

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

In the Matter of)	
)	
Wireless Telecommunications Bureau and)	GN Docket No. 12-354
Office of Engineering and Technology Seek)	RM-11788
Comment on Petitions for Rulemaking)	RM-11789
Regarding the Citizens Broadband Radio)	
Service)	

To: Chief, Wireless Telecommunications Bureau
Chief, Office of Engineering and Technology

**COMMENTS OF
THE WIRELESS INTERNET SERVICE PROVIDERS ASSOCIATION**

Alex Phillips, President
Mark Radabaugh, FCC Committee Chair
Fred Goldstein, Technical Consultant

Stephen E. Coran
Lerman Senter PLLC
2001 L Street, NW, Suite 400
Washington, DC 20036
(202) 429-8970
Counsel to the Wireless Internet Service Providers Association

July 24, 2017

TABLE OF CONTENTS

SUMMARY	iv
Introduction.....	4
Discussion.....	6
I. THE CBRS BAND PROMOTES RURAL BROADBAND AND OTHER USE CASES THAT BENEFIT THE PUBLIC	6
A. Rural Americans Continue To Lack Access To Fixed Broadband Service And Competitive Choice.....	6
B. Spectrum Is An Efficient Way To Deliver Fixed Broadband Service.....	8
C. The CBRS Band Enables Spectrum To Help Bridge The Digital Divide	9
II. THE PROPOSED CHANGES TO THE LICENSING RULES WOULD CREATE AN EXCLUSIVE AND PERMANENT BAND FOR LARGE CARRIERS AT THE EXCLUSION OF OTHERS.....	13
A. The Promise Of 5G Is An Insufficient Basis For The Commission To Preclude Other Uses.....	14
B. The Commission Should Not Adopt Petitioners’ Proposals To Increase The PAL License Term And To Add A Renewal Expectancy	17
C. The Commission Should Retain Census Tracts As The PAL Geographic Unit	20
1. Petitioners Have Not Shown That Census Tract Auctions Would Be Too Cumbersome To Implement.....	21
2. Auctioning PEAs Will Foreclose Small Companies From Participating In PAL Auctions.....	22
3. Secondary Markets Are Not An Adequate Substitute For Participation In PAL Auctions.....	25
III. THE COMMISSION SHOULD REJECT T-MOBILE’S PLAN TO FURTHER DISMANTLE THE CBRS BAND	26
A. Allowing PALs In The 3650-3700 MHz Band Will Lead To Massive Interference, Destroy Investment, Harm Consumers, And Otherwise Contravene the Public Interest.....	26
B. The Commission Should Retain Dynamic Frequency Assignment.....	30
IV. THE COMMISSION SHOULD ADOPT SOME MODEST CHANGES TO THE TECHNICAL RULES AND REJECT OTHER PROPOSALS.....	31
A. The Commission Should Retain Its Rule Providing For Limited Public Disclosure Of CBSD Registration Information	31
B. The Commission Should Not Increase The Maximum EIRP Limit For Outdoor Operations.....	31

C.	The Commission Should Modify Out-Of-Band Emission Limits For CBSDs Based On Channel Size.....	33
V.	THE COMMISSION SHOULD CLARIFY THAT THE SAS SHOULD AFFORD GAA USERS THE OPPORTUNITY TO RESOLVE CONTENTION FOR SPECTRUM.....	33
Conclusion	35

SUMMARY

In this proceeding, CTIA and T-Mobile advance ill-conceived and destructive proposals that will, if adopted, convert the Citizens Broadband Radio Service (“CBRS”) into a “5G-only” band that will decelerate the provision of fixed broadband service to those that lack access and choice, foreclose innovative uses, stifle investment, and damage the ability of existing broadband customers to continue receiving service. These proposals serve the interests of a few mobile carriers that may, someday, deploy service that today exists only as a marketing term, while those with “no G” service will continue to wait for broadband and other innovative services. CTIA and T-Mobile should not be permitted to substitute their judgment for that of the marketplace. The Commission should therefore, without delay, reject the proposed changes to the CBRS licensing rules.

The Wireless Internet Service Providers Association (“WISPA”), which represents the interests of the fixed wireless broadband industry, strongly supported adoption of the CBRS rules. WISPA views the band as a critical spectrum resource to deploying fixed broadband services in unserved and underserved areas, where wireline technologies cannot be cost-effectively installed. To this end, and as the Commission has encouraged, WISPA members have made substantial investments in equipment that can be easily software-updated to operate in the CBRS band with the Spectrum Access System (“SAS”) and Environmental Sensing Capability. A number of WISPs, venue owners, neutral host networks, and others are operating in the 3550-3650 MHz band under experimental licenses to trial equipment, determine sound network architectures, assess consumer demand, and test a host of innovative uses.

Although CTIA and T-Mobile trumpet the projected economic benefits of their proposal, their arguments fall flat. Nowhere do they attempt to ascribe any economic benefit to 5G in the

CBRS band and, more problematically, they fail to assess the costs on existing users as well as the investment, innovation, and planned deployments that would be displaced by their proposal.

CTIA and T-Mobile each argue in favor of 10-year license terms with an undefined “renewal expectancy,” coupled with Partial Economic Area (“PEA”) license areas for Priority Access Licenses (“PALs”). Taken together, these proposals would put PALs out of reach for smaller companies that simply cannot afford to compete at auction with large mobile wireless carriers for essentially permanent licenses covering hundreds of thousands of people and thousands of square miles. The longer the term, the greater the land area and the larger the population, the greater will be the cost to acquire spectrum licenses. Maintaining short-term licenses with census tracts will enable meaningful participation for PALs by all potential users – WISPs, private networks, venues, the Internet of Things, and other business cases. Spectrum disaggregation and geographic partitioning are not adequate substitutes given that PAL holders are not compelled to enter into secondary market transactions. Aggregating smaller census tracts into larger geographic areas is a much more flexible solution that will not foreclose participation in PAL auctions by businesses smaller than the cellular giants.

Nor can it be certain that census tract auctions will prove to be too cumbersome. The Commission has not proposed or adopted any auction design, and just completed the most complex spectrum auction in history to repurpose 84 megahertz of television broadcast spectrum. It is entirely premature and disingenuous for the petitioners to support their proposal with this argument.

The Commission should firmly reject T-Mobile’s separate requests to eliminate the GAA channel allocation and establish a 50-megahertz spectrum cap. These proposals constitute a transparent effort to obtain the Commission’s blessing to cause massive interference to the

customer-serving operations of existing 3650-3700 MHz licensees, to destroy private investment in deploying those services over the last nine years, and to preclude any further involvement of the smaller fixed wireless service providers and others that have been playing by the rules. Introducing PALs into a band that will then have GAA as the only commercial use after the April 2020 transition would allow new PALs to run roughshod over then-existing 3650-3700 MHz operations. Customers will then be assured of inferior service or, worse yet, no service at all (and perhaps without any other options), calling into question whether WISPs would be willing to continue to invest and provide needed service in the band. The only beneficiaries will be large mobile carriers, each with up to 50 megahertz of spectrum, that might someday deploy service. The Commission cannot seriously entertain this proposal.

The petitioners also propose changes to the SAS public disclosure rules and a few technical rules. The Commission should not modify the public disclosure rules, which set an appropriate level of disclosure of SAS information to the public. The Commission also should not increase the maximum EIRP levels, consistent with its previous decisions. The Commission should, however, modify the out-of-band emission limits for cases where contiguous channels are combined, consistent with WISPA's specific recommendations.

WISPA asks the Commission to clarify that the SAS should "facilitate coordination" among GAA Users by affording them an opportunity to resolve contention for spectrum before accepting a default solution dictated by the SAS. This clarification will ensure that GAA Users will have the right to negotiate private agreements satisfactory to them rather than accepting an automated solution that may not advance their business objectives.

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

In the Matter of)	
)	
Wireless Telecommunications Bureau and)	GN Docket No. 12-354
Office of Engineering and Technology Seek)	RM-11788
Comment on Petitions for Rulemaking)	RM-11789
Regarding the Citizens Broadband Radio)	
Service)	

To: Chief, Wireless Telecommunications Bureau
Chief, Office of Engineering and Technology

**COMMENTS OF
THE WIRELESS INTERNET SERVICE PROVIDERS ASSOCIATION**

The Wireless Internet Service Providers Association (“WISPA”),¹ pursuant to Section 1.405 of the Commission’s Rules² and in response to the *Public Notice* in the above-captioned proceeding,³ hereby strongly opposes the proposals set out in the Petitions for Rulemaking filed by CTIA⁴ and by T-Mobile USA, Inc. (“T-Mobile”),⁵ and comments on recent ex parte presentations submitted in this proceeding.

The Commission should expeditiously reject the changes to the Citizens Broadband Radio Service (“CBRS”) licensing scheme proposed by CTIA and T-Mobile. Their petitions propose to convert the CBRS band from one that fosters multiple, innovative use cases and a variety of architectures – fixed and mobile, large areas and small areas – to a band that is

¹ WISPA is the trade association that represents the interests of wireless Internet service providers (“WISPs”) that provide IP-based fixed wireless broadband services to consumers, businesses, and anchor institutions across the country. WISPA’s members include more than 800 WISPs, equipment manufacturers, distributors and other entities committed to providing affordable and competitive fixed broadband services. WISPs use unlicensed, lightly-licensed and licensed spectrum to deliver last-mile broadband and voice services to more than four million people, many of whom reside in rural areas and areas that would otherwise be unserved or underserved.

² 47 C.F.R. § 1.405.

³ See *Public Notice*, “Wireless Telecommunications Bureau and Office of Engineering and Technology Seek Comment on Petitions for Rulemaking Regarding the Citizens Broadband Radio Service,” DA 17-609 (rel. June 22, 2017).

⁴ See CTIA Petition for Rulemaking, GN Docket No. 12-354 (filed June 16, 2017) (“CTIA Petition”).

⁵ See T-Mobile Petition for Rulemaking, GN Docket No. 12-354 (filed June 19, 2017) (“T-Mobile Petition”).

available solely to meet the needs of a currently non-existent technology marketed as “5G.” If the license terms for Priority Access Licenses (“PALs”) are lengthened to 10 years and made renewable indefinitely and the size of the license areas is enlarged in the manner the petitioners suggest, smaller entities will be priced out of participating in the PAL auction, preventing the band from being used “to address the growing demand for fixed and mobile broadband capacity.”⁶ The Commission should refuse the mobile industry’s request to substitute a single 5G business model for a host of others that the marketplace may choose and at the expense of consumers that have “no G” service in their homes today.

Additional proposals proffered by T-Mobile would upset the carefully balanced, three-tier spectrum access model into a two-tier “command and control” licensing approach that the Commission previously rejected.⁷ If adopted, this recycled plan will virtually ensure that access to 150 megahertz of licensed spectrum will be limited to three large mobile carriers, cause massive interference to existing 3650-3700 MHz users and their customers, entirely eliminate the spectrum allocation for General Authorized Access (“GAA”) use, and destroy any opportunity for the band to help close the urban-rural digital divide. The Commission should refuse to entertain T-Mobile’s self-serving, preclusive, and outrageous proposal.

WISPA does not support the proposed changes to existing rules requiring the disclosure of certain CBSD registration information available to the general public and opposes any further increase in the maximum allowable EIRP limits for outdoor operations. WISPA does, however,

⁶ *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, 30 FCC Rcd 3959, 3967 (2015) (“*CBRS Order*”).

⁷ *See id.* at 3978-79.

support modification of out-of-band emission (“OOBE”) limits based on channel size and proposes specific language to amend Section 96.41(e)(1).⁸

In addition to addressing the issues presented in the petitions and the Qualcomm Letter, WISPA asks the Commission to clarify that the meaning of the term “facilitates coordination” in Section 96.53(j) requires the Spectrum Access System (“SAS”) to alert prospective GAA users about contention for spectrum and to share information between or among affected parties so that they have a defined opportunity to resolve contention through private agreements that would be reported to and incorporated in the SAS. Ongoing discussions among stakeholders have not produced a common interpretation of “facilitates coordination,” which is necessary to define the role the SAS plays in resolving contention among prospective GAA users. The Commission thus should make clear that the SAS should not substitute a default solution, dictated by the SAS, for one that parties may resolve in a manner that better addresses their business objectives.

WISPA respectfully requests that the Commission act quickly to adopt an order in this proceeding. The mere filing of the petitions has introduced uncertainty among existing and prospective users of the band, including many 3650-3700 MHz Service licensees that have made substantial investments with an eye towards using spectrum in the adjacent 3550-3650 MHz band to deploy improved service to customers and expanded service to those Americans that lack access today. By acting quickly, the Commission can limit the impact of the delay and uncertainty that the petitions have already injected.

