

**Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)
)
Amendment of the Commission's Rules with) GN Docket No. 12-354
Regard to Commercial Operations in the)
3550-3650 MHz Band)

COMMENTS OF MICROSOFT CORPORATION

Gerard J. Waldron
Jeff Kosseff
COVINGTON & BURLING LLP
1201 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2401
202-662-6000

Counsel for Microsoft Corporation

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CONTENTS

INTRODUCTION AND SUMMARY	1
I. THE PUBLIC INTEREST IS SERVED BY PUTTING THE LITTLE-USED 3.5 GHZ BAND TO WIDER USE.....	3
II. ENABLING NON-EXCLUSIVE OPPORTUNISTIC ACCESS IN THE 3.5 GHZ BAND WILL INCREASE AVAILABLE BANDWIDTH TO CONSUMERS	5
III. THE COMMISSION’S FLEXIBLE THREE-TIER PROPOSAL STRIKES THE RIGHT BALANCE BETWEEN PROTECTING INCUMBENT USERS AND ENCOURAGING NEW TECHNOLOGIES.....	8
IV. SPECTRUM SHARING IS TECHNICALLY POSSIBLE, SPECTRALLY EFFICIENT AND IN THE PUBLIC INTEREST.....	11

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Introduction and Summary

Microsoft Corporation (“Microsoft”) strongly supports the Commission’s effort in this Notice of Proposed Rulemaking (“NPRM”) to expand broadband innovation opportunities by designating spectrum in the 3.5 GHz band as Citizens Broadband Service and allowing unlicensed devices to opportunistically share the band with incumbent users.¹ The Commission should be commended for answering the call from the President’s Council of Advisors on Science and Technology (PCAST) to develop creative ways for federal and non-federal users to share spectrum and turning it into a bold, concrete proposal that can help meet the growing demand for wireless bandwidth.

While Microsoft welcomes the Commission’s proposals for make the unused 3.5 GHz spectrum available for General Authorized Access, this proposal should be viewed in the context of a broader effort to make more unused spectrum across a variety bands available for opportunistic and unlicensed access. For many of the reasons the FCC documents in the NPRM, the 3.5 GHz spectrum is by no means a substitute for other unused spectrum that the Commission has made and proposes to make available in spectrum below 1 GHz, such as the TV

¹ Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, Docket No. 12-354, *Notice of Proposed Rulemaking* (Dec. 12, 2012) (“NPRM”).

band white spaces. By making complementary unused spectrum available for opportunistic access across a variety of bands – TV white spaces, 2.4 GHz, 3.5 GHz, 5 GHz, and potentially other bands – the Commission will provide consumers access to more bandwidth and will enable new long range and outdoor applications not currently available to them on current unlicensed spectrum frequencies.

Chairman Genachowski and all the Commissioners have recognized the need over the mid- and long-term to meet growing broadband demand. The compound annual growth rate for wireless devices is approaching 50 percent, making the need for new spectrum more urgent than ever.² The proposal to put the lightly-used 3.5 GHz band to work for federal users *and* the private sector at the same time advances the goal of growing the broadband pie. It complements the Commission’s proposal to make a “substantial amount” of TV white space spectrum available on a nationwide basis for unlicensed device access and in particular to “increase the spectrum available for unlicensed use in the urbanized areas of major markets.”³ Microsoft looks forward to working with the Commission and other stakeholders to ensure that the 3.5 GHz plan is a building block for the wireless infrastructure that is necessary to support the robust and reliable broadband that consumers and businesses demand.

The NPRM raises many important questions on spectrum management, allocation, licensing, and technical requirements. We address some of those questions here; specifically, we endorse the Commission’s flexible three-tier spectrum-sharing proposal since it

² Mark Cooper, *Efficiency Gains and Consumer Benefits of Unlicensed Access to the Public Airwaves* at 7 (Jan. 2012).

³ See, e.g., Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Docket No. 12-268, *Notice of Proposed Rulemaking*, ¶¶ 232, 234 (Sept. 28, 2012).

