

**Commerce Spectrum Management Advisory Committee
Subcommittee on Operational Efficiencies - Report on Operational Efficiency**

Summary and Recommendation

In May 2003, President George W. Bush established the “Spectrum Policy Initiative” (“SPI”) which called for “a comprehensive review of spectrum management policies . . . with the objective of identifying recommendations for revising policies and procedures to *promote more efficient and beneficial use of spectrum without harmful interference to critical incumbent users.*”¹ One of the first steps in implementing the SPI was the establishment of the Department of Commerce Spectrum Management Advisory Committee (“CSMAC” or “Committee”) “to advise the Assistant Secretary of Communications and Information, Department of Commerce on needed reforms to spectrum policies and management to enable the introduction of new spectrum dependant technologies and services. Two CSMAC subcommittees were established: the Technical Efficiency Subcommittee (“TES”) and the Operational Efficiency Subcommittee (“OES”). These subcommittees were assigned responsibility for the development of recommendations for CSMAC consideration that would facilitate implementation of the SPI.

Based on the foregoing, the OES recommends that NTIA develop a new management structure for federal spectrum that emphasizes spectrum sharing and examines economic incentives that foster more efficient use of spectrum. OES recommends that NTIA begin developing a new management structure for federal spectrum that includes improved sharing arrangements. In addition, the CSMAC recommends that, as part of its next charter, the CSMAC examine economic incentives, including fees, as a possible way to improve efficiency.

Introduction

In 2003 SPI noted that “the existing legal and policy framework for spectrum management has not kept pace with the dramatic changes in technology and spectrum use.”² As a result, new approaches to spectrum management must be explored to maximize spectrum availability without undermining incumbent uses. Several studies suggest that while much of the useable spectrum (federal and non-federal) has been assigned, there is in many bands no actual shortage. The FCC’s Spectrum Policy Task Force examining non-federal spectrum?, for example, concluded: “In many bands, spectrum access is a more significant problem than physical scarcity of spectrum, in large part due to legacy command-and-control regulation that limits the ability of potential spectrum users to obtain such access.”³ Other studies have concluded that 5% to 15% of the assigned spectrum is in use at any given time or location. The combination of increased demand, sporadic usage and new spectrum-using technologies points to the need to develop alternate approaches to spectrum management for both commercial and non-commercial uses.

¹ Presidential Memo on Spectrum Policy: Spectrum Policy for the 21st Century, 39 Weekly Comp. Pres. Doc. 726, 727 (May 29, 2003) (“SPI Memo”), available at <http://www.whitehouse.gov/news/releases/2003/06/20030605-4.html>.

² Fact Sheet on Spectrum Management, June 2003, <http://www.whitehouse.gov/news/releases/2003/06/20030605-5.html>

³ FCC Spectrum Policy Task Force Report, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-228542A1.doc

Underutilization of spectrum is the result of operational or service-related issues often faced by incumbents. There are examples of public and private sector spectrum allocations and assignments throughout the USA where spectrum has been idle for 10 or more years. While there are administrative, “command-and-control” measures that the U.S. could use to remedy spectrum underutilization, other approaches, such as encouraging the development of new technologies or using market-based rules to reassign or reallocate unused spectrum, may be more effective.

“Spectrum Policy for the 21st Century” made clear that one of the Commerce Spectrum Management Advisory Committee’s primary tasks is to recommend new management approaches that accommodate the use of new technologies that use spectrum more efficiently. Optimal spectrum use occurs when no change in allocation or assignment can be made that makes one spectrum user better off without making any other spectrum user worse off.⁴ The current allocation and assignment system may inadvertently lead to less than optimal uses of spectrum in some instances. The question for the Committee is how to determine whether and how we can improve upon how spectrum management decisions are made to ensure that the nation is better off, with the techniques for that determination being including market mechanisms and administrative management.

Optimal spectrum use is not a static situation. What is optimal in one period may no longer be optimal in a later period because of changes in technology enabling the same mission to be done more efficiently and effectively, demand or other factors. Since spectrum is a public good whose use remains subject to Federal license or other approvals, this implies that the relevant Federal agencies are responsible for adjusting allocations and policies to secure the maximum public benefit in light of changing conditions and technologies.

These agencies face a number of challenges involved in meeting the goals of the SPI to optimize spectrum use. Some spectrum uses (especially Federal or public safety applications) combine high value with low constancy in utilization. It can be difficult in these circumstances to determine a priori what an optimal allocation is or when there are other, more valuable uses for the assigned spectrum. A new entrant may face an opaque situation in which it is difficult to identify the scope of use for a particular block of spectrum and, in some cases, to whom that spectrum has been assigned. This is the case among both public sector users and licensed and unlicensed private sector users; in Part 15 spectrum, for example, it is difficult to ascertain who is using the spectrum at any given time and whether efficient technologies are deployed for optimal use, particularly in Part 15 bands where many legacy applications still operate. The lack of transparency complicates management, as NTIA or an assignee has no easy way of knowing if there is a potential use offering greater value. Lack of real oversight and accountability over these quantifiable and qualifiable spectrum assets may be part of the problem.