⁸ See T-Mobile Petition at 21-22; Letter from Dean R. Brenner and John W. Kuzin, Qualcomm, to Marlene Dortch, FCC Secretary, GN Docket No. 12-354 (filed June 19, 2017) (“Qualcomm Letter”).

Introduction

WISPA has been an active participant in the proceedings leading to adoption of the CBRS rules⁹ and the grandfathering of interference protection for existing 3650-3700 MHz Service licensees.¹⁰ Even before the docket opened and before the President's Council of Advisors on Science and Technology issued its influential spectrum-sharing report,¹¹ WISPA urged the Commission to propose rules for the 3550-3650 MHz band that would permit sharing among federal and commercial fixed wireless users.¹² Subsequently, in this docket, WISPA filed several sets of Comments, Reply Comments and ex parte presentations supporting allocation of the 3550-3650 MHz band for commercial use.¹³ WISPA's advocacy focused on three critical objectives to ensure that the 3550-3700 MHz band could be used for fixed wireless broadband

⁹ See *CBRS Order; Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, 31 FCC Rcd 5011 (2016) ("*CBRS Recon Order*").

¹⁰ See *Public Notice*, "Wireless Telecommunications Bureau and Office of Engineering and Technology Announce Methodology for Determining the Protected Contours for Grandfathered 3650-3700 MHz Band Licensees," GN Docket No. 12-354, DA 16-946 (rel. Aug. 19, 2016); *Public Notice*, "Wireless Telecommunications Bureau Announces Filing Window and Procedures for 3650-3700 MHz Band Licensees to File Supplemental Information Necessary for Creating Grandfathered Wireless Protection Zones," GN Docket No. 12-354, DA 17-340 (rel. Apr. 7, 2017).

¹¹ See 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 (rel. July 20, 2012), *available at* http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf.

¹² See WISPA Comments, ET Docket No. 10-123 (filed Apr. 22, 2011). Notably, CTIA recommended that the Commission focus on spectrum below 3 GHz because spectrum above 3 GHz was not deemed to be useful for mobile broadband. See Comments of CTIA – The Wireless Association, ET Docket No. 10-123 (filed Apr. 22, 2011), at 13. No party advocated for a mobile allocation in the 3550-3650 MHz band at that time. See Comments of AT&T, ET Docket No. 10-123 (filed Apr. 22, 2011), at 7 (because "this band would also likely be allocated over a non-nationwide footprint . . . whether providers of mobile broadband services would be able to effectively offer mobile services in these bands is subject to question. . . . Still, we believe that given the substantial areas covered by exclusion zones, the most likely deployments would be fixed, rather than mobile"); Comments of T-Mobile, ET Docket No. 10-123 (filed Apr. 22, 2011), at 7 ("the spectral location of the 3550-3650 MHz, 4200-4220 MHz and 4380-4400 MHz bands make them less suitable for mobile broadband applications").

¹³ See, e.g., WISPA Comments, GN Docket No. 12-354 (filed Feb. 20, 2013); WISPA Reply Comments, GN Docket No. 12-354 (filed Apr. 5, 2013); WISPA Comments, GN Docket No. 12-354 (filed Dec. 5, 2013); WISPA Reply Comments, GN Docket No. 12-354 (filed Dec. 20, 2013); WISPA Comments, GN Docket No. 12-354 (filed July 14, 2014); WISPA Reply Comments, GN Docket No. 12-354 (filed Aug. 15, 2014); WISPA Reply Comments, GN Docket No. 12-354 (filed Jan. 12, 2016). WISPA also submitted approximately 20 ex parte letters and recently joined 16 other parties in an ex parte letter submitted on June 1, 2017. See Letter from All Points Broadband, *et al.* to The Honorable Ajit Pai, *et al.*, GN Docket No. 12-354 (filed June 1, 2017).

services: (1) the ability of 3650-3700 MHz licensees to continue to deploy service to consumers, businesses and first responders, (2) rules providing a meaningful opportunity for WISPs to access CBRS spectrum on both a Priority Access and a GAA basis, and (3) grandfathered protection rights for existing 3650-3700 MHz band users and assurance that investment would not be stranded.

In the *CBRS Order*, the Commission achieved these objectives. First, at the urging of then-Commissioner Pai, the Commission permitted existing 3650-3700 MHz Service licensees to continue to register locations to deploy expanded service to the public. As then-Commissioner Pai stated, “the *Order* now ensures that existing wireless Internet service providers can continue to deploy broadband to rural consumers rather than freezing them out during the transition to a new 3.5 GHz regime.”¹⁴ As discussed *infra*, WISPs have taken full advantage of this decision, and many more consumers now have access to affordable fixed broadband service in their homes and businesses. Second, the Commission adopted census tracts as the geographic unit for PALs, allocated spectrum for GAA use on a “license by rule” basis and established three-year PAL terms with opportunistic GAA use when and where PALs are not in use. Third, the Commission established transition and grandfathering procedures that ensure protection of existing facilities that are “in use,” in recognition that consumers would be harmed if existing services were disrupted. Taken together, this suite of policy decisions creates a framework that reduces barriers to entry and enables participation by small, rural entities that lack the resources to bid for long-term licenses with a renewal expectancy that cover large geographic areas extending beyond their service areas.

In the two years since the Commission unanimously adopted the *CBRS Order*, stakeholders have worked hard to bring the promise of the CBRS band to commercial fruition.

¹⁴ *CBRS Order* at 4142, Statement of Commissioner Ajit Pai Approving in Part and Concurring in Part.

The Wireless Innovation Forum (“WinnForum”) has made substantial progress in the development of policies and protocols for the SAS and the Environmental Sensing Capability (“ESC”) that will protect military users. The CBRs Alliance, now more than 50 strong, is focusing on the development of LTE technologies. Experimental licenses will yield important technical and market information for a wide variety of use cases.

And then . . . petitions for rulemaking appear, the mere filing of which introduce uncertainty that threaten to curb spectrum innovation, stifle investment from non-cellular providers, and deny fixed broadband service to rural Americans. Substantively, the petitions propose a twice-rejected licensing scheme that would supplant a wide variety of use cases in favor of a single “5G” model. The Commission has but one choice – to swiftly reject the disruptive and ill-conceived licensing scheme proposed by CTIA and T-Mobile and restore confidence to the market so it can refocus on the business of innovating, investing, and deploying service to those that lack broadband access and choice.

Discussion

I. THE CBRs BAND PROMOTES RURAL BROADBAND AND OTHER USE CASES THAT BENEFIT THE PUBLIC

A. Rural Americans Continue To Lack Access To Fixed Broadband Service And Competitive Choice

Recent Commission reports confirm the lack of fixed broadband availability and competition in rural areas. According to the Commission’s *2016 Broadband Progress Report*, five percent of rural Americans lack access to fixed broadband service at even 4/1 Mbps, six percent lack access to 10/1 Mbps service, and 39 percent (23 million people) lack access to 25/3

Mbps service.¹⁵ Where broadband is available to rural Americans, competition is lacking – 48 percent have access to one provider and only 13 percent have access to more than one provider.¹⁶ Only 42 percent of developed census blocks in the U.S. have access to more than one provider offering fixed broadband speeds of at least 25/3 Mbps, and only 12 percent of developed census blocks in the U.S. have access to more than one provider offering fixed broadband speeds of at least 100/10 Mbps.¹⁷ The *2016 Broadband Progress Report* also found a correlation between broadband access and household income, concluding that “[o]n average, the proportion of the population without access is highest in counties with the lowest median household population, the lowest population density, the highest rural population and the highest poverty rate.”¹⁸ And, as Chairman Pai recently stated, “[i]n urban areas 98% of Americans have access to high-speed fixed service. In rural areas, it’s only 72%. 93% of Americans earning more than \$75,000 have home broadband service, compared to only 53% of those making less than \$30,000.”¹⁹ It is likely that consumers in rural areas will be less likely to afford residential broadband service than their urban counterparts. According to the U.S. Department of Agriculture, 85.3 percent of persistent poverty counties – those that have been high in poverty over the last 30 years – are in nonmetro areas.²⁰ Chairman Pai recently summed it up:

¹⁵ *2016 Broadband Progress Report*, 31 FCC Rcd 699, 731-32 (2016). See also *id.* at 738, n.261 (average land area of census tracts without 25/3 Mbps access is 84.8 square miles compared to 5.9 square miles for census tracts with access).

¹⁶ See *id.* at 736, Table 6.

¹⁷ See “Internet Access Services: Status as of June 30, 2016,” Industry Analysis and Technology Division, Wireline Competition Bureau (April 2017) (“*2017 Internet Access Report*”), at Fig. 4. Figure 4 shows that 58 percent of developed census blocks have access to one or fewer service providers offering broadband speeds of 25/3 Mbps and 88 percent of developed census blocks have access to one or fewer service providers offering broadband speeds of 100/10 Mbps. Further, Figure 4 *overstates* the level of competition because “a provider that reports offering service in a particular census block may not offer service, or service at that speed, to all locations in the census block.” *Id.* at 6.

¹⁸ See *2016 Broadband Progress Report* at 740 (footnote omitted).

¹⁹ Remarks of FCC Chairman Ajit Pai at “Broadband for All” Seminar, Stockholm, Sweden, June 26, 2017, at 1.

²⁰ The United States Department of Agriculture, Geography of Poverty available at <https://www.ers.usda.gov/topics/rural-economy-population/rural-poverty-well-being/geography-of-poverty/> (March 1, 2017) (last visited July 15, 2017).

If you live in rural America, you are much less likely to have high-speed Internet service than if you live in a city. If you live in a low-income neighborhood, you are less likely to have high-speed Internet access than if you live in a wealthier area. The digital divide in our country is real and persistent.²¹

It cannot be disputed that there is a persistent digital divide in this country, and that rural Americans are on the wrong side of this divide. Access to spectrum for fixed broadband service is an essential ingredient for bridging that gap.

B. Spectrum Is An Efficient Way To Deliver Fixed Broadband Service

In many areas of the country, consumers can obtain access to fixed broadband service only through a WISP. A primary reason is that wired technologies such as fiber-to-the-home (“FTTH”) and cable broadband cannot be cost-effectively deployed in areas with sparse population density.²² The *Wall Street Journal* recently reported that “[r]ural America can’t seem to afford broadband: Too few customers are spread over too great a distance. The gold standard is fiber-optic service, but rural internet providers say they can’t invest in door-to-door connections with such a limited number of subscribers.”²³ According to a new report prepared by The Carmel Group, fixed wireless broadband access can be deployed at one-seventh the capital expense of FTTH and about one-fourth the capital expense of cable broadband.²⁴ Quoting a study prepared by consulting firm Wireless 20/20, RCRWireless reported that “fixed wireless could reduce capital expenditures by more than 50% for many low-density CAF II

²¹ Remarks of FCC Chairman Ajit Pai at the American Enterprise Institute, *The First 100 Days: Bringing the Benefits of the Digital Age to All Americans*, May 5, 2017, at 2.

²² See, e.g., Daisuke Wakabayashi, *Google Curbs Expansion of Fiber Optic Network, Cutting Jobs*, N. Y. TIMES, Oct. 25, 2016, available at https://www.nytimes.com/2016/10/26/technology/google-curbs-expansion-of-fiber-optic-network-cutting-jobs.html?_r=0 (last visited July 14, 2017) (“In June [2016], Google Fiber announced that it was acquiring Webpass, a company that beams high-speed internet into apartment buildings using a fiber-connected antenna. This and other wireless technologies provide a quicker and less expensive way to expand access to faster web speeds”); see also Hal Singer, *Assessing the Impact of Removing Regulatory Barriers on Next Generation Wireless and Wireline Broadband Infrastructure Investment*, (June 2017), at 32 (estimating that, even if infrastructure barriers are removed, only 71 percent of the nation’s premises will be economically viable for fiber).

²³ Jennifer Levitz and Valerie Bauerlein, *Rural America is Stranded in the Dial-Up Age*, WALL ST. J., June 16, 2017, at A1. The article estimates that it costs \$30,000 per mile to install optical fiber.

²⁴ See The Carmel Group, *Ready for Takeoff: Broadband Wireless Access Providers Prepare to Soar with Fixed Wireless*, (2017) (“Carmel Report”), at 12, Fig. 6. A copy of the Carmel Report is attached hereto as Exhibit 1.

funded high-cost rural broadband deployments.”²⁵ As Rise Broadband’s Jeff Kohler explained, “[t]he economics of the [fixed wireless broadband] business are very favorable. The reason they are is because it costs somewhere between a fifth to a tenth of the cost of building a traditional wireline network, be it cable or fiber.”²⁶ Because of the lower cost model, WISPs using spectrum for fixed wireless broadband access can begin receiving a return on investment in less than one year,²⁷ and can therefore re-invest capital into network deployment and customer acquisition.