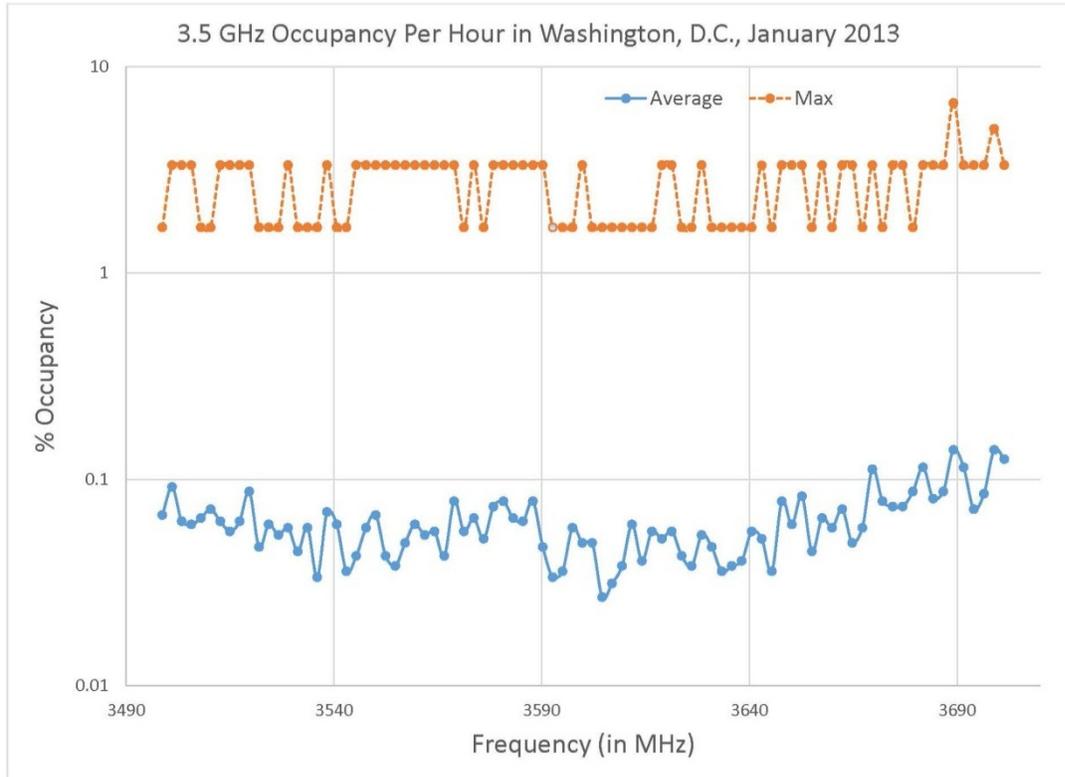
ensures that the public can opportunistically use broadband in the 3.5 GHz band without interfering with incumbent and mission-critical users. We also support proposals to permit General Authorized Access (“GAA”) devices to operate throughout the bands, to be used for outdoor as well as indoor applications, and to operate at higher power in less congested areas, so long as incumbent users are protected from interference. As the record unfolds, we also look to address many of the other important issues that are raised in the NPRM. But before turning to the specifics, Microsoft first wants to highlight its research that shows the public interest would benefit greatly from the Commission’s proposal since the 3.5 GHz band is a national resource that is badly underutilized.

I. THE PUBLIC INTEREST IS SERVED BY PUTTING THE LITTLE-USED 3.5 GHz BAND TO WIDER USE

The 3.5 GHz band is underused, and therefore has considerable room to accommodate small cell devices without displacing incumbent users such as military and maritime radar. Microsoft’s Spectrum Observatory, which collects frequency usage data from four sensor installations worldwide, has found that the 3.5 GHz band is largely unused. For instance, the graph below depicts the average and maximum hourly occupancy percentage⁴ on the 3.5 GHz band in Washington, D.C. in January 2013. It bears mention that Washington, D.C. would fall within the exclusion zone proposed by NTIA. In the chart below, maximum occupancy is the maximum percentage of minutes in any hour in January in which the received signal power on the frequency was above the noise threshold of the measurement equipment, and

⁴ See SpectrumObservatory, About Us, <http://spectrum-observatory.cloudapp.net/Home/About?activeTab=about#two>, (“The Occupancy visualization displays a two-dimensional line chart with frequency (in MHz) on the x-axis and occupancy percentage on the y-axis. The occupancy percentage is calculated as the percentage of data points over the specified time range that is greater than -90 dBm/Hz.”).

average occupancy is the average percentage of minutes in any hour in January in which the power level exceeded the threshold.



