Spectrum Allocation at the Federal Communications Commission: Time for a Reset

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I. INTRODUCTION AND SUMMARY

After years of deliberation, the Federal Communications Commission on July 14, 2016 adopted the "Spectrum Frontiers" Order and Further Notice of Proposed Rulemaking providing new federal rules for the allocation and use of spectrum above 24 GHz, often considered the "frontier" of spectrum.[2] In late June 2016, however, just a few weeks before the Spectrum Frontiers final order was adopted, the Boeing Company filed a new petition for rulemaking with the FCC in which the company asked the agency to effectively alter the allocations and power limits the FCC was about to finalize for high band spectrum.[3]

While no one can fault The Boeing Company for pursuing all avenues to its advantage, this development highlights several flaws in the FCC's administrative review process for spectrum allocations. The FCC's current process imperfectly tries to mimic market mechanisms and in so doing, needlessly extends the time it takes to move spectrum to its best and most efficient use.

High-frequency spectrum is indeed one of the last frontiers in which to find useable spectrum to support mobile broadband. Unlike the space frontiers of the fictional *Star Trek*, however, the frontiers of high-frequency spectrum are here and now.

[2] FCC, 16-89, Report and Order and Further Notice of Proposed Rulemaking, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services,* July 14, 2016. Several dockets, including one that dated from 1997, formed the foundation of the Order.

We can continue to allocate high-frequency spectrum on a piece-meal basis as we have in the past. Or we can learn from past mistakes and rely on better, more market-oriented mechanisms that accelerate the process of allocating new spectrum. The economic consequences of getting more efficient use of spectrum from market mechanisms are enormous. The consequences of not getting more efficient use of spectrum are both tragic and economically irrational.

II. HIGH-FREQUENCY SPECTRUM IS THE FRONTIER

The *frontier*: the very word evokes images of explorers, from geographic explorers of centuries past, to *Star Trek* explorers of future centuries. An important frontier today has no specific geographic boundary. It is not light years away on an intergalactic mission. It is part of the here and now, the very air we breathe and yet also what we cannot breathe; it is part of the light we see and yet also the light we cannot see; it is the sound we hear as well as the sounds we cannot hear. It is spectrum.

Since the beginning of the 20th century, scientists and engineers have expanded knowledge of the boundaries and applications of spectrum. The spectrum regulations from the Berlin Conference of 1906 pertained to 500 KHz to 1 MHz.[4] By 1922, the federal government regulated spectrum between 50kHz and 3MHz. Today, the federal Communications Act has expanded to regulate spectrum between 9 kHz and 275 GHz.[5]

[4] For a review of early spectrum regulation, see H. Furchtgott-Roth, "The Economic Value of Property Rights Concepts in Spectrum, Both With and Without Licenses," unpublished manuscript, 2016.
[5] Ibid.

Commercially valuable applications of spectrum move more slowly than the scientific frontiers of spectrum. Before 1914, commercially interesting applications were few. By 1934, spectrum below 2 MHz had some commercial value. By 1950, spectrum below 1 GHz may have had commercial value. By 1996, most observers viewed spectrum below 3GHz and a few higher bands as having particular economic value.

Today, new technologies hold extraordinary promise for the development of spectrum applications in many bands with high frequencies. The FCC consolidated several ongoing dockets with a new proceeding with a Notice of Inquiry (NOI) to look at a variety of issues about how to regulate this higher frequency spectrum above 24 GHz, particularly in six bands.[6] The FCC inquiry focuses on terrestrial mobile applications, particularly for new 5G wireless technologies. As the Commission stated:

> In particular, industry and technical groups are beginning to examine the use of higher frequencies sometimes known as millimeter wave (mmW) bands for mobile use. This examination of the possible uses of the mmW bands for mobile use takes place within the context of broader efforts to develop technical standards for so-called Fifth Generation (5G) mobile services. In view of the technological and marketplace developments outlined in this item, we seek to discern what frequency bands above 24 GHz would be most suitable for mobile services, and to begin developing a record on mobile service rules and a licensing framework for mobile services in those bands.[7]

The FCC subsequently launched a Notice of Proposed Rulemaking.[8] The NPRM included discussion of new terrestrial wireless services. Among others, mobile services were proposed in the 37-40 GHz band.[9] In July 2016, the FCC adopted rules for mobile

[6] FCC, Docket GN 14-177, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services,* Notice of Inquiry. See particularly paragraphs 46-87.
[7] FCC 14-154, Docket GN 14-177, Notice of Inquiry, October 17, 2014, paragraph 1.
[8] FCC, 15-138, Notice of Proposed Rulemaking, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services,* October 23, 2015.
[9] Ibid. paragraphs 35-53.

applications, for among other bands the 37 GHz band and the 39 GHz band, spanning from 37-40 GHz.[10] The Commission also adopted a further notice of proposed rulemaking for the 50 GHz band, from 50.4 to 52.6 GHz.[11] The FNPRM proposed to authorize terrestrial fixed and mobile operations in the 50 GHz band under the Part 30 Upper Microwave Flexible Use Service rules.

