The paper describes and critiques government regulation of spectrum, the property rights approach and its advantages and possible transition techniques. It also addresses potential objections to the property rights model, and provides a parable imagining Federal Government control of all real estate use. The author concludes by urging the FCC to continue auctioning spectrum and easing restrictions on auctioned spectrum, to move aggressively towards establishing land-like property right in spectrum, and for Congress to codify these changes in Title III of the Communications Act.

41. J. M. Peha, “**Spectrum Management Policy Options,**” *IEEE Communications Surveys*, 1998.

This article examines spectrum management issues and policy options for how spectrum can be used, determining which commercial entities can use spectrum and any associated fees, and providing spectrum for government use. The article explores the trade offs between policy decisions for unlicensed, licensed spectrum, assignment mechanisms (comparative hearings, lotteries and auctions), and government allocation and assignment of spectrum. The article concludes by calling for additional allocations for unlicensed spectrum, the introduction of more market-based mechanisms for assignment of spectrum to commercial and government (i.e., using spectrum fees paid through commercial auction revenues based on commercial spectrum auction values for government users) spectrum users. Finally, the article cautions against the use of one-time spectrum auction revenue for annual expenditures by charging auction winners annual fees.

42. H. Salgado, M. Sirbu, and J.M. Peha, “**Spectrum Sharing Through Dynamic Channel Assignment For Open Access To Personal Communications Services,**” *IEEE ICC-95* (June 1995).

This article focuses on a narrow band technical solution that uses decentralized spectrum sharing to facilitate open access among competing PCS operators. Specifically, the articles proposes using a system of dynamic channel assignment (commons approach) with anonymous reuse partitioning among multiple PCS operators with partially overlapping networks and unequal traffic shares by limiting the maximum number of channels assigned to one cell site as an incentive for operators to build more cells rather than appropriating channels from competitors. The article concludes that allowing a dynamic channel assignment approach (through licensee sub-letting) could introduce an open access market entry mechanism for potential PCS providers eliminating wasted capacity without adjusting fixed spectrum assignments.

43. D.P. Reed, “**When Less is More,**” *Future Positive*, May 21, 2002.

This article argues that by cooperating we can find more spectrum capacity. The article posits that cooperative networks, rather than uncoordinated point-to-point channels, can be scaled so as to increase the capacity of spectrum with increases in the number of spectrum users eliminating the need for property-like rights in spectrum management. The author suggests that

we need a regime that allows spectrum based networks to interoperate and cooperate in an open and experimental way, just as the Internet did.

44. A.D. Thierer, “**A Policy Maker's Guide to Deregulating Telecommunications Part 6: A Free-Market Future for Spectrum,**” Heritage Talking Points No. 11. Washington, D.C.: Heritage Foundation, March 19, 1996.

This paper argues that wireless spectrum is over-regulated and that Congress should take the following steps: (1) grant a permanent and absolute property right to current licensees with full flexibility, (2) auction as much spectrum as possible, (3) provide First Amendment parity between wireline and wireless spectrum use, and (4) transfer all remaining spectrum authority from the FCC and NTIA to the courts, private entities, and an independent body. The paper concludes by arguing that seven decades of quasisocialized federal spectrum management have diminished efficient and innovative use and that the creation of full property rights and ownership will result in a dramatic transformation of spectrum.

45. D.W. Webbink, “**Property Rights, Flexible Spectrum Use and Satellite v. Terrestrial Uses and Users,**” Chapter 11 in *Communications Policy and Information Technology: Promises, Problems, and Prospects*, edited by L.F. Cramer and S. Greenstein, MIT Press (2002), pp. 277-295. (Also can be found at Federal Communications Commission, International Bureau, 29th TPRC Conference, 2001. <http://arxiv.org/ftp/cs/papers/0109/0109016.pdf>)

This paper discusses policy questions raised by the proposals to provide terrestrial services in satellite spectrum and the ORBIT Act which forbids auctions to select among mutually exclusive applications to provide international or global satellite services. The paper explores the questions of the extent to which a government agency or spectrum users should be permitted to make the determination of when spectrum sharing is feasible and under what conditions and, on a related issue, whether sharing should be analyzed differently depending on if the satellite and terrestrial systems are under the control of a single or separate parties. The paper also explores the possibility that the ORBIT Act's prohibition on auctions for international or global satellite service use may prejudice the allocation of spectrum away from international satellite services in favor of auction revenue-generating services. The author concludes by saying that wherever feasible, it would be desirable to give companies maximum exclusive property-like rights to make spectrum sharing decisions and that the anti-auction provision of the ORBIT Act should be repealed because in the long run it will harm satellite companies more than providing them with benefits.

46. D.W. Webbink, “**Radio Licenses and Frequency Spectrum Use Property Rights,**” *Communications and the Law*, vol. 9, no. 3, (June, 1987), pp. 3-29.

This article argues for exclusive property rights in spectrum positing that private property rights will lead to more efficient production and use of the resource. It explains that private property rights require three conditions: (1) the right to exclusive use, (2) the right to receive income from the use of the resource, and (3) the right to transfer the exclusive use right in whole or in part to others. The article contends that common property rights, including for spectrum, weaken the incentive to use the resource efficiently and to conserve resources since users cannot capture the benefits of conservation. The article describes changes that the Commission made to broadcast and other spectrum service rules during the 1980s to allow for more flexible services offerings, sharing an leasing, longer license terms for non-broadcasting licenses, and relaxation of

trafficking rules to permit freer transferability of licenses. The article concludes by suggesting that the Commission change its rules to increase property rights by: (1) allowing secondary use on all private, broadcasting, and common carrier frequencies, (2) allowing all system users the ability to earn profit from the sharing, leasing or sale of their spectrum use rights, (3) the Congress repeal section 310(d) (transferability of licenses) of the Communications Act, (4) increasing the length of license terms to 15 or 20 years or in perpetuity, (5) the grant of exclusive licenses, (5) full flexibility of use, (6) auctions for spectrum licenses, and (7) repeal of sections 301 and 304 of the Communications Act (limits on transferability of radio licenses).