Source: Microsoft Spectrum Observatory

This data demonstrates that in January 2013, the 3.5 GHz band was unused or little used during the overwhelming majority of the time. Specifically, the graph shows that for the busiest hour in the month of January for each slice of spectrum, the maximum occupancy in the 3.5 GHz band did not exceed 10%. The graph further shows that the average occupancy in the band was between roughly 0.05% and 0.1%. So for the vast majority of January 2013, the 3.5 GHz band was about 99.9% vacant, and during the busiest hour it was 90% vacant.

Microsoft agrees with the PCAST that “calling the problem a shortage of spectrum is a fundamental misunderstanding; rather, the problem is one of how we better

manage the spectrum.”⁵ The Spectrum Observatory data, which is available to the public on the Web,⁶ will allow other interested parties to assess the intensity of spectrum use in different bands.⁷ This data reconfirms the Commission’s view in the NPRM that the 3.5 GHz spectrum is lightly used and therefore is an appropriate place to permit opportunistic and unlicensed access. By providing this data, Microsoft hopes to help the government and industry maximize the public value of the airwaves.

II. ENABLING NON-EXCLUSIVE OPPORTUNISTIC ACCESS IN THE 3.5 GHz BAND WILL INCREASE AVAILABLE BANDWIDTH TO CONSUMERS

Small cells “are a big deal,”⁸ as Chairman Genachowski aptly put it. Small cells are among the many devices that will help meet the exponentially growing demand for wireless bandwidth. Just as Wi-Fi has helped revolutionize Internet access in the past decade, a new generation of multimodal small cells – powered by Wi-Fi, LTE, and other wireless standards – will lead to faster and more accessible broadband in the next decade. Indeed, IEEE has a technical Task Group working on a new standard, 802.11af for TV white spaces, that can be leveraged to enable Wi-Fi devices to be used in 3.5 GHz spectrum, as well as other white space spectrum. Other standards-based and proprietary technologies could likewise be used in the 3.5 GHz band. These multi-modal devices, capable of opportunistically accessing a variety of

⁵ President’s Council of Advisors on Science and Technology, Report to the President, Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth, July 2012 (“PCAST Report”) p.11.

⁶ <http://spectrum-observatory.cloudapp.net/>.

⁷ We acknowledge the limited geographic scope of this dataset, and thus would welcome other parties adding their own spectrum occupancy data to the Microsoft spectrum observatory.

⁸ FCC Chairman Julius Genachowski Prepared Remarks to International CTIA Wireless 2012 New Orleans (May 8, 2012), http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0508/DOC-313945A1.pdf.

spectrum bands, will increase the amount of bandwidth available to consumers and will enable higher-power, longer range versions of existing technologies, such as Wi-Fi.

In recent small cell trials in areas that had long experienced mobile coverage problems, AT&T found that small cells “gave the area almost 100 percent coverage and virtually eliminated dropped calls.”⁹ This trial validates prior research conducted by Richard Thanki and other economists on the relative efficiency of small cell architectures. Wi-Fi carries more than half of all data traffic on laptops, tablets, and smartphones, and Thanki estimates that households worldwide derive between \$52 billion and \$99 billion in economic benefits from Wi-Fi’s efficiency.¹⁰ According to Thanki, small-cell architectures use spectrum to deliver broadband much more efficiently than cellular networks. For example, the aggregate spectral efficiency of the 2.4 GHz band is at least 30 times greater than the overall efficiency of any cellular band. The Commission thus correctly concluded that “the widespread adoption of Wi-Fi illustrates many of the potential benefits of small cells”¹¹ and that “small cells can be deployed relatively easily and inexpensively for capacity and coverage purposes.”¹²

For this reason, the industry is quickly adopting small cells. Analysts expect that small cell device revenue will grow at a compound annual rate of 73 percent between 2011 and 2016, and that by 2017, manufacturers will ship approximately 8 million small cell devices annually.¹³ Just as 2.4 GHz Wi-Fi access points deployed by consumers and businesses have

⁹ Christina Bonnington, *AT&T Trial Shows Small Cells Bring Nearly Perfect Coverage to Problem Areas*, WIRED (Jan. 30, 2013).

