Comments Filed with the National Telecommunications and Information Administration on the Matter of "Development of a National Spectrum Strategy"

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In Re:	)	Matter No. 230308–0068
Development of a	)	Regs.gov No. NTIA-2023-0003-0001
National Spectrum Strategy	)	

Comments of Economists

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I. Introduction

In its Request for Comments (RFC), the NTIA seeks "to identify at least 1,500 megahertz of spectrum for in-depth study to determine whether that spectrum can be repurposed to allow more intensive use."[1] In these comments we discuss underlying economic concepts important for making good spectrum policy decisions and then offer several specific suggestions that follow from these guiding concepts.

The three key concepts are that incentives matter, spectrum policy must consider opportunity cost, and that we must allow for the inherent uncertainty about future technology and demand. Policies consistent with these concepts include using market mechanisms as much as possible, narrowing interference protections to make it more difficult for incumbents to block progress, and allowing non-interfering use.

II. Principles for Good Spectrum Policy

NTIA should incorporate the following economic concepts into its spectrum planning:

- Incentives matter
- Consider opportunity cost
- Take into account uncertainty about the future

A. Incentives Matter

While commercial entities have well-understood incentives to maximize profit, government agencies and personnel also face incentives that the NTIA should consider in determining spectrum policy since these incentives can affect agencies' behavior. For example, different government agencies have opposed and slowed the transfers of spectrum from the government to commercial use and the opening of some previously exclusive government spectrum to sharing.

Such opposition may be rational. An agency may not benefit from releasing spectrum when it can otherwise use that resource essentially for free, at least from its perspective. If it releases control of spectrum, in the future it will have to complete its mission with less resources (as it may not realize any net budget increase despite needing to substitute for the lost resource). In addition, individual spectrum managers within agencies are unlikely to be rewarded for conserving on spectrum use but may face problems if more spectrum is needed in the future for a new service or mission and they have previously released the spectrum to others.

B. Consider Opportunity Cost

Because there is demand for spectrum at a price of zero, any use of the spectrum precludes other uses to some extent. The other uses are the opportunity cost. For example, government use may preclude commercial uses, or exclusive licensed use may preclude unlicensed use. There are some proposed sharing rules to increase access to specific spectrum

[1] NTIA, *In the Matter of Development of a National Spectrum Strategy, Request for Comments*, Docket No. 230308-0068, 88 FR 16244, Mar. 16, 2023, https://ntia.gov/sites/default/files/publications/ntia_nss_frn_rfc_final.pdf.

bands, however these rules have opportunity costs that must be considered when trying to maximize social welfare from spectrum use.

While spectrum may not be identical to real estate, it shares some important properties. One of them is that location matters – spectrum in different bands has different transmission properties that may be more attractive for certain uses or that may reduce costs for other uses. In addition, both spectrum and real estate have contention in use. There is no way to eliminate contention for spectrum use that would allow all potential users to operate freely just like not everyone cannot freely use the same acre of land.

C. Take Into Account Uncertainty About the Future

As Yogi Berra put it, "It's tough to make predictions, especially about the future." No one knows what wireless (or other) technologies will be available, their costs, and consumer demand in ten years and beyond. NTIA should do everything possible to get spectrum allocation right for today's uses, but allocation needs to be able to change with changes in supply and demand.

The overall spectrum allocation process should strive to be both statically and dynamically efficient. That is, it is important to optimally allocate spectrum today, but regardless of how well we determine an "optimal" allocation and use for spectrum at any point in time, changes in consumer preferences and technology eventually cause that allocation to become suboptimal. Spectrum must be able to continue to move to different uses as supply and demand conditions change over time, which means the government must not dictate specific uses of any given spectrum band. Allocating bands to uses without agreed, low-transaction cost approaches for changes, is arguably the original spectrum sin that has driven controversy and slowed wireless development over the past century.

Consider, for example, the economic losses if the spectrum that wireless providers initially used for analog cellular service had not been granted flexibility for technological upgrades. More conceptually, though, we do not know what types of wireless services consumers will want ten, twenty, or more years from now and we need to ensure that spectrum can migrate to those uses without long, costly battles.

