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Microsoft

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Submitted via Regulations.gov

Stephanie Weiner
Acting Chief Counsel
National Telecommunications and Information Administration
U.S. Department of Commerce
1401 Constitution Ave, NW
Washington, DC 20230

Re: Comments of Microsoft Corporation in Response to the Request for Comment on Development of a National Spectrum Strategy (NTIA-2023-0003)

Dear Ms. Weiner:

Microsoft Corporation (Microsoft) appreciates the opportunity to provide comments in response to the National Telecommunications and Information Administration's (NTIA) request for comments on Development of a National Spectrum Strategy.[1] Microsoft commends NTIA for taking a proactive and forward-looking approach to future spectrum planning and for committing to work with the Federal Communications Commission toward identifying at least 1,500 megahertz of spectrum for in depth study to determine whether that spectrum can be repurposed to allow for more intensive use.

Introduction

Microsoft's mission is to empower every person and every organization on the planet to achieve more. Connectivity via radio frequency spectrum has long been important to delivering on this mission. As NTIA recognizes, sufficient access to spectrum is vital to our shared national interests, including national security, public safety, scientific discovery, next-generation communications, and increased innovation, connectivity, and competition. Additionally, sufficient spectrum is also necessary to meet our customers' current and future needs in the myriad of ways they access and use Microsoft's cloud-based services, whether via Wi-Fi, commercial and private wireless networks, or satellite networks. This broad visibility across the communications landscape in the United States and across the globe informs Microsoft's view of how to approach a national spectrum strategy. As NTIA provides guidance on a national spectrum strategy, Microsoft recommends the following:

[1] NTIA, Development of a National Spectrum Strategy, Request for Comment, Docket No. 230308-0068, 88 Fed. Reg. 16244 (Mar. 16, 2023), https://www.federalregister.gov/documents/2023/03/16/2023-05406/development-of-a-national-spectrum-strategy.

- Developing a network of interconnected spectrum pipelines, each of which addresses the spectrum needs for different radiocommunication services and applications, may be more effective than attempting to develop a single pipeline;

- Any long-term spectrum plan should remain flexible enough to account for rapid technological and commercial advancements, and building trust among divergent stakeholders may help to facilitate a steady series of incremental improvements through existing processes; and

- The government can encourage private sector-led innovation and advancement by creating spectrum sandboxes, further developing dynamic spectrum sharing techniques, and supporting private sector research and development efforts.

We provide additional context and suggestions related to each of the three pillars that NTIA identifies in the Request for Comment below.

Pillar #1 – A Spectrum Pipeline to Ensure U.S. Leadership in Spectrum-Based Technologies

Many of Microsoft's products are used in combination with a broad array of terrestrial and satellite spectrum connections, including Wi-Fi, commercial wireless networks, private networks, satellite connectivity, and more.

First, customers leveraging our cloud-based services over terrestrial networks use both licensed and unlicensed spectrum. In enterprise environments, we support customers using both Wi-Fi networks using unlicensed spectrum and private 4G and 5G networks using licensed, lightly licensed, and unlicensed spectrum. Our gaming services rely on unlicensed spectrum for wireless connectivity, while our Augmented and Virtual Reality (AR/VR) offerings use a combination of licensed and unlicensed spectrum. Through Azure for Operators, Microsoft supports network virtualization and Open Radio Access Network development and deployment for both commercial wireless operators and other enterprises deploying private wireless networks. Based on this broad visibility across the terrestrial communications landscape, Microsoft sees a need for additional unlicensed and licensed spectrum for terrestrial use to support growing data needs and advanced applications as wireless technology evolves.

Second, Microsoft's Azure Space initiative includes the terrestrial-based Azure Orbital ground-station-as-a-service offering, as well as space-based efforts with satellite partners. Through Azure Space, Microsoft sees a need for spectrum to support both non-terrestrial networks and inter-satellite links as components in a broader communications infrastructure. For non-terrestrial networks, it may make a difference from a regulatory standpoint whether non-terrestrial networks are considered a satellite component of IMT or part of the Mobile Satellite

Service. Additionally, identifying spectrum for small satellite (SmallSat) telemetry, tracking, and control (TT&C) will be necessary to address the rapid growth of this category of satellite connectivity.

Third, among other activities, Microsoft's Airband program partners collaborates with fixed wireless access and commercial satellite partners to help bring broadband connectivity to unserved and underserved communities.

Based on these varying needs, Microsoft supports development of a network of inter-related spectrum pipelines, each of which addresses the spectrum needs for different radiocommunication services and applications, rather than identifying a single, over-arching spectrum pipeline.