The spectrum above 24 GHz is underutilized, but it is not entirely undeveloped or without technological applications. More than 20 years ago, the FCC even auctioned licenses in several of these bands;[12] however, the applications for higher-band frequencies have not, to date, been as commercially successful as applications deployed on lower frequencies.

III. PROPERTY RIGHTS CONCEPTS ARE IMPORTANT FOR THE ECONOMIC VALUE OF SPECTRUM, INCLUDING HIGH-FREQUENCY SPECTRUM

It is perhaps all too human nature to stake a claim to that which is new and which appears to be in one's grasp. A child seeing a toy enter her home might assume the toy is hers to decide how to use it, to enjoy, and to discard when no longer wanted. Never mind that the toy may be designated for another child. Kings in a bygone era may have viewed territorial conquests much the same way as a child viewing a new toy. Never mind that the territory may have individuals with other loyalties and other claims and an entire set of property rights in place. And so it is with spectrum.

[10] FCC, 16-89, Report and Order and Further Notice of Proposed Rulemaking, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services,* July 14, 2016.
[11] Ibid., paragraphs 418-423.
[12] See in particular the 24 GHz band, the 39 GHz band, and the LMDS band.

There is a vast literature about the importance of property rights to ensure the efficient use of spectrum and the efficient transfer of interests in spectrum.[13] While spectrum in the United States is not an unalloyed form of property,[14] many property rights concepts have evolved around it.[15] Over the past 30 years, property right concepts in spectrum, both licensed and unlicensed, have been at least partially clarified at the FCC. In large part as a consequence, the economic value of spectrum and spectrum-based services has exploded globally and in the United States.

Many economic studies have shown the value of spectrum and spectrum-based services are growing rapidly, more rapidly than the remainder of the economy.[16] These studies reveal hundreds of billions of annual economic value of spectrum to the American and to the global economy. Although there are major economic contributions from broadcast and satellite services, the vast majority of value in spectrum-based services is from terrestrial services, both licensed and unlicensed. Increasingly, the distinction between

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[13] Two of the most influential papers on the importance of property rights and efficient economic allocation began with the example of the inefficient allocation of FCC radio licenses. Coase, Ronald H. (1959). "The Federal Communications Commission." *The Journal of Law & Economics*, *2*, 1–40. Retrieved from http://www.jstor.org/stable/724927 See Coase, Ronald H. (1960). "The Problem of Social Cost." *The Journal of Law & Economics*, *3*, 1–44. Retrieved from http://www.jstor.org/stable/724810
See also fn 4 above.

[14] In language predating Professor Coase's work, federal statute prohibits the private ownership of spectrum. 47 U.S.C. 301. But federal statute, in language from 1993, requires the auctioning of licenses for mutually exclusive applications that are part of blocks of spectrum transferred from the federal government to the private sector. 47 U.S.C. 309(j).

[15] See H. Furchtgott-Roth, unpublished manuscript, 2016.

[16] For the increase in demand for licensed spectrum, see, e.g., Coleman Bazelon and Giulia McHenry, "Substantial Licensed Spectrum Deficit (2015-2019): Updating the FCC's Mobile Data Demand Projections," June 23, 2015, prepared for CTIA, at http://www.ctia.org/docs/default-source/default-document-library/brattle_350MHz_licensed_spectrum.pdf. For the increase in demand for spectrum not subject to licenses, see Cisco, "Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020 White Paper," February 1, 2016, at http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.html See also Roger Enter, "The Wireless Industry: Revisiting Spectrum, The Essential Engine of U.S. Economic Growth, April 2016; GSMA, Valuing the Use of Spectrum in the EU, June 2013; Harold Furchtgott-Roth, (2009). *The Wireless Sector: A Key to Economic Growth in America*, report prepared for CTIA.

spectrum-based services and the remainder of the economy is blurred as practically all of the economy has become at least in part dependent on spectrum-based services.