¹⁰ Richard Thanki, *The Economic Significance of License-Exempt Spectrum to the Future of the Internet* (June 2012) at 8.

¹¹ NPRM ¶ 33.

¹² *Id.* ¶ 32.

¹³ Informa Telecoms & Media, *Small Cell Market Status* (December 2012).

been the savior for mobile operators looking to offload traffic from overloaded 3G and 4G networks, small cells in the 3.5 GHz band will likewise provide further consumer benefits. In a recent survey, 98 percent of mobile operators said that small cells are essential for their networks' future.¹⁴ Small cells are not just a hypothetical solution or a passing fad; it is a highly effective technology in which companies are investing substantial time and money. And companies are ready to deploy it *now*.

Small cells are especially appropriate for the 3.5 GHz band because they provide high-capacity local coverage without interfering with incumbent users. The Commission recognizes the elegance of small cell technology for this band: the chief characteristic of the band that makes it uninviting for licensed commercial mobile providers — the rapid signal decay over relatively short distances — makes it especially well-suited for high-capacity small cell coverage.¹⁵ Other mobile broadband technology cannot provide the same level of coverage in the 3.5 GHz band. In 2010, the National Telecommunications and Information Administration (“NTIA”) first identified the 3.5 GHz as potential spectrum for unlicensed devices.¹⁶ But the NTIA only analyzed the use of wide-area broadband devices. The NTIA concluded that those devices would interfere with maritime radar systems that operate on the 3.5 GHz band, and therefore recommended excluding the devices from all areas within 200 miles of coastline.

Because this would effectively exclude more than half of the country's population,¹⁷ PCAST

¹⁴ Informa Telecoms & Media, 98% of Mobile Operators Say Small Cells Essential for Future of Networks (December 4, 2012).

¹⁵ NPRM ¶ 20.

¹⁶ NTIA, An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, 4200-4220 MHz, and 4380-4400 MHz Bands (October 2010) (“Fast Track Report”).

¹⁷ NPRM ¶ 67.

considered alternatives to wide-area broadband, and concluded that small cell technology would be the most effective way to utilize the 3.5 GHz band.¹⁸ Another benefit from small cell technology in 3.5 GHz is the freeing up of additional spectrum for last-mile (and last few hundred meters) backhaul access. This is critical to drive down the cost of backhauling broadband data.

III. THE COMMISSION’S FLEXIBLE THREE-TIER PROPOSAL STRIKES THE RIGHT BALANCE BETWEEN PROTECTING INCUMBENT USERS AND ENCOURAGING NEW TECHNOLOGIES

The PCAST correctly recognized that a workable plan for the 3.5 GHz band must ensure that on the one hand the military and other incumbents have confidence that they will not experience interference, and on the other give innovators and entrepreneurs assurance that they can invest in new technologies to utilize the band.¹⁹ The NPRM strikes the right balance. The NPRM’s three-tier proposal, which includes GAA in its proposed tiers, ensures that incumbent and critical-needs users will not experience interference, and that the public, including mobile operators, can opportunistically use this spectrum for a variety of wireless applications.

Microsoft agrees that incumbent federal users should receive the highest level of protection because these high-powered radar systems are crucial to national defense.²⁰ The NPRM also correctly includes fixed satellite service earth stations in this tier.²¹

¹⁸ PCAST Report at p. 51 (“Dedicating the 3550-3650 MHz band to small cell, low power use could allow for significant reduction or even elimination of the exclusion zones.”).

¹⁹ PCAST Report at p. viii (“Before they will embrace the new system, incumbent Federal spectrum users will need to have confidence that sharing of the spectrum they have been allocated will not cause harmful interference to the technologies that they operate, and commercial operators with new technologies will need to make sure of the reliability of the spectrum access needed for their business models.”).

²⁰ NPRM ¶ 66.