In general, Microsoft supports focusing on spectrum repurposing efforts that: (1) increase the number of use cases for which individual consumers, enterprises, governments, and other organizations can wirelessly access our cloud-based services; and (2) allow for multiple, large channels in spectrum bands used for handling significant amounts of data traffic (*e.g.*, unlicensed spectrum bands). The existence of more and larger on-ramps to the cloud improves user experience and empowers every organization to achieve more.

Microsoft has long been a supporter of spectrum sharing, where it is feasible. Over time, we have learned that depending on the incumbents and the potential new entrant(s) to a spectrum band, spectrum sharing may be technically feasible but not always commercially viable if the required conditions are too restrictive.

In addition to spectrum sharing through frequency, time, and/or location domains, which can be static or dynamic, which NTIA recognizes in the RFC, Microsoft also recommends considering signal separation and signal processing as a fourth category to enable sharing. For example, our experience with TV White Spaces (TVWS) was that the majority of television station broadcasts were horizontally polarized. Thus, TVWS transmitters were typically vertically polarized, which not only served the purpose of further reducing the risk of harmful interference to broadcasters, but also improved receipt of the TVWS signal in the presence of adjacent band broadcast TV signal leakage. Here, the use of signal separation by polarization, improved the potential for sharing spectrum in the TV bands. Additionally, these four sharing mechanisms can be used independently, or in combination as the circumstances of the specific spectrum band dictate.

Pillar #2 –Long-Term Spectrum Planning

Microsoft agrees there is a need for an ongoing spectrum planning process between commercial interests represented by the FCC and federal users represented by NTIA, but urges NTIA to avoid adopting any rigid plans that attempt to project future national spectrum requirements many years into the future. Repurposing spectrum can be a long process and efforts to open additional frequencies for new and more intensive uses should begin now. Nonetheless, technology is evolving quickly, and any long-term plan must account for the fact that projections made now may change unexpectedly in the near future.

As NTIA attempts to develop future national spectrum requirements and a long-term spectrum planning process, we recommend keeping in mind the following:

1) Long-term planning implies that there are agreed upon projected future national spectrum requirements that all stakeholders or the Nation are working towards. However, different groups of stakeholders, such as mobile network operators and related infrastructure providers, satellite system operators, the Wi-Fi ecosystem, and the U.S. defense base, may each have a different definition of future national spectrum requirements and a recommended means to achieve them. Some of these recommended means can be mutually exclusive and must be balanced to enable a broad range of future services and use cases.

2) Spectrum planning and allocation decisions continue to be viewed by most stakeholders as a zero-sum game. It is hard to expect the cooperative behavior and sharing of information amongst stakeholders necessary to develop a plan – long-term or intermediate – if the perception among incumbent stakeholders is that new entrants will displace existing uses. Microsoft and others have long promoted the idea of spectrum sharing, both static and dynamic, as a means of changing the perception that spectrum repurposing can only be achieved through clearing a band and relocating the incumbents. Rather than first looking at repurposing a band for a new entrant by clearing incumbents, the starting point should be to examine whether the new entrant(s) can technically share the band with incumbents, and if so, whether the sharing is commercially viable.

3) Any long-term spectrum plan is based on a snapshot in time and may not easily be able to accommodate technological or commercial breakthroughs that require licensed spectrum. Assessing how a given technological or commercial breakthrough might impact an existing spectrum plan is challenging. While the breakthrough may represent a discrete break with the current state and have considerable upside potential, its impact may not be felt for a few years, if at all. For example, the dramatic reduction in the cost of launching a pound of payload into space has had a dramatic effect on spectrum policy, one which may not have been fully appreciated at the time. Other breakthroughs, though, have not led to commercial success. Fundamentally, though, transforming a technological breakthrough into commercial success requires private investment. If having sufficient licensed spectrum is on the critical path to commercial success, being

locked out of a long-term spectrum plan could be a strong disincentive for investment. Therefore, any long-term plan should recognize that conditions will change and that adjustments may need to be made in the future.

4) Projections of an industry's future spectrum needs are forward-looking statements and should be treated as such rather than as fact. The further out in time these projections cover, the greater the likelihood that some assumptions will no longer be valid, causing the actual need to use certain spectrum bands or the required amount of spectrum to deviate from the conventional wisdom held several years back.

As an alternative to developing a long-term spectrum plan, the Spectrum Coordination Initiative could be used to improve current processes. As NTIA recognizes, a key requirement is building trust. Sometimes a steady series of incremental improvements over a relatively short time period can lead to a more successful outcome than a larger, higher profile effort. The Memorandum of Understanding between the FCC, representing commercial interests, and NTIA, representing Federal users, should help in the discussion of considering bands that can be shared between commercial and Federal users, and under what technical conditions. Building trust amongst the groups or categories of affected stakeholders, many with competing and diverging interests, is a separate challenge. Several existing groups touch on spectrum planning, and it is not clear that creating new groups will resolve current challenges.