Spectrum and spectrum-based services have extraordinary economic value today. They have contributed substantially to the economic growth of America in the past few decades. Indeed, there would have been arguably little if any economic growth in the United States over the past few decades without new wireless and Internet developments.[17] And yet, as explained here and elsewhere, spectrum in the United States is not efficiently allocated with market mechanisms. The potential economic benefits to the United States and the global economy from more market-based spectrum allocations are substantial.

While property right concepts in spectrum at the FCC and elsewhere have increased over the past 30 years, they remain weak and imperfect. Various studies recommend strengthening those property rights concepts.[18] There is no doubt that clearer property right concepts in spectrum would increase economic value further for all bands of spectrum, including those above 24 GHz. The commission has collected a large record in the 14-177 docket, but there is no focus on fundamental property right concepts in spectrum itself.[19] Indeed, the word "property," much less "property right," does not appear in the NOI. "Property" appears in the context of location of use of the 37 GHz

[17] See, e.g., H. Furchtgott-Roth and Jeffrey Li, With Jeff Li, "The Contribution of the Information, Communications, and Technology Sector to the Growth of the U.S. Economy: 1997-2007," August 2014, Hudson Institute, at http://hudson.org/research/10545-the-contribution-of-the-information-communications-and-technology-sector-to-the-growth-of-u-s-economy-1997-2007.
[18] See H. Furchtgott-Roth 2013 and 2016.
[19] As of November 30, there were 862 posted comments for the Docket 14-177 in the FCC's ECFS database. Many more comments were filed earlier in previous dockets.

band and indoor use of Part 15 devices in the NPRM. Property appears only once in the Order in the context again of the 37 GHz band, but not in the rules themselves. Unsurprisingly, most comments ignore property rights altogether.

IV. LESSONS LEARNED FROM ILL-CONSIDERED ALLOCATIONS IN LOWER-FREQUENCY SPECTRUM

NTIA maintains a spectrum allocation chart using a color code to show the allocation in each band of spectrum for both federal and non-federal users.[20] The chart is a beautiful rainbow of colors, but it hardly reflects a unique or efficient allocation. It incorporates, for example, narrow channels in the 800 and 900 MHz bands, vestiges of a time when narrow channels had substantial value given the contemporaneous technology. The NTIA spectrum allocation chart represents allocations that may have once made sense, but which, just a few years later, no longer did. It is impossible to believe that a rational system starting from scratch would look the same. Nor is it possible to believe that the chart would look the same in a market-based system where spectrum rights owners could aggregate spectrum and could choose the most beneficial spectrum uses consistent with the Coase Theorem.

Parties frequently petition the FCC to change spectrum allocations. What follows is often years of delay, if a reallocation is made. The ultimate reallocation, if made by an administrative agency considering a wide range of non-economic factors, may not make economic sense, either at the time of the reallocation, or years in the future.

[20] https://www.ntia.doc.gov/files/ntia/publications/2003-allochrt.pdf.

The challenge for the FCC is not to be omniscient of future technologies. That is impossible. Nor is the challenge for the FCC to discern which among competing interested parties has a better and more accurate story to tell about the future. That too is impossible. And yet, the Commission unwittingly and unnecessarily puts itself in this position in allocation proceeding. The Commission makes decisions about the use and allocation of an extraordinarily valuable asset, spectrum, based upon its judgment about future technology and the representations of interested parties.

The better solution is to devise spectrum allocations with clearer property rights principles to allow interested parties with an economic interest in spectrum to be able to shift and to change in accordance with changing market conditions without reverting to the FCC for years of reallocation proceedings. This would include more flexible-use allocations that reduce the necessity of formal reallocations. Indeed, the *Spectrum Frontiers* Order has some limited elements of spectrum flexibility, such as allowing mobility in some bands.[21]

V. COMPETING PROPOSALS FOR THE USE OF THE 40 GHZ AND 50 GHZ BANDS

The inefficiency of the FCC spectrum allocation process can be seen in the *Spectrum Frontiers* proceeding as well as in the Boeing Petition. The Spectrum Frontiers order adopted in July 2016 is the culmination of various proceedings that have churned for

[21] See, e.g., mobile rights in LMDS. Spectrum Frontiers Order, paragraphs 37-42.

more than a decade. Yet, a week before the proceeding was about to draw to a close, a party filed a new Petition for Rulemaking that impacts the very spectrum allocations the FCC addressed in its decades long proceeding. In June 2016, the Boeing Company filed its petition asking the FCC to enable "the allocation and authorization of additional uplink (Earth-to-space) spectrum for the Fixed-Satellite Service ("FSS") in the bands 50.4-51.4 GHz and 51.4-52.4 GHz."[22] The additional uplink band would then be paired with the 5 GHz FSS downlink band at 37.5 – 42.5 GHz to provide the spectrum foundation for a new NGSO fixed broadband service.[23] These modifications are not in the *Spectrum Frontiers* Order.