Increasing consumer demand for bandwidth has increased congestion in unlicensed bands. With its good propagation characteristics and the promise of high spectral re-use combined with SAS interference management, the CBRS band offers a new and immediate opportunity for WISPs to invest in network upgrades that can expand the availability of reliable and affordable fixed broadband service.

C. The CBRS Band Enables Spectrum To Help Bridge The Digital Divide

In the *CBRS Order*, the Commission made clear that its rules were intended to accommodate a number of different use cases, including rural broadband access:

This regulatory adaptability should make the 3.5 GHz Band hospitable to a wide variety of users, deployment models, and business cases, including some solutions to market needs not adequately served by our conventional licensed or unlicensed rules. Carriers can avail themselves of “success-based” license acquisition, deploying small cells on a GAA basis where they need additional capacity and paying for the surety of license protection only in targeted locations where they find a demonstrable need for more interference protection. Real estate owners can deploy neutral host systems in high-traffic venues, allowing for cost-effective

²⁵ Berge Ayvazian, *Analyst Angle: 4G LTE leveraged for fixed wireless broadband in rural communities*, RCRWIRELESS, June 6, 2017, available at <http://www.rcrwireless.com/20170606/analyst-angle/20170606wireless4g-lte-leveraged-for-fixed-wireless-broadband-in-rural-communities-tag10> (last visited June 27, 2017).

²⁶ See Mike Dano, *Top 10 ISPs to watch: From C Spire to Redzone to Sonic*, FIERCE TELECOM, June 26, 2017, available at <http://www.fiercetelecom.com/special-report/top-10-isps-to-watch-from-c-spire-to-redzone-to-sonic> (last visited July 14, 2017).

²⁷ See Carmel Report at 12.

network sharing among multiple wireless providers and their customers. Manufacturers, utilities, and other large industries can construct private wireless broadband networks to automate processes that require some measure of interference protection and yet are not appropriately outsourced to a commercial cellular network. *Smart grid, rural broadband, small cell backhaul, and other point-to-multipoint networks can potentially access three times more bandwidth than was available under our previous 3650-3700 MHz band rules.*²⁸

WISPA's interest in the band is manifest not just in its long-term advocacy and its members' need for additional flexible yet affordable spectrum, but in its members' deployments in the 3650-3700 MHz band and their numerous experimental operations underway in the 3550-3650 MHz band. Since the Commission began accepting applications for nationwide non-exclusive 3650-3700 MHz Service licenses in November 2007, the Commission has granted more than 2,780 regular licenses that remain in active status and has registered more than 83,200 locations. Provided with the opportunity in the *CBRS Order* to continue to deploy fixed broadband service to consumers in the 3650-3700 MHz band, WISPs have done exactly that. Licensees include rural WISPs,²⁹ enterprise broadband providers,³⁰ energy companies,³¹ municipalities and government agencies,³² telecommunications cooperatives,³³ private networks,³⁴ resorts³⁵ and educational institutions. Since April 18, 2015 – the day after the

²⁸ *CBRS Order* at 3962 (emphasis added).

²⁹ Examples include Sacred Wind Communications, Inc. (Call Sign WQII541) with 753 locations (many that are on or near Tribal lands), Kansas Broadband Internet, Inc. (Call Sign WQHV739) with 35 registered locations, Bug Tussel Wireless LLC (Call Sign WQIB703) with 54 locations, and Softcom Internet Communications, Inc. (Call Sign WQIG223) with 803 locations,

³⁰ For example, BOB, LLC dba Business Only Broadband (Call Sign WQIF263) has 54 registered locations at buildings in the Chicago and Milwaukee areas. KGT, LLC (Call Sign WQHV407) has 17 registered locations and serves businesses in the Phoenix area.

³¹ Chevron USA Inc. (Call Sign WQHV404) was one of the first licensees in the band. It has registered more than 600 locations. ConocoPhillips Communications Inc. (Call Sign WQJC317) has 78 registered locations. San Diego Gas & Electric (Call Sign WQJD279) has 50 registered locations. RigNet Satcom, Inc. (Call Sign WQIQ622) provides services to oil rigs in the Gulf of Mexico.

³² Examples include the City of Houston, Texas (Call Sign WQJC308) with 1707 registered locations and the Utah Department of Transportation (Call Sign WQKL878) with 12 registered locations..

³³ Examples include Farmers Telecommunications Cooperative, Inc. (Call Sign WQID246), a rural cooperative based in Rainsville, Alabama, with registered 15 locations, Red River Telephone Association (Call Sign WQII527), based in Abercrombie, North Dakota, with 28 locations and Gardonville Cooperative Telephone Association (Call sign WQID890), based in Brandon, Minnesota, with four registered locations.

³⁴ For example, NASCAR (Call Sign WQJJ961) has 30 registered locations at race tracks around the country.

Commission froze the issuance of new licenses in the band – the Commission has registered more than 23,300 locations, none of which is eligible for grandfathered interference protection.³⁶

What are the primary drivers of this rapidly increasing use of the 3650-3700 MHz band? First, consumer demand, particularly in unserved rural markets, is fueling deployment by fixed wireless broadband providers. In many locations, wireline technologies are simply too expensive to deploy, leaving fixed wireless as the only affordable low-latency broadband access solution. Second, licensees are deploying LTE-based equipment and other equipment that can be software upgraded to incorporate operations in the 3550-3650 MHz band in conjunction with the developing SAS and the ESC. Licensees have deployed thousands of sites serving tens of thousands of customers and made equipment design, investment, and deployment decisions in reliance on the certainty of the CBRS rules. Third, competition among LTE manufacturers is also reducing equipment costs and promoting innovation, for the benefit of service providers and the consumers and applications they serve.

Interest among rural broadband providers and other licensees is not confined to the 3650-3700 MHz band. For WISPs, the ability to use LTE-based equipment and to increase spectrum capacity from small channels in 3650-3700 MHz to wider channels in 3550-3700 MHz on either a PAL or GAA basis *without purchasing or changing out base station or customer premise equipment* (“CPE”) is driving substantial investment and deployment. One LTE manufacturer recently reported that its customers are installing more than 300 base stations per month in the United States. Factoring in other equipment manufacturers, that number is likely much higher.

³⁵ Resort Broadband, Inc. (Call Sign WQHV745) has registered 67 locations in the Steamboat Springs, Colorado area. ResortNet, LLC (Call Sign WQJC428) has four registered locations at Keystone and Breckenridge, Colorado.

³⁶ See 47 C.F.R. § 90.1307(b) (generally prohibiting Commission from granting new licenses or license renewals after April 17, 2015, with limited exceptions).

Despite this interest and growth in the wireless infrastructure ecosystem, the petitioners pretend that 5G is the only viable use of the CBRS band. CTIA trumpets the fact that AT&T and Verizon have obtained experimental authorizations to test 5G radio systems in the 3.5 GHz band.³⁷ But CTIA ignores the fact that many other entities also have obtained experimental authorizations to trial equipment and technology in the band for purposes other than testing 5G radio systems. The examples listed and summarized in Exhibit 2 illustrate that “significant effort and investment has already occurred for the CBRS band by companies across the communications sector based on the current rules.”³⁸

As is readily apparent, industry is responding to the “regulatory adaptability” the Commission established as a linchpin of the CBRS band. Ongoing operations in the 3650-3700 MHz band can be easily transitioned for use across the entire 150 megahertz of spectrum for rural broadband deployment and other beneficial uses, consistent with the Commission’s encouragement for “Grandfathered Wireless Broadband Licensees to procure equipment with an eye toward complying with the Part 96 technical rules once the transition is completed.”³⁹ Significant investments have been made in reliance on the CBRS rules adopted in 2015 as broadband providers prepare to expand their networks and increase throughput by incorporating the 3550-3650 MHz band into their spectrum toolboxes. Technology and market trials demonstrate significant investment and innovation for private networks, venues, neutral hosts, and a large variety of other use cases.

When the Commission adopted the *CBRS Order*, Commissioner O’Rielly stated that “[s]ometimes, too much experimentation can harm and ultimately delay successful deployment

³⁷ See CTIA Petition at 4.

³⁸ See Letter from Kalpak Gude, Dynamic Spectrum Alliance President, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 17, 2017). The Commission’s database includes a number of pending applications for experimental licenses in the 3550-3650 MHz band.

³⁹ *CBRS Order* at 4079.

of new services.”⁴⁰ As the above discussion makes clear, however, successful deployment is already widely occurring, awaiting only final SAS, ESC, and equipment certifications, all of which are now in process.

II. THE PROPOSED CHANGES TO THE LICENSING RULES WOULD CREATE AN EXCLUSIVE AND PERMANENT BAND FOR LARGE CARRIERS AT THE EXCLUSION OF OTHERS

If the proposals in the CTIA and T-Mobile petitions to modify the licensing rules are adopted, the Commission will be repressing the innovative services that are already in trial, destroying investment and, perhaps worst of all, telling millions of rural Americans that they will need to wait longer to obtain affordable broadband service in their homes and businesses. These outcomes would sharply contradict Commissioner O’Rielly’s prescient observation about how the CBRS rules should be implemented: “The Commission ought to encourage a diverse array of business models. Many entrepreneurs, *even those living in rural communities*, have told me of their strong preference for PALs, which they explain would ensure better reliability and quality of service.”⁴¹ The Commission should remain mindful of these words as it considers the unavoidable impact of the petitioners’ proposals.

CTIA, and more egregiously T-Mobile, propose a complete reversal of the licensing scheme the Commission crafted and unanimously approved just two years ago. They each propose to authorize PALs for 10-year terms with some sort of undefined renewal expectancy.⁴² They each propose Partial Economic Areas (“PEAs”) as the geographic bidding unit for PALs.⁴³ Going way beyond these objectionable proposals, T-Mobile proposes to eliminate GAA channels altogether, add PALs to the 3650-3700 MHz portion of the band, set a PAL cap of 50 megahertz,

⁴⁰ *Id.* at 4144, Statement of Commissioner Michael O’Rielly Approving in Part and Concurring in Part.

⁴¹ *Id.* (emphasis added).

⁴² See CTIA Petition at 6-9; T-Mobile Petition at 11-13.

⁴³ See CTIA Petition at 9-11; T-Mobile Petition at 16-19.

and eliminate dynamic frequency assignment in favor of specific frequency assignments for PALs.⁴⁴ All of these proposals must be rejected as soon as possible.

Indisputably, the combined effect of these changes will create a 3550-3650 MHz band that will be available exclusively for use by a few large mobile carriers. Greatly increasing both license terms and geographic license areas will make it impossible for WISPs and other smaller entities desiring to serve smaller geographic areas to even bid at a PAL auction. It is obvious that it will cost less for a bidder to acquire a PAL for six years in a census tract with 4,000 persons than it will to acquire a PAL in perpetuity in a PEA with hundreds of thousands of people. And it is also obvious that the higher stakes will favor bidders that can spend billions of dollars on spectrum for large areas over small ones that cannot. The undefined “renewal expectancy” will ensure that there will never be an opportunity for this to change.

Worse still, eliminating the GAA spectrum allocation in the 3550-3650 MHz band and allowing PALs into the 3650-3700 MHz band will introduce massive, unchecked harmful interference to existing operations as PALs overwhelm post-transition GAA use of grandfathered operations. Most assuredly, beginning in 2020, customers would lose service from, perhaps, the one provider actually able to serve them. That T-Mobile has even proposed this licensing model raises questions about the wisdom of WISPs and others continuing to invest and deploy service in a band that may soon be unavailable to them and their customers.

A. The Promise Of 5G Is An Insufficient Basis For The Commission To Preclude Other Uses

As grounds for their claims that the Commission should effectively bar other uses from the CBRS band, CTIA and T-Mobile tout global interest in using mid-band spectrum for 5G.⁴⁵ There are several flaws with this speculative argument.

⁴⁴ See T-Mobile Petition at 9-11, 15-16.

First, CTIA and T-Mobile presume that there is demand for 5G and that such demand is so great that the Commission should ignore the consumer benefits of all other uses. The discussion in Part I, *supra*, makes clear that the Commission's rules contemplate and are intended to facilitate a wide variety of innovative services, not just some amorphous "5G" standard, which at this point is little more than a basket of ideas including both incremental advancements in 4G technology with the use of the very dissimilar, short-range-only millimeter waves. In fact, neither CTIA nor T-Mobile even acknowledges the host of other services enabled by the CBRS rules or the possibility that 5G services "could share common wireless technologies"⁴⁶ and can co-exist with other uses.