²¹ *Id.* ¶ 69. In this context, Microsoft supports the Commission’s order to freeze applications for new earth stations as a necessary step to manage the interference situation.

Microsoft supports the Commission’s proposal to create a second tier of narrowly-defined “priority users,” which receive priority access in a portion of the 3.5 GHz band.²² In order to ensure that the public has the greatest access to the 3.5 GHz spectrum and that it is most intensively used, it is important that the Priority Access tier is limited to mission critical uses and to indoor or private campus use. To that end, the NPRM correctly limits this band to mission critical users and uses, and suggests that this category include hospitals, utilities, and emergency providers with a distinct need for quality of service.²³ This definition will ensure that GAA users, ranging from individual users to mobile and other network operators, have opportunistic access to all of the 3.5 GHz spectrum so long as these mission critical users are protected from harmful interference. The fairest and most administratively workable way to ensure that the public can derive the greatest benefit from the 3.5 GHz spectrum is to maximize its access for GAA users, while making a portion of the spectrum available on a priority basis for narrowly-defined mission critical uses and users.

The NPRM seeks comment on a proposal to only allow two tiers of access: Incumbents and Priority.²⁴ The two-tier proposal should be rejected since it would deprive the public entirely of the tremendous innovation and entrepreneurship that will be unleashed by creating a genuine *Citizens* Broadband Service. The two-tier proposal would take this under-utilized band and wall it off from most of the Nation’s business and residential users who could not take advantage of small cells in this new band. By allowing a second tier of exclusive use, the two-tier proposal risks creating a second set of white spaces, defeating the very purpose of

²² *Id.* ¶ 72.

²³ *Id.* ¶ 73.

²⁴ *Id.* ¶ 84.

allowing spectrum sharing in the first place. It would be a mistake for the Commission to allow for new commercial operation in the 3.5 GHz band and to leave out general devices and users.

On this point, Microsoft agrees with the conclusion in the NPRM:

We believe that for the 3.5 GHz Band to be used efficiently, we must authorize opportunistic uses beyond the Priority Access tier described above. Under our proposal, GAA devices could be used for a variety of residential, business, and enterprise purposes to offset capacity shortages and extend wireless coverage to currently unserved or underserved areas.²⁵

Only a flexible three-tier plan, as proposed by the Commission, will enable individuals (as well as technology companies and network operators) to unleash the full potential of the 3.5 GHz band.

Lastly, Microsoft urges the Commission to keep an open mind on how broadband mobile users in this band, *i.e.*, GAA users, should be regulated. The NPRM indicates support for the notion of having GAA users be licensed-by-rule under the Commission’s Section 307 authority.²⁶ The NPRM identifies some reasons why the Commission should abandon the Part 15 approach to general-use devices,²⁷ but these reasons seem small when measured against the profound change that would be realized by not using the familiar Part 15 structure for general-use devices. One argument the NPRM cites is that the Commission has used licensed-by-rule in recent years for similar services, but it bears mention that the examples cited in the NPRM — the Wireless Medical Telemetry Service, the Medical Device Radiocommunications Service, and the Dedicated Short-Range Communications Service On-Board Units — are not the same kind of

²⁵ *Id.* ¶ 75.

²⁶ *Id.* ¶ 76.

²⁷ The NPRM identifies the benefits from using a licensed-by-rule approach as (i) “allow[ing] the Commission a great deal of flexibility to establish appropriate service and allocation rules” and (ii) “promot[ing] administrative efficiency by maintaining the rules governing the Citizens Broadband Service in a single rule part.” *Id.* ¶ 62.

“opportunistic uses . . . for a variety of residential, business, and enterprise purposes” envisioned for the Citizens Broadband Service.²⁸ Accepting for now the assertion that the Commission has authority under Section 307 to adopt a licensed-by-rule approach,²⁹ we urge the Commission to proceed cautiously and to consider as well the Part 15 approach that the NPRM correctly identifies as a possible alternative.³⁰

IV. SPECTRUM SHARING IS TECHNICALLY POSSIBLE, SPECTRALLY EFFICIENT AND IN THE PUBLIC INTEREST

The most efficient and effective way to protect incumbent users from interference is to allow them to register in databases, as the NPRM proposes.³¹ The databases would ensure that small cell devices receive robust access to the spectrum without interfering with incumbent and mission-critical users, as we have already seen in the development of white space devices.³² Reliance on databases would also enable the Commission to flexibly adjust GAA device access parameters over time – for example, adjusting exclusion zones over time as receivers become better able to reject unwanted signals.