CTIA,[24] Straight Path Communications,[25] and others filed various documents in Docket GN 14-177 noting the conflict between Boeing's proposed use of the 40 GHz band and the 50 GHz band for a satellite-based service with terrestrial wireless services proposed in the *Spectrum Frontiers* NPRM and Order. Boeing asserts that the satellite and terrestrial services are incompatible.[26]

There is little in the record thus far to determine unambiguously the technical issues about the compatibility of these different uses of high band spectrum. The FCC will be

[22] FCC, Boeing Company, Petition for Rulemaking, Allocation and Authorization of Additional Spectrum for the Fixed-Satellite Service in the 50.4-51.4 GHz and 51.4-52.4 GHz Bands, June 22, 2016.
[23] Ibid.
[24] Letter from Scott K. Bergmann, Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 14-177 et al, at 3 (Jul. 7, 2016) ("CTIA July 7 Letter").
[25] Letter from Davidi Jonas, CEO and President, Straight Path Communications, Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 14-177, at 4 (Jul. 7, 2014) ("Straight Path Written Ex Parte").
[26] Letter from Bruce A. Olcott, Counsel to the Boeing Company, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket NO. 14-177, July 8, 2016; Comments of the Boeing Company, September 30, 2016; Reply Comments of the Boeing Company, October 31, 2016; Written Ex Parte Notice of the Boeing Company, November 21, 2016.

left to conduct its own tests or rely on the tests of other parties, many with vested interests in the outcome. There is even less, practically nothing, in the record about the economics of the proposed reallocation. The costs and benefits of the proposed reallocation, aside from qualitative cheers, are not in the record. The costs and benefits of Boeing or others using alternate bands of spectrum for specific services are not in the record either.

Thus, absent another multi-year effort to gather information that may or may not prove accurate, the Commission has no basis on which to make an informed decision about the questions posed by Boeing. This is the crux of the Commission's problem with regard to its current process for making spectrum allocation decisions.

VI. VARIOUS MEANS OF RESOLVING DISPUTES FOR THE USAGE OF SPECTRUM

I have no view about whether Boeing or CTIA or Straight Path has the better technical arguments about the compatibility or incompatibility of various services proposed for high-frequency spectrum. Rather, the dispute between the parties, as publicly recorded in a series of documents at the FCC, represents an economically inefficient, even irrational, means of resolving commercial disputes between parties. As noted above, more efficient spectrum allocation could and likely would have substantial benefits to the American economy.

Below, I describe four methods of resolving conflicting proposals for the allocation and use of high band spectrum, from the most efficient to the least efficient. More than 30 years ago, the FCC was primarily using the least efficient means of allocating spectrum. Since then, the FCC has improved spectrum allocation substantially, but still is far from using the most efficient approach it could use.

A. A pure property rights concept approach

A pure property rights concept approach to resolving disputes over the usage of spectrum would assign spectrum rights of an entire band to a party much as a plot of land is assigned by a deed to a party. The FCC would reasonably regulate emissions and interference coming into the band or exiting the band, but the Commission would not regulate these emissions or interference *within* the band, such as between satellite and terrestrial applications. The party with the assigned rights could sell or lease those rights to others for various purposes, and that party would be able to determine the interference conditions between the terrestrial and satellite users, high-power and low-power users, etc. The result would be what economists refer to as the Coase Theorem, whereby, in the absence of transactions costs, assets will gravitate towards their highest-valued use.[27] Of course, initial allocations affect the payments between and among parties, but assets should end up with their highest valued use. If any entity, including the Boeing Company or Straight Path, believes it has a higher valued use for spectrum in the 40 GHz and 50 GHz bands, it can and would approach the entity that has the rights to those bands and seek to acquire certain rights to use those bands. That controlling party might decide

[27] See discussion in Furchtgott-Roth, 2016.

that only one of competing applications would be allowed, or that both would be allowed under conditions that it would determine by contract. The primary role of the FCC would be limited to ensuring that parties with interests in adjacent spectrum bands are not affected by harmful interference. Another role of the FCC would be as the recorder of deeds for spectrum.[28] I have seen nothing to suggest that the FCC envisions this approach to resolving the dispute over the usage of various spectrum bands.