Second, although the petitioners make claims about the impact of 5G on economic growth,⁴⁷ their data is both misleading and tone deaf to other consumer benefits that can't always be measured in financial projections. Notably, their projections estimate growth for 5G generally and not 5G within the CBRS band, so their assumptions necessarily overstate the impact on economic growth. But more importantly, neither petitioner attempts to quantify the adverse economic impact on those rural consumers who will continue to reside on the wrong side of the digital divide because the CBRS spectrum resource is unavailable to them. With WISPs conducting technical and market trials in the 3550-3650 MHz band and working every day to provide affordable service to the 23 million rural Americans who lack 25/3 Mbps broadband and others that lack competitive choice, it cannot be denied that restricting CBRS to 5G will delay deployment of fixed broadband service. Nor have the petitioners assessed the economic and human impact foreclosing private networks, Internet of Things ("IoT"), neutral host networks,

⁴⁵ See CTIA Petition at 3-6; T-Mobile Petition at 5-9.

⁴⁶ *CBRS Order* at 3962.

⁴⁷ See CTIA Petition at 8.

and other innovative uses. Simply stated, the petitioners cannot reliably quantify the claimed economic benefits and don't even bother to assess the costs.

Third, T-Mobile brazenly states that “[i]mproving the use of the 3.5 GHz band for licensed use, which can be integrated into existing networks to support 5G operations, *is the best way* to encourage investment in the spectrum.”⁴⁸ But the number and variety of experiments that are underway or being planned casts substantial doubt on the veracity of this unsupported statement.⁴⁹ The Commission should not be misled into believing that there is one, and only one, best business model that will encourage investment.

Fourth, comparisons to the 5G initiatives of other countries are entirely unavailing.⁵⁰ Unlike other countries, in the United States the 3.5 GHz band is shared with earth station licensees and ground-based and shipborne military radar systems. This necessitates use of an SAS and ESC to control spectrum access in areas where about half of the U.S. population resides. Moreover, neither CTIA nor T-Mobile has made the case that changing a licensing system – and evicting all other use cases in the process – is a requirement for 5G.

Fifth, claims of the potential for explosive 5G use are overstated. A recent analysis concluded that policymakers must be careful when relying on spectrum forecasts, stating that “[o]verestimating the growth of mobile network traffic and focusing on exclusive-use licenses, for example, can crowd out other types of wireless communication by increasing scarcity.”⁵¹ The Commission should not accept at face value predictions about the need for exclusive-use spectrum, especially where, as here, other viable and beneficial services would be victimized.

⁴⁸ T-Mobile Petition at 8 (emphasis added).

⁴⁹ See Exhibit 2.

⁵⁰ See CTIA Petition at 4-6; T-Mobile Petition at 6-7.

⁵¹ Aalok Mehta & J. Armand Musey, CFA, JD/MBA, *Overestimating Wireless Demand: Policy and Investment Implications of Upward Bias in Mobile Data Forecasts*, 23 CommLaw Conspectus 300, 307 (2015) (citation omitted).

In sum, the petitioners have not and cannot make the case that converting the licensing scheme to a “5G-only” band will promote the public interest. While there may be benefits associated with 5G at some point in the future, that does not mean that the CBRS band should be *de facto* re-designated to a single-purpose band, and that other use cases and associated consumer benefits should be displaced or ignored.

B. The Commission Should Not Adopt Petitioners’ Proposals To Increase The PAL License Term And To Add A Renewal Expectancy

Extending PAL terms to 10 years and adding a renewal expectancy will undoubtedly drive up the price of PALs to amounts that small providers will be unable to afford. It goes without saying that a 10-year license – or as proposed, effectively a permanent license – will cost significantly more at the outset than a shorter-term license. Through the mechanism the Commission adopted, shorter term licenses offer a “pay as you go” option for those PAL holders that would like to extend their licenses beyond the initial six years, concluding that “time-limited PALs will promote investment by traditional and non-traditional providers of wireless broadband service.”⁵² The Commission’s present method is designed to make PALs available to those who would actually use them, while a renewable 10-year license would become yet another speculative asset.

WISPA is unsympathetic to the petitioners’ complaints about the length of time it will take for “standards development, certification, and production of new equipment, and the introduction of a new frequency band into end-user devices”⁵³ and “the economics of deploying a vast network of small cells.”⁵⁴ Rural broadband providers can deploy in the CBRS band almost immediately – much certified 3650-3700 MHz equipment can be easily modified for

⁵² *CBRS Order* at 3996.

⁵³ CTIA Petition at 7.

⁵⁴ *Id.* at 8. See T-Mobile Petition at 11-12.

operations in the CBRS band with the SAS, the LTE standard is already built into equipment (and some manufacturers will continue to utilize proprietary equipment), and CPE is in place. So, while a single business model – 5G – may be several years away from deployment, that is certainly not true with higher power fixed deployments and other use cases. And, even if CTIA’s argument has any resonance, equipment certifications and SAS/ESC approval will be in place before PALs are auctioned. Any delay in standards development that compromises small cell deployment will stem from the industry’s failures, not the Commission’s, and should not delay the Commission’s auction of PALs that can be put to use in targeted areas much sooner.

CTIA also argues that “an auction is not necessary to achieve market-oriented reassignment of spectrum” because the “Commission adopted secondary market rules for that purpose.”⁵⁵ This is misleading. First, the Commission decided to permit only leasing of *entire* PAL areas, and expressly prohibited partitioning and disaggregation, so the full scope of secondary market transactions is not available in the CBRS band.⁵⁶ Second, there is no obligation on the part of PAL holders to lease their spectrum to third parties. This is true for all licensed bands, and there are cases where licensees choose to retain unused spectrum rather than lease it to third parties that would deploy commercial service. Third, assuming PAL holders decide to lease, partition or disaggregate spectrum, the universe of potential third parties will be markedly smaller because, under the rules proposed by CTIA and T-Mobile, the use cases would be substantially limited and the market for other equipment will erode.

Tellingly, neither CTIA nor T-Mobile attempt to define the “renewal expectancy” they seek. In other services, the Commission has established “substantial service” or construction thresholds, required showings that identify where facilities are located and certifications

⁵⁵ CTIA Petition at 8.

⁵⁶ See *CBRS Recon Order* at 5070.

regarding compliance with Commission rules as conditions to license renewal.⁵⁷ Without any build-out requirements in CBRS, CTIA and T-Mobile beg, but do not answer, the question of what would be required to renew a PAL. The lack of any suggested “renewal expectancy” standard suggests that there would be no standard – just file a bare-bones renewal application and the license is renewed for ongoing consecutive 10-year terms *ad infinitum*.⁵⁸

CTIA further asserts that a 10-year license term with a renewal expectancy would conform the licensing scheme to the Commission’s “proven approach in many other bands.”⁵⁹ But this is precisely the point – CBRS was never intended to promote the “same old, same old” licensing scheme that leads to a few large companies holding permanent licenses at the exclusion of others that might seek to bid or lease. Rather, the Commission wanted to see the band used for “a wide variety of users, deployment models, and business cases,”⁶⁰ and that is what is emerging – rural broadband, private networks, venues, IoT, and other uses are in trial operations and poised to deploy for the benefit of consumers. These consumers should not be forced to sit on the sidelines while the mobile industry warehouses spectrum and figures out a 5G standard, develops handsets, designs networks, obtains access to sites, and finally deploys (and maybe then not even to rural areas).

In its April 7, 2017 ex parte letter, WISPA stated that it would not oppose a very modest increase in the license term to five years for some, but not all PALs, with the opportunity for

⁵⁷ See, e.g., 47 C.F.R. § 27.14.

⁵⁸ WISPA notes that the Commission has released a draft order that would, if adopted in its present form, establish “safe harbors” for expedited renewal, *but this proceeding specifically excludes CBRS*. See *Amendment of Parts 1, 22, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services*, Second Report and Order and Further Notice of Proposed Rulemaking, WT Docket No. 10-112, FCC-CIRC1708-05 (July 13, 2017), at Appendix I.

⁵⁹ CTIA Petition at 9.

⁶⁰ *CBRS Order* at 3962.

renewal.⁶¹ WISPA explained that “terms in excess of five-years would likely make the cost of PALs too expensive for smaller entities seeking protected spectrum in order to provide high-quality, competitive services.”⁶² The Commission could, if the record supports, retain its three-year terms for some PALs and adopt five-year terms for other PALs. WISPA also suggested that “PALs could be renewed upon payment of a fee based on the auction price paid by the PAL holder (i.e., some amount above 100% of the winning bid). This would preserve opportunistic GAA use of PALs when and where they are not used and avoid the need for Commission staff review of build-out obligations upon PAL expiration.”⁶³ If it determines that PALs should be renewable, the Commission should consider these modest changes in order to ensure greater certainty that “the underlying spectrum assets . . . will continue to be available.”⁶⁴ But any changes to the PAL licensing model must be strictly confined to the limited extent suggested by WISPA.

C. The Commission Should Retain Census Tracts As The PAL Geographic Unit

Both CTIA and T-Mobile ask the Commission to assign PALs on a PEA basis rather than by census tract.⁶⁵ If the Commission somehow believes this proposal has merit, it will send a clear and unfortunate message to millions of rural Americans that the CBRS spectrum resource will be unable to serve as a fixed broadband access platform. Simply put, requiring PALs to be auctioned by PEAs will exponentially increase the geographic area and population of auctioned spectrum, dramatically increase the cost of PALs, and assuredly foreclose participation by smaller providers that have a desire to serve smaller areas and lack the ability to bid against T-Mobile and its multi-billion dollar mobile wireless competitors for areas that far exceed the size

⁶¹ See Letter from Stephen E. Coran, WISPA Counsel, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed Apr. 7, 2017).

⁶² *Id.* at 2.

⁶³ *Id.* at 2-3.

⁶⁴ T-Mobile Petition at 12.

⁶⁵ CTIA Petition at 9-11; T-Mobile Petition at 16-19.

of smaller, targeted areas. This problem is exacerbated by orders of magnitude when combined with the petitioners' proposals to lengthen the license terms to 10 years and to add a renewal expectancy that would essentially make PALs permanent. The Commission should reject this proposal.

1. Petitioners Have Not Shown That Census Tract Auctions Would Be Too Cumbersome To Implement

CTIA and T-Mobile attempt to bolster their ill-conceived proposal with a few transparent arguments that reveal their “5G-only” model. They contend that auctioning up to seven PALs in 74,000 census tracts is a “complicated licensing scheme”⁶⁶ that will require carriers to evaluate each census tract⁶⁷ and challenge SAS administrators and licensees.⁶⁸ These arguments are speculative, unsupported, and at best premature. The Commission has not even sought comment on the auction design it proposes to employ, but CTIA and T-Mobile apparently want the Commission to believe that a simultaneous, multi-round auction design is the only option. One alternative model the Commission could employ would be a one-round, sealed bid auction that would be very simple to administer. Any eligible party could submit a single bid for its desired census tract, and the Commission would select the seven highest bids. Or the Commission could implement a rolling auction that makes PALs in some geographic areas available for bid before others, thereby reducing the inventory of census tracts in subsequent auctions until all PALs in all census tracts were auctioned. Other innovative auction designs are also possible. In sum, if necessary, there are ways to make the auction less complicated than the petitioners imply. Even so, it cannot be presumed that conducting a simultaneous, multi-round auction would be overly complicated. The Commission recently completed the broadcast incentive auction, which is

⁶⁶ CTIA Petition at 9; T-Mobile Petition at 16.

⁶⁷ See T-Mobile Petition at 16.

⁶⁸ See CTIA Petition at 9.

universally regarded as the most complex spectrum auction in history. If the Commission can construct a complex reverse and forward auction that enables companies like T-Mobile to spend billions of dollars on licenses, it can certainly design and implement auctions for census tracts.

Further, CTIA presents no evidence to support its claim that SAS administrators will find it “unnecessarily challenging” to manage census tract licensing.⁶⁹ That more than 10 parties have submitted applications to be SAS administrators *under existing census tract licensing rules* should provide ample evidence that CTIA’s speculative argument is unfounded.

2. Auctioning PEAs Will Foreclose Small Companies From Participating In PAL Auctions

CTIA and T-Mobile assert that “PEAs offer sufficient licensing flexibility.”⁷⁰ Not surprisingly, they point to language from the broadcast incentive auction proceeding to support their definition of “flexible”⁷¹ and note that PEAs nest within even larger geographic bidding units the Commission has in the past auctioned.⁷² But this entirely ignores the fact that PEAs were intended to promote advanced mobile services such as 5G and the CBRS band was never intended to be auctioned solely for mobile networks that require larger footprints. The notions of “targeted” and “localized” areas mean one thing to large mobile wireless carriers and quite something else to rural broadband providers, private networks, airports, campuses, shopping malls, electric grids, stadia and arenas, and a host of other use cases that do not divide the country into 416 geographic areas that are too large for their service needs and too expensive for their wallets.

⁶⁹ *Id.*

⁷⁰ CTIA Petition at 10; T-Mobile Petition at 17

⁷¹ See T-Mobile Petition at 17, *citing* Letter from Rebecca M. Thompson, CCA General Counsel, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-268 (filed Nov. 27, 2013), at 2.