III. Proposals for Managing Spectrum

Principles are important as guiding stars, but actionable suggestions are crucial for making progress. We offer three proposals for advancing spectrum policy:

- Continue moving towards use of market mechanisms for all stages of spectrum allocation
- Narrow interference protections to limit incumbents' veto power over new technologies and uses
- Allow non-interfering use

A. Use Market Mechanisms Wherever Possible

Spectrum decision-making has two general phases: allocation and assignment. In the allocation phase, broadly defined acceptable use is determined. Whether spectrum will be used for terrestrial, satellite, government, commercial, licensed, unlicensed, or shared uses are all outcomes of allocation decisions. This decision is currently never market-based.

In the assignment phase, specific licensees are chosen. Auctions and other market mechanisms are used to assign some, but not all, licensed and some shared spectrum.

Prior to assignment auctions, commercial spectrum was generally assigned by "beauty contest," which refers to the process in which interest groups lobby the relevant regulator to assign a spectrum band to their preferred use. This lobbying is mostly done via competing technical reports, each purporting to show the benefits of the group's preferred use and harms from alternative uses. The key problem is that beauty contests cannot properly take into account how consumers (broadly defined) actually value different uses. Even if the contest leads to the best use as defined by engineering criteria, that does not necessarily mean it is going to the most valuable social use. Hazlett (2017) and many other authors show the infirmities of the beauty contest approach.[2]

Flexible-use licensees allow spectrum users to pursue business plans and bear the risks (positive and negative) from their investments and business decisions.[3] When customer tastes, technology, or other factors change, spectrum users can adapt to increase the value of their services and increase their returns subject to protection of other spectrum users' rights. With a sufficient number of providers, consumers will have choice and providers will invest to attract them from competitors, leading the allocation to be closer to optimality.

The history of beauty contests also highlights a potential weakness in the NTIA's approach as reflected in the RFC. Specifically, "Pillar #3 – Unprecedented Spectrum Access and Management through Technology Development" misses the key point that optimal spectrum decision-making requires understanding more than technology. It must also take into account other demand and supply conditions, which is what market mechanisms do.

Market mechanisms continue to make inroads in some areas, such as compensating incumbent users to vacate spectrum to make way for higher-value uses, although the best way to compensate them remains debated (see Rosston and Skryzpacz, 2021).[4] The broadcast TV incentive auction and digital transition, initially proposed by FCC economist Evan Kwerel and

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[2] Thomas W. Hazlett, The Political Spectrum: The Tumultuous Liberation of Wireless Technology, from Herbert Hoover to the Smartphone (Yale University Press, 2017).

[3] Flexible use means the ability to choose technology, transmission sites, power, services, business models, and other factors with constraints on, for example, out-of-band emissions, power limits, or geographic boundaries.

[4] Gregory L. Rosston and Andrzej Skrzypacz, *Reclaiming Spectrum from Incumbents in Inefficiently Allocated Bands: Transaction Costs, Competition, and Flexibility*, Apr. 2021, https://web.stanford.edu/~skrz/Transaction_Costs_and_Overlays.pdf.

engineer John Williams, is a leading example.[5] The C-Band auction is another instance of using incentives to transition spectrum to higher valued use by incorporating incentive payments.

Sometimes it has been necessary to include other incentives in addition to relocation costs to move incumbents off the spectrum band. This began with the 1994 PCS auction, where winners paid microwave incumbents' relocation costs and added incentives for faster relocation (Cramton, Kwerel, and Williams, 1998).[6] Recently, terrestrial TV broadcasters and satellite operators in the C-Band received premium payments. In these cases, mechanisms limited licensees' ability to hold out for higher prices, preventing them from extracting value from new uses and hindering relocation incentives.

But beauty contests continue to be the mechanism by which the government makes key spectrum allocation decisions, including whether spectrum should be for terrestrial or satellite use and whether it should be licensed, unlicensed, or shared and, when not licensed, what the various governing rules should be.

Consider the decision to allocate spectrum to satellite or terrestrial use. Instead of the government selecting one or the other, it could use the market to decide what service is better suited to use the spectrum. Auctioning a flexible use right that incorporates both the terrestrial and satellite rights could result in a much more efficient use of spectrum. For example, in 1997, the FCC decided that satellite radio and terrestrial radio should share use of the 2.3 GHz band. To implement such sharing, the FCC set aside 25 MHz for satellite radio and mandated stringent power constraints on the adjacent terrestrial use. These rules cost consumers dearly. Instead, the FCC could have designed an auction that would have allowed bidders to express the tradeoff of one use for another and possibly figured out a way to provide both satellite and higher power terrestrial service.