B. The auction approach

The second approach to resolving a spectrum dispute in a band would have two steps: (1) first, ascertain that the federal government retains primary rights in the band and those rights have not been allocated for a specific purpose; and (2) second, auction off spectrum rights, consistent with 47 U.S.C. 309(j), even for competing allocations. The advantage of the auction approach is that it would reveal which party values the spectrum the most, independent of the application or allocation. In practice, every band of spectrum is already allocated, usually for multiple purposes, and usually with different allocations for both federal and non-federal users. In theory, the federal government could reclaim lightly used high-frequency spectrum bands for this auction purpose, but few if any bands of spectrum have no incumbent use. I have seen nothing in the record to suggest that the Commission is considering this approach to resolve the disputes at 40 GHz or 50 GHz.

C. The quantitative administrative state

[28] It is unclear, which party, if any, has a claim to control either the 40 GHz or 50 GHz bands.

The third approach to resolving disputes over the usage of spectrum is what I would characterize as a quantitative administrative state. Here the FCC would do the implicit calculations that should mimic the property-rights approach above.

1. *Value of spectrum to each party and to the public* The FCC would use quantitative information to assess the economic and financial merits of each party to the dispute. The FCC would assess the net economic value of spectrum assignments to various parties as well a net consumer value of various spectrum assignments. As part of this economic calculation, the FCC would consider potential uses of alternative spectrum bands. Although Boeing has presented descriptive information of the business plan of FSS broadband service, I have seen no cost-benefit analysis of the proposed service, either to Boeing or the public. It is unclear why this FSS service would succeed where others have failed. It is also unclear why Boeing could not use other spectrum bands, particularly where FSS services are authorized. Given the general dominance in value of terrestrial based services in almost every spectrum band, it is difficult to see how based on quantitative information the FCC would conclude that the 40 GHz or 50 GHz bands would be different. Historically, the FCC has allocated substantially swaths of spectrum to satellite use. Some satellite bands have proved quite profitable and publicly useful, while many others have not.

2. *Mutual exclusivity of service* The FCC would receive or would conduct quantitative studies of the potential compatibility of various services in a band. This is

the issue that the Boeing Company and Straight Path Communications are presenting to the Commission.

3. *Past Commission experience* The Boeing petition involves new satellite services. Over the past three decades, the FCC has allocated many bands of spectrum to various satellite services. Some have been geostationary, and others have been low-earth orbit services. With the exception of direct broadcast satellite services, most if not all of these satellite services have struggled. In allocation proceedings that consider past Commission experience, the Commission might reasonably consider the experience of allocations to the broader satellite industry.

4. *Separating allocations from assignments* The Commission usually separates sequentially the allocation from the assignment process. The Boeing Petition appears to seek both reallocation of spectrum and use and license assignments within that new allocation, all apparently without an auction. While there may be reasonable but rare circumstances when the Commission should reallocate and assign licenses in the same proceeding—an example might be when a licensee seeks to expand service into an adjacent fallow band of spectrum and where there is no practical alternative use of the spectrum--the burden of proof should be on the party seeking assignments without an auction.

The Commission would combine these various quantitative assessments to allocate spectrum. Presumably, these quantitative assessments would be replicable.

D. The qualitative administrative state

The fourth approach to resolving disputes over competing uses of spectrum is what I would characterize as a qualitative administrative state. Here, the FCC would decide on allocations of spectrum, including reallocations of spectrum, based on factors that are difficult to quantify or replicate. These qualitative factors might be labeled "public interest" even though reasonable individuals might differ on how to assess these qualitative factors. An example would be the rules the FCC devised for the current incentive auction involving set asides and other attempts to specifically advantage some companies over others.

VII. CONCLUSION

High-frequency spectrum is part of one of the last frontiers. Unlike the space frontiers of *Star Trek*, the frontiers of high-frequency spectrum are here and now. They are not science fiction; they are the reality that scientists and engineers are rapidly developing.

The Commission will continue to be confronted with petitions to reallocate spectrum. Some will have merit; others will not. Current practice is for the Commission to take years to decide through laborious proceedings that predict future technologies and economics only to be proved exactly wrong.

We can continue to allocate high-frequency spectrum as we have in the past. Or we can learn from past mistakes and rely on better, more market-oriented allocation mechanisms.

The economic consequences of getting more efficient use of spectrum from market mechanisms are enormous. The consequences of not getting more efficient use of spectrum are both tragic and economically irrational.