As part of an evolving and expanding shared access system, Microsoft supports the PCAST’s proposals to allow 3.5 GHz users to register in the existing white spaces databases.³³ The industry has learned much about managing spectrum through databases in the implementation of databases for the TV white spaces. This knowledge provides an excellent

²⁸ *Id.* ¶ 75.

²⁹ *Id.* ¶¶ 62-63.

³⁰ *Id.* ¶¶ 62, 86.

³¹ *Id.* ¶ 58.

³² See David Talbot, *New Airwave-Sharing Scheme Will Launch a Wireless Revolution*, MIT TECHNOLOGY REVIEW, Dec. 11, 2012 (“In some ways, the move resembles what the FCC did when it opened up so-called ‘white spaces’ -- unused bands between TV channels[.]”).

³³ NPRM ¶ 97.

starting point for a spectrum access system for the 3.5 GHz band. Permitting 3.5 GHz users to register in existing white space databases will also reduce redundancy and increase efficiency.

To ensure that small cells are deployed as quickly as possible in the 3.5 GHz band, the Commission should allow the industry to set specification standards for the databases and devices, similar what is now occurring in the TV white spaces.³⁴ As the NPRM correctly recognizes, the database “would require significant planning and testing.”³⁵ Industry is best positioned to understand the technical requirements that are necessary for spectrally effective 3.5 GHz small cells, and how to prevent that technology from interfering with incumbent users. Government-developed specifications would cause delays in deploying much-needed small cells. For example, the White Space Database Administrators already have developed a database-to-database interface specification for potential database managers, which has been submitted to the Commission. Likewise, a standardized interface is being developed for white space database to devices connectivity. A similar industry-driven approach would work for governing opportunistic access to the 3.5 GHz band.

Rather than dictating the specific technology that goes into access coordination, the Commission should ensure that the databases are run by genuinely independent private entities with the incentive to manage the spectrum in the public interest. To ensure this independence, there should be multiple commercial database managers, as in the white spaces arena. These managers should have the ability to provide access to unlicensed devices opportunistically using a variety of spectrum bands. Providing a single entity with total control over the interference database could lead to inefficiency, favoritism, and unnecessary costs.

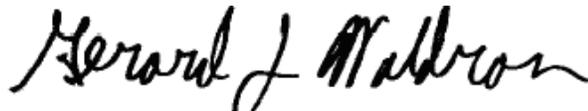
³⁴ *See id.* ¶ 98 (seeking comment on “whether the Commission, a commercial entity, or another federal entity should create and manage the SAS.”).

³⁵ *Id.* ¶ 95.



The Commission has long recognized the need for “sufficient, flexible spectrum that accommodates growing demand and evolving technologies.”³⁶ In recent years the Commission has taken major steps toward achieving this goal. Allowing small cells to operate on an unlicensed basis in the 3.5 GHz band is an important next step — not the only one, to be sure, but an important one.³⁷ Microsoft wholeheartedly supports the Commission’s efforts to make the best use of spectrum, strongly endorses creation of a Citizens Broadband Service that is actually available to the public, and looks forward to working with the staff and other stakeholders to advance this important proposal.

Respectfully submitted,



Gerard J. Waldron
Jeff Kosseff
COVINGTON & BURLING LLP
1201 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2401
202-662-6000

Counsel for Microsoft Corporation

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³⁶ Federal Communications Commission, National Broadband Plan 75 (2010).

³⁷ See Comments of Google Inc. and Microsoft Corporation, *In the Matter of Expanding Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Docket No. 12-268 (January 25, 2013) p. 5 (“Commission action to both create new unlicensed wireless designations in the 600 MHz and protect remaining white spaces in the broadcast band will promote economic growth, support innovation, and expand access to broadband.”).