Similarly, market mechanisms can help determine whether spectrum should be licensed or unlicensed, both of which have created enormous value. If sharing of spectrum had no constraints, there would be no need for licenses anywhere. However, even license-free spectrum has rules that limit transmissions to ensure others can also use the spectrum. To date, government makes the licensed vs. unlicensed allocation decision as a "beauty contest" where the parties with the most political power are able to get three FCC commissioner votes to allocate spectrum in the direction they want.

Market mechanisms can help harness, not suppress, the power of unlicensed use. NTIA could encourage private and other groups to bid for spectrum that they would then allow others to use (subject possibly to equipment makers paying fees for the use). Another approach would be to put reserve prices on spectrum so that if bidders for exclusive use do not bid above a certain level the spectrum band would become unlicensed. While this approach would not

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[5] Evan R. Kwerel and John R. Williams, *Changing Channels: Voluntary Reallocation of UHF Television Spectrum*, FCC OPP Working Paper Series No. 27, Nov. 1992, https://transition.fcc.gov/Bureaus/OPP/working_papers/oppwp27.pdf.

[6] Peter Cramton, Evan Kwerel, and John Williams, *Efficient Relocation of Spectrum Incumbents*, 41 J. Law & Econ. 647-75 (1998).

completely rely on market forces, it would require the government to determine a value of unlicensed use and, in essence, put in a bid to have an unlicensed band.

The NTIA and FCC can push progress in this area by encouraging more research and experimentation with different approaches on how to decide whether spectrum should be licensed, unlicensed, shared, or perhaps some other model. Only by bringing the proper incentives and market mechanisms into this decision can we know if spectrum is being allocated to its highest valued use.

B. Narrow Interference Protections to Limit Veto Over New Uses

Operators need some assurance of interference expectations on the spectrum band that they use to provide service. A key question is whether they can transmit their signal and have users receive it based on the technology they are using. A second concern is what might happen when they change technology or operations or if operators in adjacent bands do so.

Communications systems tend to be capital intensive and require up-front investments before they can be used. These upfront investments can lead to "path dependency" that can dictate future technological innovation. In addition, existing investments can cause parties to oppose expansion by neighboring uses if it would require incumbents to upgrade their equipment. Early investors might have an incentive not to invest as much if they think they will not bear the cost of upgrades or can be paid off to change their use.

Kwerel and Williams (2012) proposed protection levels adapting to flexible use in adjacent bands rather than being set in perpetuity based on existing use and first-in-time priority.[7] Such a change in standards can free up spectrum use in adjacent bands.

By setting standards that ensure operation in both bands, spectrum can be repurposed and used efficiently and incumbents or first-in-time users will not have the ability to block new uses (or to demand payment to allow such use).

C. Allow Non-Interfering Use

Because spectrum does not degrade with use, transmitting when or where the licensee is not trying to operate does no harm (other than potential competition) to the licensee's rights to transmit. In principle, a rule based on harms and "no harm, no foul" would be economically more efficient than letting spectrum remain unused.

One possibility, proposed by several analysts, could be some form of "use it or share it" for licensed spectrum, which would allow transmission by users other than the licensed operator so long as they do not interfere with the ability of the licensee to transmit to and receive from its users.[8]

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[7] Evan Kwerel and John Williams, *Solving the Receiver Problem Without Receiver Standards,* FCC Workshop on Spectrum Efficiency and Receiver Performance, Mar. 13, 2012, https://transition.fcc.gov/bureaus/oet/receiver-workshop1/Session6/SESSION-6-1-Kwerel-Williams-FCC.pdf.

[8] See, for example, Michael Calabrese, "Use it or Share it: A New Default Policy for Spectrum Management," Open Technology Institute, March 2021 (*available at* https://www.newamerica.org/oti/reports/use-it-or-share-it/). Some

A strongly enforced condition of such a rule, of course, must be that operation by others must cease immediately if it causes harm or interference to the licensee's authorized operation. By having a firmly enforced rule allowing operation without harm, but protection for the licensee, both parties have opportunities to increase the value of the use of the spectrum. Such non-interfering use under a "use it or share it" rule would be allowed across the board – for commercial and government spectrum.