⁷² See T-Mobile Petition at 18.

That PEAs will be too large to enable auction participation by WISPs and other small entities is a foregone conclusion. Overall, 337 of the 416 PEAs have a population of more than 100,000, whereas the optimum population of census tracts is about 4,000.⁷³ As one example, PEA 278 covers 5,880 square miles and a population of 179,889 in 10 mostly rural counties in Southeastern Kansas and Northeastern Oklahoma. Within PEA 278 are 60 census tracts, with an average population of about 3,000. Applying the petitioners' rationale, a WISP or other bidder seeking to cover a private venue or to serve a farm with agricultural management services with PAL spectrum in one or a few census tracts where demand exists would be forced to be the highest bidder for the entire PEA of 179,889 people and 5,880 square miles.

Undoubtedly, that bidder would be unsuccessful. The results of the broadcast incentive auction illustrate that ultimate outcome. In that auction, the first to use PEAs, the vast majority of licenses were acquired by multi-billion dollar global and nationwide companies. Of the 2,776 licenses that were auctioned, 2,295 were won by just five bidders – T-Mobile, DISH Network, Comcast, AT&T and U.S. Cellular, with T-Mobile itself acquiring more than 50 percent of the licenses. The other 45 winning bidders accounted for the remaining 481 licenses. All told, more than 82 percent of the 600 MHz PEA licenses were bought by just five companies, all of which are large, well-entrenched mobile wireless or broadband providers.⁷⁴ If small companies cannot participate in the CBRS auction, a similar outcome will no doubt result. If T-Mobile's proposal to eliminate the GAA tier and set a 50-megahertz cap is adopted, the concentration of entities holding PALs will be even greater.

Licensees holding PEA-sized areas are also likely to concentrate their deployments in the most urbanized areas within each PEA. Of the 74,000 total census tracts, 59,487 have a land

⁷³ See *CBRS Order* at 3991 & n.223.

⁷⁴ See *Public Notice*, DA 17-314 (rel. Apr. 13, 2017), at Appendix B.

area of less than 64 square kilometers. Collectively, these PEAs hold 80 percent of the population, yet occupy only 5.4 percent of the land area. Lower frequency bands including 600 MHz, 700 MHz, 800 MHz cellular, PCS, AWS-1, and AWS-3 all have better mobile propagation characteristics and thus can enable mobile service at a lower cost than CBRS. The value of CBRS to a mobile operator is primarily, then, for small cell deployments in urban areas, where its locality may be used to advantage, and where census tracts are smaller. Conversely, fixed deployments by rural WISPs have a longer range, due to the use of directional-gain antennas at the CPE.

The consequences of auction foreclosure extend beyond the obvious problems of license concentration and business models that will not get off the ground. WISPA members are preparing to participate in the Commission’s upcoming Connect America Fund (“CAF”) Phase II reverse auction,⁷⁵ and are focusing on using CBRS spectrum to meet the performance and build-out requirements to serve identified unserved rural areas. While GAA might be usable for some such deployments, PALs provide protection against interference that improves the quality of broadband service. There is thus an interrelationship between the ability to deploy fixed broadband on CBRS spectrum and the opportunity to obtain federal subsidies to help offset deployment costs and accelerate broadband deployment to defined unserved areas. Another aspect of this interrelationship is that the Commission has tentatively proposed to accept CAF bids for eligible census blocks within census block groups for the CAF auction.⁷⁶ Because census block groups nest within census tracts, the opportunity for a WISP to bid on similar – if

⁷⁵ See *Connect America Fund*, 32 FCC Rcd 1624 (2017).

⁷⁶ See *Connect America Fund*, 31 FCC Rcd 5949, 5979 (2016); *Fact Sheet and Draft Public Notice*, “Comment Sought on Competitive Bidding Procedures and Certain Program Requirements for the Connect America Fund Phase II Auction (Auction 903),” AU Docket No. 17-182, FCC-CIRC1708-01 (rel. July 13, 2017), at 4-5 (“Bidding at the census tract level could be particularly problematic for small providers that may seek to construct smaller networks or expand existing networks because a larger minimal geographic area, *like a census tract or county*, may extend beyond a bidder’s service territory, franchise area, or license area”) (emphasis added).

not identical – small, targeted geographic areas provides a means for efficient deployment of fixed broadband service to unserved Americans. Adopting the petitioners’ proposals will destroy this opportunity as well.

3. Secondary Markets Are Not An Adequate Substitute For Participation In PAL Auctions

Allowing partitioning and disaggregation of PEAs would not, as T-Mobile suggests, “allow the marketplace [to] determine the most effective use of spectrum.”⁷⁷ To the contrary, without a build-out requirement, and with the ability to displace opportunistic GAA use when mobile carriers finally overcome the delays they assert, there is no real incentive for holders of PEAs to engage in secondary market transactions. As has been the case historically, large carriers acquire licenses for large areas, build out in the urban core where the population is more dense, and warehouse spectrum in rural areas that could be used for broadband deployment. A far better alternative – the one the Commission adopted in the *CBRS Order* – is to auction census tracts to enable PAL holders to aggregate census tracts if they so desire. Not only does this create incentives to build out, it also avoids the need for parties to negotiate partition and disaggregation agreements and make administrative filings to report the transactions, and for the Commission to expend administrative burdens in processing those filings.

CTIA states that “smaller, micro-targeting providers willing to operate on the GAA tier can gain access to 3.5 GHz spectrum on a GAA basis.”⁷⁸ Ignoring the circular reasoning, not all small providers view GAA as an adequate substitute for the exclusive rights that PALs confer and the benefits of protected spectrum to investment and to quality of service. In some cases PALs and GAA will be complementary. As WISPA’s participation throughout this proceeding illustrates, and as the experimental licenses and standards development process illustrate, there is

⁷⁷ T-Mobile Petition at 19. *See also* CTIA Petition at 10-11.

⁷⁸ CTIA Petition at 11.

great interest among WISPs to acquire PALs. Suggesting that they be relegated to the GAA tier shows that CTIA well understands the inevitable outcome if PALs are auctioned on a PEA basis – small companies will be confined solely to GAA status when and where PALs are not in use. That result would fly in the face of the Commission’s objectives and thumb a nose to other use cases.

III. THE COMMISSION SHOULD REJECT T-MOBILE’S PLAN TO FURTHER DISMANTLE THE CBRS BAND

T-Mobile makes additional proposals to deconstruct the three-tier CBRS licensing model and convert it into a “5G-only” band for three large mobile wireless carriers. Amplifying its obvious disdain for other use cases and, in particular, service to rural Americans that lack fixed broadband access, T-Mobile asks the Commission to eliminate the GAA spectrum allocation and designate the entire 150 megahertz of spectrum for auctioned PAL use.⁷⁹ T-Mobile also proposes to establish a 50-megahertz spectrum cap to accommodate three licensees. Taken together, T-Mobile’s proposal would convert the CBRS to another garden variety “command and control” licensed band, a scheme diametrically opposed to the model the Commission adopted just two years ago based on a full and complete record. The Commission should quickly dismiss this proposal, which would change the fundamental purpose of the band.

A. Allowing PALs In The 3650-3700 MHz Band Will Lead To Massive Interference, Destroy Investment, Harm Consumers, And Otherwise Contravene the Public Interest

Incredibly, T-Mobile asserts that “designating additional spectrum for PALs will *broaden* the CBRS experiment, allowing for greater testing of an environment with both PAL and GAA operations.”⁸⁰ T-Mobile’s myopic view of the band brushes aside the existing users of the 3650-3700 MHz band that have been serving customers since as far back as 2008 – well beyond any

⁷⁹ See T-Mobile Petition at 9-11.

⁸⁰ *Id.* at 10 (emphasis in original).

experimental stage – who will lose all interference protection and suffer massive interference as PALs intrude on their GAA operations. In addition, T-Mobile ignores other uses that can co-exist with non-opportunistic use of the band on spectrum allocated for GAA use.

T-Mobile is simply wrong in its belief that converting the band to 150 megahertz of exclusively licensed spectrum will have positive effects.⁸¹ Its proposal will *not* “limit incentives to invest and inhibit technological growth;”⁸² instead, it will result in massive interference to consumer services, destroy innovation, wipe out investment, and foreclose use by anything other than 5G. Its proposal will *not* preserve GAA for opportunistic use in a way that will enable innovation;⁸³ instead, without allocation of channels for only GAA use, any remaining opportunistic use of GAA would be extremely limited. And its proposal most certainly will not benefit the public interest; instead, it will serve the private interests of a few large mobile carriers at the expense of rural Americans.

In a clumsy effort to salve the wounds of existing 3650-3700 MHz Service licensees, T-Mobile proposes to allow Grandfathered Wireless Broadband Licensees in the 3650-3700 MHz band to be protected “consistent with the current rules.”⁸⁴ Under those rules, following the transition of Part 90, Subpart Z rules into Part 96, the 3650-3700 MHz band will include only incumbent earth station licensees, grandfathered GAA uses and non-grandfathered GAA operations.⁸⁵ The Commission wisely decided to not permit PALs in the 3650-3700 MHz band so that grandfathered operations could be maintained without existing service to the public being disrupted.⁸⁶ The Commission also permitted grandfathered equipment to operate in only the

⁸¹ *See id.*

⁸² *Id.* at 9.

⁸³ *See id.* at 10.

⁸⁴ *Id.*

⁸⁵ *See* 47 C.F.R. § 96.11.

⁸⁶ *See CBRS Order* at 4074.

3650-3700 MHz segment of CBRS, exempt from the requirement to be able to operate anywhere in the band. In reliance on these rules, and as the Commission observed, there have been “substantial investments in equipment deploying various services in the band.”⁸⁷

T-Mobile’s statement that protection would be “consistent with the current rules” means that all Grandfathered Wireless Broadband Licensees operating post-transition *on a GAA basis* would be subject to massive interference from PALs that would populate the band, or would be required to exit the band if they should cause interference to PALs. This is exactly the situation the Commission sought to avoid when it established the grandfathering and Part 90 transition processes, stating that “our decision not to allow Priority Access use in the 3650-3700 MHz band segment means that *this portion of the band will continue to be licensed on a non-exclusive basis* and thus will continue to be available on a non-exclusive basis to former Part 90 incumbents.”⁸⁸

Unapologetically, T-Mobile has not proposed to make any accommodation for Grandfathered Wireless Broadband Licensees then operating on a GAA basis. If T-Mobile gets its way and PALs are permitted in the 3650-3700 MHz band segment, tens of thousands of consumers receiving fixed broadband and other services from thousands of registered base stations and CPE will lose service entirely or suffer massive interference from new PALs.⁸⁹ T-Mobile will then have succeeded in evicting fixed wireless licensees, stranding investment, and disrupting service to consumers that may lack choice in fixed broadband access. Even if Grandfathered Wireless Broadband Licensees were to retain PAL status post-transition – something that T-Mobile does *not* propose – existing licenses would be confined to their existing operations with no ability to use additional spectrum for GAA in the 3650-3700 MHz band given

⁸⁷ *Id.*

⁸⁸ *Id.* (emphasis added).

⁸⁹ See Letter from Brett Kilbourne, Utilities Technology Council Vice President, Policy and General Counsel, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 14, 2017) (citing the 3.5 GHz band “as another example of where incumbent utility operations are threatened by interference”).

the presence of higher-tier PALs and no assurance of any GAA availability. Eventually, in areas where interference might be tolerable, the existing ecosystem will dry up as manufacturers turn their attention to other bands and stop supporting legacy equipment.

Few will choose to invest in developing equipment to use on a purely opportunistic GAA basis because there will be no guarantee that any GAA spectrum will be available to it should the PEA licensee build out near its area of operation. A GAA operator thus would have to shut down, rather than move to other GAA spectrum. This creates an unacceptable risk to investment – who would invest in a band when at any moment they could find themselves with no usable frequencies?

And with the cabal of three carriers controlling most if not all of the band for 5G, more equipment vendors will be likely to exit, rather than enter, the market, as large carriers tend to make volume purchases from a small number of large suppliers. With only three licensees, there will be fewer users of the SAS, and it can also be expected that many SAS administrators will disappear or be unable to compete with the few remaining SASs.

WISPA also disputes T-Mobile’s unsupported claim that eliminating the GAA spectrum allocation “will likely generate additional auction revenue.”⁹⁰ By foreclosing participation for all but a handful of bidders, there will be fewer bidders competing for PALs, which will tend to drive down the price of winning bids. Moreover, without auction procedures in place, T-Mobile’s conjecture is unprovable. For example, the Commission could adopt auction design techniques such as package bidding, bidding credits for certain bidders or areas, and other methods that would affect bidding entry and strategies. In sum, T-Mobile’s bald assertion is at best premature and at worst unprovable.