Pillar #3 – Unprecedented Spectrum Access and Management through Technology Development

Microsoft supports spectrum management tools, techniques, and models that facilitate more efficient sharing of spectrum between and amongst licensed and unlicensed users of spectrum. Spectrum sharing solutions cover a continuum of complexity, from a spectrum manager keeping an electronic ledger of spectrum usage in a band, to the Spectrum Access System in the Citizens Broadband Radio Service managing access to the spectrum for priority access licensees and those seeking general authorized access. The spectrum sharing approach should only be as complicated as necessary to protect incumbents in a given band. Sharing can be either static or dynamic, depending on the band's specifics. The technical conditions for spectrum sharing likewise depend on the band's specifics. But as stated above, while spectrum sharing may be technically possible, the technical conditions to do so may be sufficiently severe to where it is not commercially viable. In instances where spectrum sharing has been shown not to be commercially viable in a specific band, the options become not to allow the new entrant to operate or to relocate incumbents to another band.

Microsoft expects that the combination of cloud-based spectrum management platforms and the application of machine learning, artificial intelligence, and greater intelligence at the edge of networks will enable more dynamic spectrum management capabilities in the near future.

However, even with these technological advancements, fundamental policy differences in the general approach to spectrum sharing make a huge difference on whether spectrum sharing is possible or if the only option is to clear the band and relocate incumbents. These essential policy details include the use of Monte Carlo based models versus a static analysis of the worst case possible, looking at short-term versus long-term interference potential, agreeing on how antenna arrays should be taken into account in different frequency ranges, the appropriate application of various available propagation and clutter models, how to address undesired signals that may be present even if its magnitude does not cause harmful interference, etc. The combined effect of these small policy decisions and assumptions used regarding future deployments, such as deployment densities, heavily influences the results of sharing and compatibility studies used to determine whether a new entrant can share the band with incumbent services.

Further, Microsoft believes that any National Spectrum Strategy should take a very light touch in considering actions to identify policies to enable development of new and innovative uses of spectrum. The private sector is best positioned to identify new and innovative uses of spectrum, though the government can take certain actions to support innovation without putting its thumb on the scale. For example, the Federal government can support industry through the creation and availability of 'spectrum sandboxes' for experimentation, in addition to supporting research and development.

As one example, there is much discussion regarding the potential use of frequencies in bands above 95 GHz. At this time, commercialization of these bands is in a very early stage of development. The FCC created the Spectrum Horizon Experimental License in its 2019 Report and Order. A 'Terahertz' or 'Sub-millimeter' sandbox at NTIA's Institute for Telecommunication Sciences (ITS), used in conjunction with the Spectrum Horizon Experimental License could accelerate experimentation leading to more rapid commercialization. Such sandboxes can also provide real world data that could help in the formulation of additional technical rules, if required, to enable sharing with incumbent services. We recommend that these 'Terahertz' or 'Sub-Millimeter' sandboxes be authorized and funded through ITS. This mechanism would create the opportunity for ITS staff to support some of these sandbox efforts, through different contractual mechanisms, such as a cooperative research and development agreement (CRADA).

Another role the government can play to support industry in expanding the overall capacity or usability of the radiofrequency spectrum is through funding research and development. Specifically, we support federal investment to advance potential new dynamic spectrum sharing models and regimes. While there have been technical advances in dynamic spectrum sharing technologies and techniques over the years, more work still needs to be done to realize its full potential. The time scale for 'dynamic sharing' in a given band may vary

depending on the incumbent, and even with advances in artificial intelligence and machine learning, achieving dynamic spectrum sharing on relatively short time scales presents many challenges. Achieving certain time scales for dynamic sharing may not be achievable today based on the current state of underlying technologies, but may be possible with additional research and development.

Generally speaking, different spectrum bands with different incumbents will require different dynamic spectrum sharing solutions. And in particular, spectrum bands where there are classified federal operations will have to be addressed separately. The Public Notice raised several questions with respect to the incumbent informing capability (IIC), but the issue is even broader given the number of Federal bands that mobile network operators are interested in accessing. Where information regarding incumbent operations is classified out of necessity, it makes it very challenging for a broad swath of industry to participate in the technical work regarding sharing technologies with any specificity. For these bands, it is likely that providers of secure clouds will have to participate in the process, likely in partnership with DoD contractors and mobile network operators.

Conclusion

Microsoft appreciates the opportunity to provide comments on NTIA's RFC on Development of a National Spectrum Strategy. If you have additional questions, please reach out via email at paula.boyd@microsoft.com or phone at 202-263-5900.