Greater transparency could lead to more efficient use, and CSMAC should recommend to NTIA that it consider how to provide greater transparency in spectrum allocations among Federal

⁴ Known in economics as a Pareto-efficient outcome. See Chris Doyle, “The pricing of radio spectrum: using incentives mechanism to achieve efficiency,” January, 2007, ITU, http://www.itu.int/osg/spu/stn/spectrum/workshop_proceedings/Background_Papers_Final/Chris%20Doyle%20-%20Incentive%20based%20spectrum%20prices.pdf

agencies as a means to improve management. NTIA's development of an automated, web-based coordination mechanism that allows Federal and non-Federal spectrum users to coordinate requests for licenses or authorizations in the 70 to 95 GHz range is an example of new processes that expand transparency, and the Committee considered this as a useful precedent for developing recommendations for further transparency in spectrum allocation and use.

Greater transparency may create concern by incumbent Federal users that they will be targeted for relocation. To alleviate these concerns, market or other mechanisms should be explored that would empower incumbents with a greater degree of control over any changes in their spectrum assignments and the scope and terms of additional uses while permitting them to internalize some benefit (such as financial arrangements) from sharing the spectrum resource whether with other federal or non-federal users. .

Expanded Spectrum Sharing

Some kinds of spectrum sharing arrangements are already routine (although they usually do not involve the opportunistic exploitation of spectrum). New technologies and new administrative procedures will enable even greater sharing. Under the President's Initiative, for example, NTIA's Test-Bed Pilot Program is evaluating the ability of DSA "Dynamic Signal Access" devices with spectrum sensing and geo-location techniques to share spectrum with LMR systems at 410-420 MHz. The GAO reported in 2002 that Federal and non-Federal users already share more than half of the spectrum from 9 kHz to 3.1 GHz.⁵

Many of the sharing arrangements are among government agencies, particularly federal, state, and local public safety agencies. These agencies have incentives to share that involve better mission performance, greater interoperability, limited spectrum resources, and lower costs. In many cases, they also have established rules and mechanisms for dispute resolution. Sharing is easier among like users with like uses.

Other public sector incumbents may lack similar incentives. Expanding sharing arrangements may require finding creative ways to reduce uncertainty among 'unlike users,' particularly among private and public sector users. As part of any spectrum sharing test initiatives, NTIA may want to consider developing model protocols for "cohabitation" and joint use arrangements for sharing that address likely sources of uncertainty.

Spectrum sharing raises "ownership" issues, and incumbent concerns over loss of control are one of the obstacles to greater spectrum sharing. Previous allocations had been essentially grants made in perpetuity for an incumbent to control a block of spectrum. This "grant" approach decreases risk for the incumbent, helps ensure the availability of essential services and, in some cases, has spurred investment. However, grants can also lead to underutilization and an undesirable lack of flexibility in adapting new technologies.

Once NTIA allocates spectrum, it can be difficult to reallocate that spectrum to higher value

⁵ Government Accountability Office, "Telecommunications: Better Coordination and Enhanced Accountability Needed to Improve Spectrum Management," September 2002

activities. However, private sector investors may be unwilling to build the necessary infrastructure if sharing creates uncertainty over use, interference, or priority. Federal agencies may be concerned about surrendering long-term control of spectrum and the potential effect on mission capabilities. An incumbent who has been assigned spectrum but is not using it could be made worse off when that spectrum was reallocated if their mission planning entailed future use of the allocation. They have no assurance that if they give up their spectrum allocation now that they will be able to obtain what they need in the future. As a result, Federal agencies would face additional expenses to reacquire what has been, until now, essentially a free resource. Moreover, if utilized by the commercial industry, and the new federal use is incompatible with the existing use, it is questionable whether there would be feasible access at all. The prospect of additional unpredictable expense is one of the incentives for “warehousing” spectrum. However, when there is another use for that spectrum that may provide equal or greater value, this pits the legitimate interests of the incumbent against this another potential use.