⁹⁰ T-Mobile Petition at 11.

T-Mobile's proposal would undercut the trade-offs that incumbent users made to gain the potential for access to 100 megahertz of PAL and GAA spectrum. The framework the Commission adopted in the *CBRS Order* respected the rights of incumbent 3650-3700 MHz licensees, granted them grandfathered protection, allowed them to continue to register new locations and deploy service, and offered the opportunity to participate in the PAL auctions. Licensees, though, accepted new obligations to limit grandfathering and to re-register locations in order to obtain grandfathered protection. Existing licensees also will be required to operate under the control of the SAS and likely pay SAS administration fees. If T-Mobile were to get its way, the trade-off instantly devolves into a one-sided deal where existing licensees are evicted from the band and have only opportunistic use available. That is not acceptable. The Commission wisely did not pick winners in crafting its CBRS rules, and it should not be changing course here.

B. The Commission Should Retain Dynamic Frequency Assignment

The final nail in the CBRS coffin is T-Mobile's proposal to eliminate dynamic frequency assignment in favor of specific frequency assignments.⁹¹ Together with eliminating the GAA spectrum allocation, eliminating dynamic frequency assignment would remove the need for the SAS and convert the band to full "command and control" licensing. The proposal also would harm the few PAL holders, who would have no GAA spectrum to use when and where they are required to vacate frequencies to accommodate shipborne Naval radar operations. With no real need for the SAS, the T-Mobile proposal does not explain how the ESC systems would operate. The Commission should reject this proposal as well.

⁹¹ See *id.* at 15-16.

IV. THE COMMISSION SHOULD ADOPT SOME MODEST CHANGES TO THE TECHNICAL RULES AND REJECT OTHER PROPOSALS

A. The Commission Should Retain Its Rule Providing For Limited Public Disclosure Of CBSD Registration Information

Both CTIA and T-Mobile ask the Commission to delete Section 96.55(a)(3), which makes CBSD registration available to the public while obfuscating the identities of the licensees providing the information.⁹² They claim that making CBSD registration information raises “competitive and personal privacy concerns”⁹³ and “does not serve any relevant purpose.”⁹⁴

WISPA disagrees with the proposed rule change. CBRS is not an unlicensed service. GAA is “licensed by rule,” such that the SAS essentially takes the place of ULS in identifying where spectrum is in use. GAA users can make use of the public data to plan their deployments, identifying which frequencies are most likely to be clear and which base station locations are least likely to cause conflict. Accordingly, the Commission should retain Section 96.55(a)(3).

B. The Commission Should Not Increase The Maximum EIRP Limit For Outdoor Operations

The Commission should not adopt T-Mobile’s proposal to increase the maximum EIRP limit for outdoor operations.⁹⁵ It proposes to increase the maximum EIRP from 30 dBm/10 MHz to 36 dBm/10 MHz for Category A outdoor CBSDs, from 47 dBm/10 MHz to 49 dBm/10 MHz for non-rural Category B CBSDs and from 47 dBm/10 MHz to 56 dBm/10 MHz for rural CBSDs.⁹⁶ T-Mobile argues that, despite the Commission’s prior decision to increase maximum allowable power levels, the “EIRP limits are still not sufficiently high for robust deployment of 5G technologies.”⁹⁷

⁹² See CTIA Petition at 11-12; T-Mobile Petition at 19-20.

⁹³ CTIA Petition at 12.

⁹⁴ T-Mobile Petition at 20.

⁹⁵ See T-Mobile Petition at 22-23.

⁹⁶ See *id.* at 23.

⁹⁷ *Id.*

The Commission should reject this proposal. First, the same arguments were previously presented in petitions for reconsideration and largely rejected by the Commission just one year ago. In particular, the Commission stated that increasing the maximum EIRP for Category A CBSDs to 36 dBm/10 MHz “would require the Exclusion Zones to be reconsidered and expanded, preventing deployments in large portions of the country prior to the development and approval of an ESC.”⁹⁸ With regard to Category B CBSDs, the Commission determined that conforming the maximum EIRP limits for all Category B CBSDs “will also simplify the rules by removing the distinction between rural and no-rural power levels, allowing for uniform development and deployment of Category B CBSDs.”⁹⁹ Overall, the Commission found that:

given the interference risks associated with higher power levels, the delays in deployment of this new service that would result from revisiting the size of the Exclusion Zones prior to implementing an ESC capability, and the disruption to the balance between PAL and GAA use struck in the *3.5 GHz R&O*, we conclude that the maximum EIRP for Category A CBSDs should remain capped at 30 dBm/10 MHz.

Second, because the Commission rightly conformed the maximum EIRP for all Category B CBSDs, SAS and ESC standards development has been simplified. Adopting T-Mobile’s proposal to de-conform power levels would require additional features in the SAS and ESC to ensure that users do not deploy higher power rural CBSDs in non-rural areas and require the Commission to reconsider the size of exclusion zones with attendant delays in initiating commercial service. Third, higher power limits will require larger full-time ESC zones and exclusion zones when a Naval radar activates, restricting use in larger areas along the coastlines. In sum, T-Mobile’s claims are no more convincing now than they were when the Commission rejected identical arguments on reconsideration just one year ago.

⁹⁸ See *CBRS Recon Order* at 5032.

⁹⁹ *Id.*

C. The Commission Should Modify Out-Of-Band Emission Limits For CBSDs Based On Channel Size

T-Mobile and Qualcomm ask the Commission to modify the OOB limits for CBSDs and End User Devices in cases where the operating channel is larger than 10 megahertz.¹⁰⁰ WISPA supports these rule changes because they will enable spectrum to be used more efficiently without increasing the potential for harmful interference. However, the OOB limits should be expressed in proportion to channel sizes to accommodate legacy operations in 3650-3700 MHz where different channel sizes are used (e.g., 15 MHz, 25 MHz, 30 MHz), rather than as discrete values for 10-, 20- and 40-megahertz channels as proposed. Exhibit 3 contains WISPA's proposed changes to Section 96.41(e)(1).

V. THE COMMISSION SHOULD CLARIFY THAT THE SAS SHOULD AFFORD GAA USERS THE OPPORTUNITY TO RESOLVE CONTENTION FOR SPECTRUM

Over the last several months, WISPA and other WinnForum stakeholders have debated the role of the SAS in “facilitat[ing] coordination” among GAA users. On one hand, some believe that the SAS should resolve contention based on an automated default solution, in which the SAS selects every GAA device's frequency, which does not afford the affected parties the opportunity to discuss a compromise. On the other hand, some like WISPA believe that the affected GAA Users should always have the opportunity to resolve the contention privately, and then report the negotiated solution to the SAS. Unfortunately, the two camps have not been able to achieve a consensus, which is holding up the SAS development process. WISPA therefore asks the Commission to clarify the role of the SAS with respect to GAA-GAA coordination.

In the *CBRS Order*, the Commission discussed the “high level functions” of the SAS¹⁰¹ and adopted Section 96.53(j) to require the SAS to “facilitate coordination between GAA users

¹⁰⁰ See T-Mobile Petition at 21-22; Qualcomm Letter at 1-3.

¹⁰¹ *CBRS Order* at 4054.

operating Category B CBSDs, *consistent with section 96.35.*”¹⁰² The Commission explained that this requirement “entails a general responsibility for SASs to promote spectral efficiency and non-discriminatory coexistence among GAA users.”¹⁰³ The Commission also acknowledged that the SAS “will help to minimize interference such as by avoiding assignment of the same frequency to multiple GAA users at the same location to the extent possible,”¹⁰⁴ but did not place an affirmative obligation on the SAS to *resolve* interference claims. Rather, that obligation appears in the relevant language of Section 96.35(e), which states that “General Authorized Access *Users* operating Category B CBSDs must make every effort to cooperate in the selection and use of available frequencies provided to an SAS to minimize the potential for interference and make the most effective use of the authorized facilities.”¹⁰⁵ The emphasis in the rule is on the obligation of *Users* to cooperate, not for the SAS to make automated decisions in the first instance.

The foregoing suggests that the term “facilitates coordination” should not be construed to require the SAS to make all default interference mitigation decisions on behalf of GAA Users. Rather, it is the *Users* that have the opportunity to determine their fate through various acceptable spectrum sharing techniques. As a simple example, an SAS might decide to assign one 10-megahertz channel to each of two GAA Users, but the GAA users may prefer to share 20 megahertz of spectrum geographically, temporally (e.g., via contention-based operation), or in different spectrum allocations. In WISPA’s view, the GAA users should have an opportunity to determine their fate rather than have an unsatisfactory SAS decision forced upon them.

¹⁰² 47 C.F.R. § 96.53(j) (emphasis added).

¹⁰³ *CBRS Order* at 4055.

¹⁰⁴ *Id.*

¹⁰⁵ 47 C.F.R. § 96.35(e) (emphasis added).

WISPA realizes that the opportunity for GAA Users to resolve interference issues cannot be open-ended. WISPA believes that the SAS should be able to bound the obscuring of identity from the general public *to* the general public, and provide a means for potential interferors to communicate with one another. All parties would be required to act in good faith to achieve a private solution, which would then be reported to and enforced by the SAS.

WISPA believes that the clarification it seeks is a reasonable interpretation of the Commission's rules and the *CBRS Order*, and will lead to privately negotiated solutions that will foster efficient spectrum use and deployment.

Conclusion

In the *CBRS Order*, the Commission explained that:

We believe that it is vitally important to establish flexible, yet simple, rules that would allow for a wide variety of innovative services to be deployed in the 3.5 GHz Band and we are encouraged that many commenters share this view. Ensuring that the band is available for multiple use cases should encourage rapid network deployment, promote the development of a robust device ecosystem, and help to ensure the long-term viability of the band.¹⁰⁶

But if CTIA and T-Mobile get their way, none of this will matter. We will be left with nothing more than another “command and control” licensing scheme that ensures permanent licensing for a few large mobile wireless carriers for a single prospective purpose. Lost will be the opportunity for rural consumers to use CBRS spectrum to receive affordable fixed broadband service and for all consumers to obtain access to innovative offerings that are being developed under the rules adopted just two years ago.

¹⁰⁶ *CBRS Order* at 4024.

The Commission should swiftly reject the CTIA and T-Mobile licensing proposals to remove the uncertainty they have injected, and enable CBRS investment, innovation, and deployment opportunities to accelerate.

Respectfully submitted,

**WIRELESS INTERNET SERVICE
PROVIDERS ASSOCIATION**

July 24, 2017

By: */s/ Alex Phillips, President*
/s/ Mark Radabaugh, FCC Committee Chair
/s/ Fred Goldstein, Technical Consultant

Stephen E. Coran
Lerman Senter PLLC
2001 L Street, NW, Suite 400
Washington, DC 20036
(202) 429-8970
Counsel to the Wireless Internet Service Providers Association

Exhibit 1
Carmel Report

2017



Ready for Takeoff:

Broadband Wireless Access Providers
Prepare to Soar with Fixed Wireless

THE BWA INDUSTRY REPORT: 2017

Table of Contents

About This Report	2
Executive Summary	4
What is Broadband Wireless Access?	5
How Does BWA Work?	7
BWA: A Solution to the Broadband Gap	8
International Proof of Concept	8
U.S. BWA Growth Forecast	9
Seven Key Growth Drivers	11
<ul style="list-style-type: none"> • Fixed wireless costs less • Spectrum trends favor fixed wireless • Video is fueling overall growth in demand for broadband • Standards-based technologies give providers more choices • Capital availability and government support are growing • New entrants are validating the business model • New markets and service categories = more opportunities 	
Fixed Wireless Versus Other Technologies	17
BWA Providers Face Challenges	19
Conclusion	19
Appendix	20

FIGURE 1: U.S. Fixed Wireless Broadband Availability	5
FIGURE 2: Typical BWA Network Architecture	7
FIGURE 3: BWA Industry Revenue Review and Forecast	9
FIGURE 4: BWA Customer Growth	10
FIGURE 5: BWA Average Monthly Billing Review and Forecast	10
FIGURE 6: Consumer Broadband Comparative Economics	12
FIGURE 7: Popular BWA Spectrum Bands	13
FIGURE 8: Rising Global Internet Traffic	14
FIGURE 9: OTT is Driving Internet Growth	14
FIGURE 10: BWA Annual Residential Subscriber Growth, 2015 to 2016	20
FIGURE 11: BWA Average Subscriber Acquisition Cost (SAC) for Residential Customers	21
FIGURE 12: BWA Average Revenue per Unit for Residential Users	21
FIGURE 13: BWA Average Monthly Churn	22

About This Report

The purpose of this report is to provide a comprehensive, independent, informational, and analytical resource that describes the Broadband Wireless Access (BWA) industry and provides perspectives on future opportunities, threats, and outlooks.