NTIA or FCC could experiment with "use it or share it" rules on some spectrum allocations to allow to observe and measure the effect of such rules on users of the spectrum.

D. Inventory Government Spectrum and Estimate its Opportunity Cost

The U.S. government, particularly the Department of Defense, controls vast swaths of the electromagnetic spectrum. The list of NTIA administrators that have tried valiantly over the decades to find ways to make government agencies understand the opportunity cost of the spectrum they control and behave appropriately is long and bipartisan, but progress has been slow. Several institutional factors are responsible.

Administrations change regularly, as they should, but government institutions change far more slowly, also as they should. These mismatched timelines and frequent "resetting" of the political representatives mean that those with an interest in the status quo can delay action to simply wait out the other side.

Additionally, the government is not a single, monolithic entity. Each agency can have many groups that use and manage spectrum differently, not to mention the many oversight organizations with responsibility. The current structure for federal spectrum valuation is made up of NTIA's Interagency Radio Advisory Committee (IRAC) for reallocations and swaps between federal agencies, the Office of Management and Budget (OMB), NTIA's Institute for Telecommunications Sciences (ITS), and the Executive Office of the President's Office of Science & Technology Policy (OSTP) for input on spectrum allocation decisions. The Council for Economic Advisors (CEA) and the National Economic Council (NEC) may also be asked to weigh in on spectrum policy at the level of the White House as well.

Even so, economic incentives and welfare estimates should be the guiding framework for how to best order the needs of a digital economy, federal operations, and global security. NTIA should continue spending analytical resources to estimate the opportunity cost of federal spectrum inventories. That key piece of information is crucial to any method of causing federal agencies to respond to economic incentives. Publicizing estimates of the opportunity cost of government spectrum could be an important step towards creating pressure for agencies to behave in an economically rational fashion.

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have gone further and proposed (and in some circumstances the FCC has implemented "use it or lose it" rules for either a full license or for specific geographic areas that are unused. With our proposal, such measures are unnecessary.

E. Two Simple Proposals to Free Up Spectrum

Reallocating spectrum that is not covered by flexible use licenses is always challenging. The two following proposals may help solve some outstanding problems.

1. Overlay Licenses to Facilitate Reallocation of TV Broadcast Spectrum

The FCC's "Broadcast Incentive Auction" successfully relocated spectrum to a much higher valued use. Even after that auction, a large amount of spectrum is still used for television broadcasting today with no ready mechanism to reallocate it to flexible use. While another two-sided auction may not be as successful and would be complicated, it would be straightforward to allocate overlay licenses with flexible use rights (Hazlett, 2014, Rosston and Skrzypacz, 2021).[9] Television broadcasters would retain the ability to broadcast or come to an agreement to reduce or eliminate that right.

2. Include Terrestrial and Satellite Rights in Future Licenses

Debates between satellite and terrestrial interests currently are resolved by beauty contests about what is technically possible rather than what is socially beneficial. Knowing this, licensees have obtained satellite transmission rights and then leveraged those into rights to terrestrial transmission or rights to block terrestrial transmission without payment. In the future, new flexible rights should be comprehensive and include terrestrial and satellite transmission. By combining the rights, licensees would have the ability to determine which service would be most valuable and internalize the tradeoffs of trying to accommodate both types of transmission within the spectrum.

IV. Conclusion

NTIA should focus on incentives and opportunity costs, consider overlay licenses, and include terrestrial and satellite rights in future licenses. By following economic principles, policymakers can ensure that spectrum is allocated efficiently, promoting economic growth and innovation while satisfying the needs of current and future spectrum users.

[9] Thomas Hazlett, *Efficient Spectrum Reallocation With Hold-ups and Without Nirvana*, George Mason Law & Economics Research Paper No. 14-16 (2014), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2440003; Gregory L. Rosston and Andrzej Skrzypacz, *Reclaiming Spectrum from Incumbents in Inefficiently Allocated Bands: Transaction Costs, Competition, and Flexibility*, Apr. 2021, https://web.stanford.edu/~skrz/Transaction_Costs_and_Overlays.pdf.