Government incumbents are more likely to accept a policy to increase spectrum sharing if they are assured that their long-term access to spectrum and the potential effect on mission capabilities will be addressed – how the risks of entering a sharing arrangement will be mitigated. The focus of risk mitigation in spectrum sharing lies in the terms of any agreement or contract, and how they apply to duration, compensation, interference handling, and priority use. These are all complex issues and in public-private sharing arrangements, their negotiation can take months. If there was a policy decision to expand the number of sharing arrangements, NTIA could streamline this negotiation process by developing best practices or standard arrangements for sharing, with perhaps one set optimized for urban areas and another for rural areas. Model agreements or protocols could also lower the transaction costs associated with creating sharing arrangements.

A decision to increase spectrum-sharing arrangements would also need to consider how these arrangements are initiated. Given the perceived risks to incumbents (particularly involving loss of control), there may not be sufficient incentives to overcome any reluctance to begin spectrum sharing arrangements. The Advisory Committee may wish to recommend that NTIA put in place policies and practices to reduce the risk to incumbents that can arise from spectrum sharing.

One item for future consideration by the committee is whether a spectrum management policy that emphasizes sharing should include an expanded use of auctions that would take advantage of opportunistic spectrum-using technologies. With the advent of tools and systems that manage the real time allocation of spectrum rights, unused spectrum could be made available to public and private entities as the capability to dynamically assign these assets in real time in specific geographies increases (sometimes referred to as “Real Time Dynamic Auctions”). New technologies like Software Defined Radio and Cognitive Radio could make the business case more justifiable for short-term spectrum leasing.

Economic IncentivesThe President’s Spectrum Policy Initiative (which led to the creation of the CSMAC) called upon NTIA to identify and implement new kinds of incentives for efficient spectrum use:

NTIA, in coordination with the federal agencies, should initiate a plan to identify and implement incentives that promote more efficient and effective use of the spectrum. The plan should include development of methods or models to

determine spectrum value. However, recognizing that market-based incentives may not be appropriate for all federal radio services and in all bands, NTIA should apply these incentives only in appropriate situations.⁶

The U.S. has considered spectrum user fees in previous spectrum management initiatives. A 1991 NTIA Report, “U.S. Spectrum Management Policy: Agenda for the Future,”⁷ proposed that NTIA study the possibility of leasing spectrum from the Federal government to private sector uses, as well as possibly establishing a fee system for Federal government spectrum users, to encourage greater spectrum efficiency among such users.

The most prominent example of fees for licensed spectrum involves Administrative Incentive Pricing (AIP). AIP is a spectrum management technique used in several countries. AIP usually is used to complement conventional allocation techniques. In AIP, an incumbent spectrum holder pays an annual fee for their assigned spectrum. The rationale for the payment is not to cover administrative costs of spectrum management (as is the case in some existing spectrum fee systems), but to provide a continuing incentive for more productive use of the spectrum resource. The ITU notes, “Administrative methods of spectrum assignment are increasingly being supplemented by the use of spectrum prices,”⁸ for which the ITU cited examples ranging from cost-based spectrum management fees, AIP and auctions.

AIP is used extensively by Ofcom in the UK; however, it has not been applied to all commercial services⁹. The introduction of AIP was part of a larger spectrum management reform effort that examined existing uses in the commercial and public sectors, projected demand for spectrum, and expanded rights for some public sector users. U.K. spectrum reform efforts have been explicit that AIP is not a one-way street in terms of only user fees, but also encompassing enhanced user rights (e.g., buying, selling, leasing spectrum). The 2005 Cave Audit stated: “However AIP is a relatively conservative and lagging indicator of value. The Audit is keen that an incentive structure is put in place which encourages bodies to also be more active in their management of spectrum, to react in a timely manner to changes in the value of their spectrum holdings, and to gain financially from doing so.”¹⁰

Various models for setting prices involve estimates of a number of factors including opportunity cost, the cost of relocation, and estimates of the opportunity cost of the spectrum (e.g. the gains if it is used for another purpose). Administrative spectrum prices in the UK are based upon Ofcom’s assessments of the opportunity cost of the spectrum in question and a consideration of other factors, including bandwidth, coverage, degree of sharing, and geographical location. Price information from auctions and other transactions can also help determine an administrative price.

Any notion of introducing fees for spectrum faces the concerns commonly heard when user fees are introduced in other sectors – that there are intangible benefits not reflected in the price, and that transaction costs are undervalued. Various models exist for determining price, however, and

⁶ “SPECTRUM POLICY FOR THE 21ST CENTURY” – The President’s Spectrum Policy Initiative: Report 1: Recommendations of the Federal Government Spectrum Task Force - June 2004

⁷ Found at <http://www.ntia.doc.gov/osmhome/91specagen/1991.html>

⁸ <http://www.ictregulationtoolkit.org/en/Section.1280.html>. The 2005 CSMAC Charter also gives the Committee the mission of “evaluating the value of spectrum to the public and private sectors.”