The target audience for this report includes BWA companies, stakeholders, investors, policymakers, strategic advisors, analysts, equipment and software vendors, and anyone with an interest in the fixed wireless and broadband industries. The author's aim is to provide objective data and insights to help readers make informed business, investment, and policy decisions.

METHODOLOGY

This report is based on independent research conducted in 2016, including interviews with representatives of 30 wireless broadband service providers, vendors, and thought leaders. The interviews were conducted by The Carmel Group and lasted approximately two hours each. The Wireless Internet Service Providers Association (WISPA) and Wireless Communications Association International (WCAI), as well as several other groups and telecom companies, also provided input. Filings at the U.S. Securities and Exchange Commission by a publicly traded company in the BWA sector were another resource. Other third parties, such as bankers and financiers, were also interviewed. Finally, extensive surveys of operators, equipment manufacturers, and vendors were distributed to members of WISPA and WCAI in Q3 of 2016, to gain another critical layer of research and analysis.

The charts and graphs in the Appendix are based on survey results from 169 U.S.-based BWA providers.

THE REPORT SPONSORS

Prominent stakeholders from today's BWA community and two major trade groups representing the industry's interests in Washington, DC – WISPA and WCAI – selected Jimmy Schaeffler of The Carmel Group (www.carmelgroup.com) to conduct this project based upon his expertise in performing studies on the future of the telecom, media, and entertainment industries.

The Carmel Group prepared this report on behalf of the parties listed below.

- **All Points Broadband**
- **Amplex**
- **AtLink Services**
- **Cambium Networks**
- **Comelec Internet Services**
- **Huawei**
- **Mimosa**
- **RFelements**
- **Rise Broadband**
- **Safelink**
- **SpeedConnect**
- **TransWorld Network**
- **ViaSat**
- **WCAI**
- **WISPA**
- **Wisper ISP**
- **ZTE**

Unless authorized in writing by The Carmel Group, this report is intended solely for the sponsors' exclusive use. Any unauthorized distribution or use is strictly prohibited.

Individuals interested in further information may contact The Carmel Group via telephone at +1-831-622-1111 or email at: jimmy@carmelgroup.com.

ACKNOWLEDGEMENTS

The authors thank the following individuals for their assistance: Stephen Coran, Esq., of Lerman Senter PLLC; Dale Curtis of Dale Curtis Communications; Gerard F. Hallaren, CFA; William Joseph Shepard of The Carmel Group; and Deborah Sauri of iSpy Creative.

CAUTIONARY LANGUAGE CONCERNING FORWARD-LOOKING STATEMENTS AND DISCLAIMER

Information set forth in the following materials contains financial estimates and other forward-looking statements that are subject to risks and uncertainties, and actual results may differ materially. The Carmel Group disclaims any obligation to update or revise statements contained in this report and any accompanying news release based on new information or otherwise. The report is based on information that The Carmel Group believes to be reliable, but no guarantee is made as to its accuracy. Those using this report should verify the data and should not make any business decisions without proper verification and consultation with proper legal and financial advisers. Additionally, the information in this report is not in any way a recommendation to purchase or sell any security.

Executive Summary



- The Broadband Wireless Access (BWA) industry is experiencing robust growth in the United States and worldwide, and The Carmel Group expects this growth to continue for at least the next five years.
- There are at least seven key growth drivers lifting the fixed-wireless-based, BWA industry to new heights:
 - 1 The economics of wireless technology enable network deployments at a fraction of the cost of wireline.
 - 2 The economics of unlicensed spectrum and trends in spectrum regulation are favorable to fixed wireless.
 - 3 Consumer demands for broadband connectivity and associated applications, especially video, are surging at an exponential rate.
 - 4 Global standards-based technologies, such as LTE, and a growing equipment ecosystem are being leveraged for fixed wireless uses.
 - 5 Industry consolidation and a healthy funding environment from private and government sources are driving investment.
 - 6 New entrants and hybrid networks are validating the business model.
 - 7 New markets in urban areas and categories such as home automation, home security, and the Internet of Things (IoT) present further opportunities for fixed wireless growth.
- Bringing broadband to under-served markets is a difficult challenge. But for the foreseeable future, BWA providers using fixed wireless technologies will offer the most cost-effective solution in vast areas of the United States and the world.
- The existence of large, successful BWA providers in other nations underscores the sector's potential in the United States. Developing nations that lack wireline infrastructure present rich growth opportunities.

What is Broadband Wireless Access?

Broadband Wireless Access (BWA) providers – also known as Wireless Internet Service providers (WISPs), Fixed Wireless Access providers (FWA), Competitive Broadband Providers (CBPs), and/or Wireless Local Loop providers (WLL) – deliver broadband service to consumers in fixed locations, primarily via wireless technology.

es, and community anchor institutions.

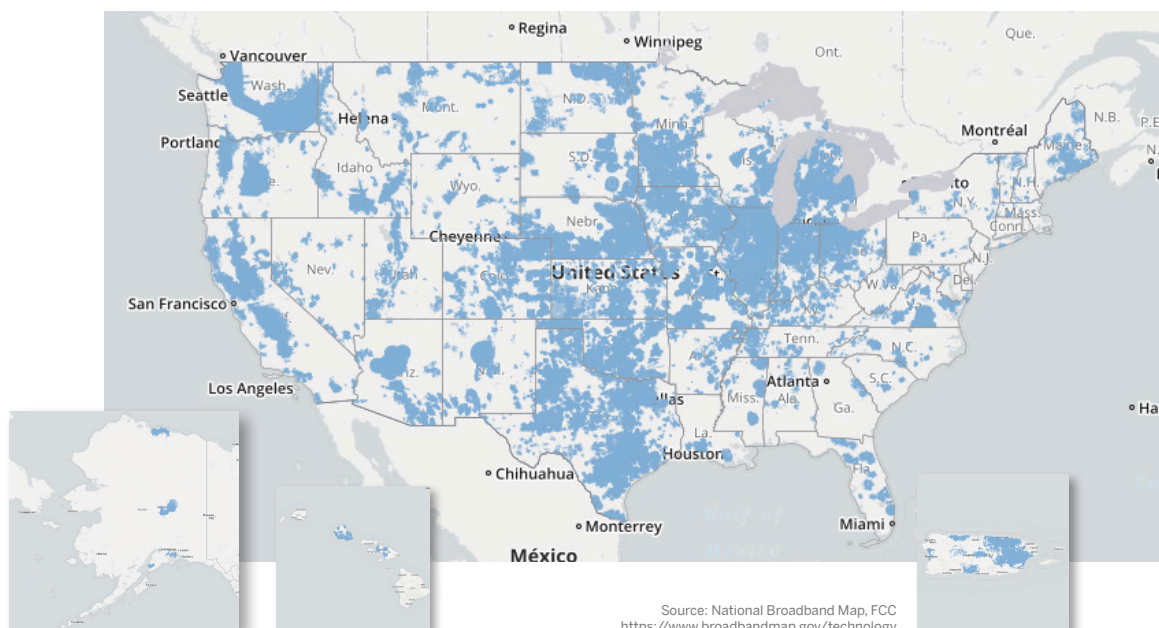
Services delivered by BWA providers may include data as well as voice, video, security, and ancillary products and services.

BWA providers deliver their services over a combination of licensed spectrum, lightly licensed spectrum (or “shared access” spectrum), and unlicensed spectrum. Many also use fiber optics in parts of their infrastructure, creating efficient “hybrid” networks. Typical download speeds are in the range of 5 to 50 Megabits per second (Mbps), a number that is rising as technology improves and equipment costs become more competitive. Fixed wireless technology can support Gigabit download speeds.

Whereas most wireless infrastructure today serves *mobile* consumers, BWA providers use wireless technology to serve customers in *fixed* locations such as residences, businesses, and community anchor institutions.

Whereas most wireless infrastructure today serves *mobile* consumers, BWA providers use wireless technology to serve customers in *fixed* locations such as residences, business-

FIGURE 1: U.S. Fixed Wireless Broadband Availability



Currently in the United States, more than 2,000 BWA providers deliver service to nearly 4 million customers. As shown in Figure 1, each state has at least one fixed wireless provider. The largest concentrations of BWA providers are found in the Midwest, Northwest, and Southwest, as well as the central and northern parts of California.

To date, the industry has served mostly rural and suburban markets where fiber and cable deployment is not cost-effective. However, given the favorable economics of fixed wireless, many BWA providers are expanding into urban markets as well, offering competitive alternatives to customers there.

Most U.S. BWA providers are small and medium-sized businesses. Rise Broadband, with nearly 200,000 subscribers, is the largest U.S.-based BWA provider. Other large providers include AtLink Services, Comelec Internet Services, Safelink, SpeedConnect, Trans-World Network, and Wisper ISP. However, the American BWA networks serve an average of approximately 1,200 customers. Very small BWA providers, especially those that serve small rural communities, may count customers in the low hundreds.

Many BWA leaders interviewed for this study indicated their “ideal” deployment occurs in residential clusters of 100 to 1,500 locations per square mile, areas that wired technology platforms often ignore because of the higher per-location cost to deliver service across sparsely populated areas.

Bringing broadband to under-served markets is a difficult challenge. At this time, BWA providers using wireless technologies are the most cost-effective solution in vast areas of the United States and the world.

How Does BWA Work?

In a typical BWA network, broadband content is received by the BWA provider from an external distribution point via fiber or microwave connections. From there, signals are delivered to BWA customers via wireless transmitters on towers. The towers are interconnected by licensed or unlicensed spectrum and can carry up to 5 to 10 Gigabytes of capacity. Customers receive the signals via antennas that are attached to the subscribers' premises. This is why the technology is called fixed wireless, as opposed to mobile/cellular wireless.

Within the subscribers' premises, the signal is most commonly delivered via a Wi-Fi router or ethernet cable to personal computers, TV monitors, and other stationary and mobile devices in the home or business.

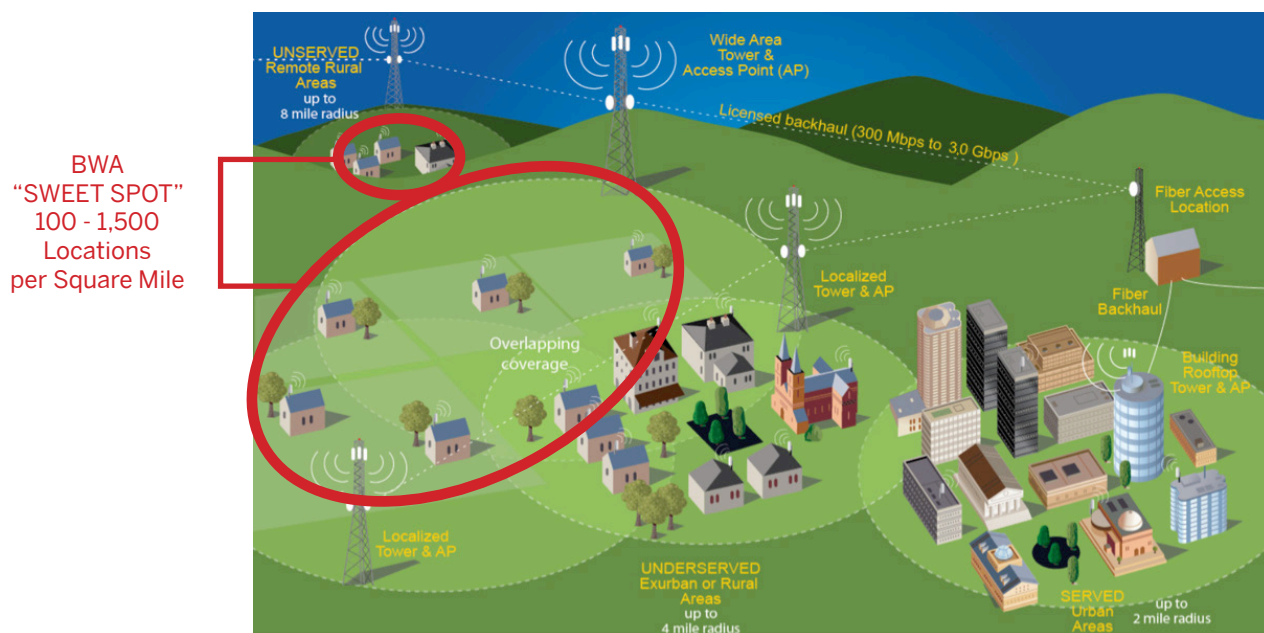
BWA providers typically employ a variety of licensed and unlicensed spectrum to deliver their services. For last-mile, point-to-multipoint connections, unlicensed spectrum bands such as 900 MHz and 2.4 GHz were

commonly used in the early years of the industry. However, these bands have given way to 5 GHz, 3.65 GHz, and 2.5 GHz to accommodate increasing speed, coverage, and capacity needs. Unlicensed 5 GHz and licensed 6-24 GHz point-to-point connections are most commonly used to connect towers and serve high-volume enterprise customers, with FCC microwave licenses readily available at nominal cost.