⁹ Ofcom does not have unilateral authority to impose AIP on the UK Ministry of Defense.

¹⁰ Independent Audit of Spectrum Holdings by Professor Martin Cave, December 2005, at page 19.

these models can be adjusted to include intangible factors. The discussion of valuation has a long history in government policy. In essence, the commercial spectrum-based services market simply does not provide many spectrum-based government services. These are public goods whose prices is not easily determined (spectrum, it should be noted, does not fall into this category as pricing data for adjacent bands or similar uses is often available). Nevertheless, the OES recognizes that there are a number of federal agencies that rely on specific spectrum for global deployments and have other mission critical spectrum applications. Further study is necessary to determine how to best value these types of uses for A-11 purposes.

Renewed consideration of fees also is important because of changes in the Office of Management and Budget's Circular A-11¹¹ which states:

To integrate spectrum resources more clearly into the capital planning process, the Office of Management and Budget (OMB) and NTIA should explore modifying and applying existing capital planning and investment control procedures to better identify associated spectrum requirements and costs of major investments. As part of the capital planning process, OMB and NTIA, together with the federal agencies, should explore modifying agencies' existing procedural and analytic guidelines for major spectrum dependent projects so that agencies give more consideration to spectrum use in their capital planning and management processes to determine the most cost-effective approach to obtaining radiocommunication services. This effort will improve the government's recognition of the opportunity costs and trade-offs of various telecommunications options in meeting operational requirements.

A-11 states that “[s]pectrum should generally not be considered a free resource, but rather should be considered to have value and be included, to the extent practical, in economic analyses of alternative systems. In some cases greater investments in systems would reduce spectrum needs (*e.g.*, purchase of radios that use less bandwidth than less expensive models); in other cases the desired service can be met with other forms of supply (*e.g.*, private wireless services or use of landlines). In addition to considering cost minimizing strategies, agencies are encouraged to consider whether the investment would provide net benefits.”

Circular A-11 does not require user fees to demonstrate that economic valuation is being considered, but provides executive guidance on the budget to agencies. Section 33 of the Circular requires agencies to consider the economic value of radio spectrum when developing economic and budget justifications for procurement of major systems. The changes in A-11 follow the direction laid out by the SPI which called for the creation of incentives for more efficient spectrum use, including, but not limited to, the development of methods or models to determine spectrum value. The Circular instructs agencies not to regard spectrum as a “free resource,” but to include an estimate of the spectrum’s value in analyses of Federal systems and investment, and to consider tradeoffs in telecommunications technology and service provider options

¹¹ http://www.whitehouse.gov/omb/circulars/a11/current_year/a_11_2008.pdf. Section 33.4 is on spectrum valuation.

The intent, according to OMB, was to consider explicitly the economic value of spectrum “used in major telecommunication, broadcast, radar, and similar systems, when developing economic and budget justifications for procurement.” Conversations with OMB officials suggest that spectrum would be treated like rent (where agencies must allocate funds in their budgets for the space they occupy, even if it is in Federal buildings). Circular A-11 does not mention rent but states that the value of spectrum should “be included, to the extent practicable, in economic analyses of alternative systems.” OMB has not issued guidance on how to value spectrum, leaving this to agency discretion, but OMB wants certainty about the valuation - economic rather than technical - based on comparing agency use to uses in the private sector. OMB has also recognized that identifying such value with any mathematical precision would be extremely difficult. A-11 instructs that “spectrum valuations may be estimated based on recent prices of similar bands in spectrum auctions, or through other estimation methods” and notes that NTIA can “review these analyses in making spectrum assignments.”

OES recommends that NTIA begin developing a new management structure for federal spectrum that includes improved sharing arrangements and economic incentives including fees. In addition, the CSMAC recommend that, as part of its next charter, the CSMAC examine economic incentives including fees, as a way to improve economic efficiency and explores additional methods for implementing OMB Circular A-11. .

Any consideration of fees must also review compensatory mechanisms to ensure that a public sector incumbent shares in the gains from releasing spectrum. The Advanced Wireless Services (AWS) is a useful precedent, as it raised nearly \$13.9 billion, some of which was used to cover the costs of relocating incumbents. Fees impose a cost on an incumbent for holding spectrum; compensation provides an incentive for its sharing or improvements in use.

The next CSMAC also may wish to discuss whether allowing for secondary markets by federal users would provide an alternative means to allow spectrum to move to higher value uses. It is possible that a marketplace mechanism for Federal users to maintain rights to, but obtain a return on their assigned spectrum, would provide incentives for greater sharing and means of funding greater deployment of spectrally efficient technologies. These ideas would likely require regulatory or legislative changes, but have the attraction of giving market mechanisms a greater role in spectrum management.