Equipment designed for use in unlicensed spectrum bands is limited in power output to reduce interference to other users, as mandated by the FCC, and is designed to perform well in environments with more potential for interference than equipment designed for use in exclusively licensed bands.

The BWA "sweet spot" – where providers can offer the best service and economics – is often in exurban areas with 100 to 1,500 locations per square mile, such as those shown on the left side of Figure 2.

FIGURE 2: Typical BWA Network Architecture



BWA: A Solution to the Broadband Gap

America's broadband performance is middling at best. According to the Organization for Economic Cooperation and Development (OECD), in 2015 the United States was ranked 15th out of 34 member nations in the number of fixed broadband subscriptions per 100 inhabitants.

- Only 4 percent of urban Americans lack access to 25 Mbps/3 Mbps broadband.

The United States faces a variety of challenges that have made it difficult to ensure universal broadband coverage. Chief among them are low population density and rugged

terrain in large portions of rural America. BWA providers using fixed wireless technology can be a large part of the solution, largely because of their favorable economics. (See Figure 6.)

Bringing broadband to under-served markets is a difficult challenge. At this time, BWA providers using wireless technologies are the most cost-effective solution in vast areas of the United States and the world.

And according to the [FCC's 2016 Broadband Progress Report](#):

- 10 percent of all Americans (34 million people) lack access to 25 Mbps/3 Mbps service; and
- 39 percent of rural Americans (23 million people) lack access to 25 Mbps/3 Mbps; but

Without BWA providers, America's broadband gap already would be much larger. The data further suggests that many under-served Americans reside and do business in rural areas where BWA providers are thriving, validating the opportunity for them to become a key part of the solution to America's broadband gap.

International Proof of Concept

BWA providers are more common in some nations than in the United States, in most cases because cable and other broadband infrastructure is non-existent, aging, and/or very expensive to install and upgrade. For example, Australia, Canada, Italy, the Philippines, and Russia all have BWA providers with customer counts in the hundreds of thousands, or in the case of the Philippines, millions. Developing nations present significant growth opportunities for the industry.

Non-U.S. demand for BWA services has pushed the technology forward. Innovators like Cambium Networks, Ericsson, Huawei, Mimosa, Nokia, Ubiquiti, and ZTE are competing in both established and emerging markets around the world.

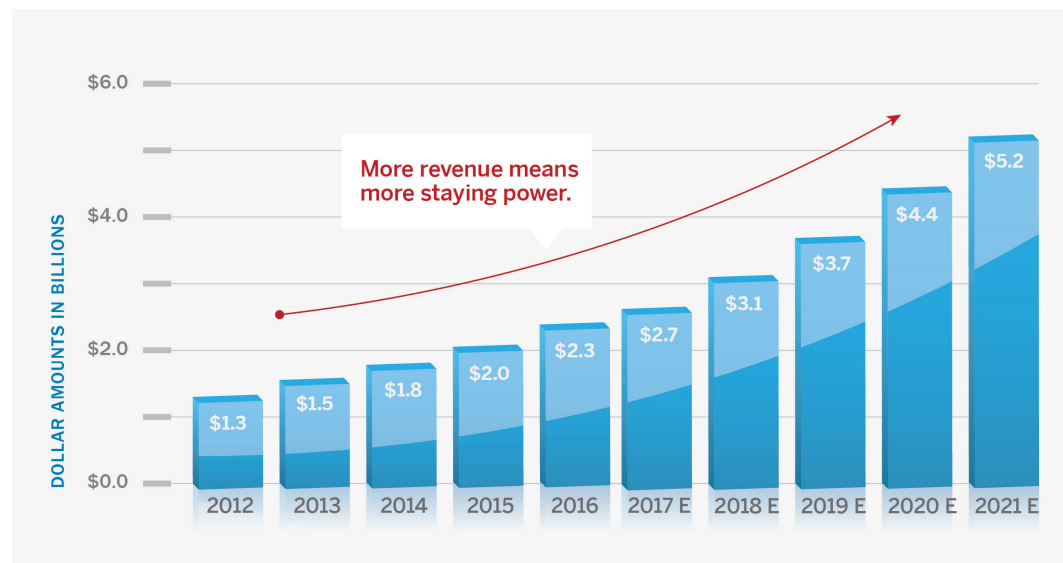
The notion of "carrier grade" fixed wireless was not widely accepted in the past, but it is now becoming more prevalent in the United States and worldwide.

U.S. BWA Growth Forecast

The Carmel Group estimates that the current upward trajectory of BWA industry revenues in the United States will continue for at least the next five years. (See Figure 3.) Core BWA industry revenues from provision of service to end-users were estimated conservatively at \$2.3 billion in 2016. These are expected to rise to more than \$5.2 billion by the end of 2021.

Drivers of growth include explosive consumer demand for broadband services, continuing deployment to unserved and under-served areas, commercial and business demand, improvements in technology at competitive prices (including standards-based LTE equipment), and the combination of existing services with ancillary services that are increasing the average revenue per unit (ARPU).

FIGURE 3: U.S. BWA Industry Revenue Review and Forecast

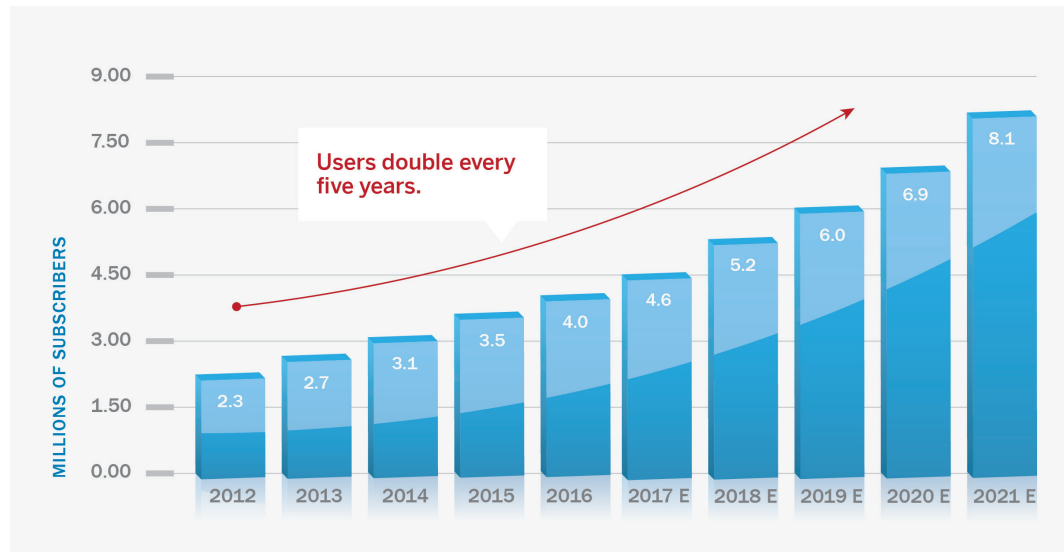


Source: The Carmel Group
Copyright 2017, Property of The Carmel Group. All Rights Reserved.

The Carmel Group believes that customer subscriptions will roughly double, from 4.0 million in 2016 to 8.1 million in 2021, as BWA providers expand in under-served areas and

contend effectively in the burgeoning number of areas where they offer superior customer service and a local presence. (See Figure 4.)

FIGURE 4: U.S. BWA Customer Growth

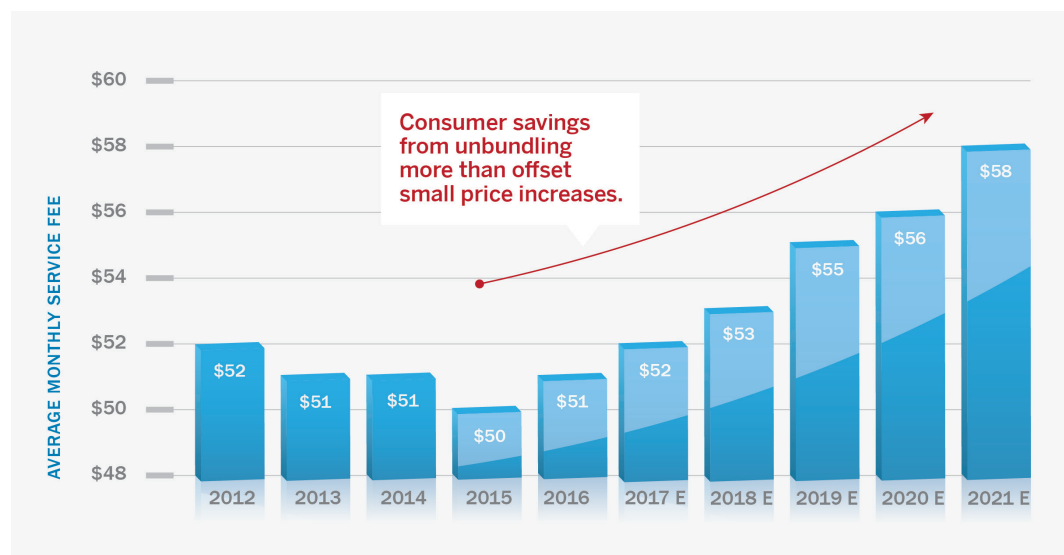


Source: The Carmel Group
Copyright 2017, Property of The Carmel Group. All Rights Reserved.

The Carmel Group believes that per-customer monthly revenue also will continue to rise, in part because consumers will be willing to pay more for the improved services and speeds

that will flow from network upgrades, standards-based technologies, and ancillary services. Figure 5 depicts our projections.

FIGURE 5: U.S. BWA Average Monthly Billing Review and Forecast



Source: The Carmel Group
Copyright 2017, Property of The Carmel Group. All Rights Reserved.

Seven Key Growth Drivers

The BWA industry is experiencing robust growth in the United States and worldwide. The Carmel Group expects this growth to accelerate for at least the next five years, due to seven key growth drivers:

- 1** The economics of wireless technology enable network deployments at a fraction of the cost of wireline.
- 2** The economics of unlicensed spectrum and trends in spectrum regulation are favorable to fixed wireless.
- 3** Consumer demand for broadband connectivity and associated applications, especially video, is surging at an exponential rate.
- 4** Global standards-based technologies, such as LTE and 5G, and a growing equipment ecosystem are being leveraged for fixed wireless applications.
- 5** Industry consolidation, a healthy funding environment, and greater support from government are driving investment.
- 6** New entrants and hybrid networks are validating the business model.
- 7** New markets and categories such as home automation, security, and the Internet of Things (IoT) present further opportunities for fixed wireless.

We delve further into each of these drivers below.

1 Fixed wireless costs less

The economics of fixed wireless are already very attractive and only becoming more so. For example, it costs nothing to install, maintain, or repair the spectrum resource, and fixed wireless equipment is inexpensive relative to fiber, coax, and twisted pairs – all of which incur extensive installation, maintenance, and repair costs. (See Figure 6.)

Moreover, upgrading fiber, cable, satellite, or mobile broadband is highly capital intensive. For these technologies, each generation of improvement requires significant network upgrades. In contrast, BWA networks can be scaled incrementally over time.

Advances in radio technology are improving wireless speeds to the point where they are approaching cable and ultimately will catch up to fiber. Industry standards and software-defined radios enable incremental upgrades without leaving past customers behind.

The following figure compares relative capital expenditures per residential subscriber, as well as speed, upgrade costs, average revenue per unit (ARPU), and payback times for the five most popular U.S. broadband technologies.

This is a relative presentation comparing the four other technologies to BWA, which is set to an index value of 10. Fiber costs about 7x BWA costs; Cable is 4.5x more. Satellite costs about the same per sub, but this analysis excludes the cost of satellites because network costs vary greatly. Mobile's capex per sub is a little more than 2x BWA's, although it offers mobility. As household density drops, capex for wireline rises but remains relatively constant for wireless.

This analysis suggests that with a payback period of just under one year, BWA offers the most attractive economics of the top U.S. broadband technologies.

The estimates for fiber, cable, and BWA assume the indicated speeds and average network reach. Satellite and mobile data are estimated from national averages. In an effort to present a rational and fair relative cost analysis, The Carmel Group constructed several cost models for each technology. The Relative Capex/Subscriber reflects a blend of these models with some analytical adjustment. Actual results vary.

FIGURE 6: Residential Consumer Broadband Comparative Economics

	FIBER	CABLE	SATELLITE	MOBILE	BWA
CAPEX/SUB RELATIVE TO BWA ⁽¹⁾	70	45	10.5 ⁽²⁾	21	10
SPEED ⁽³⁾	1 Gbps	150 Mbps	12-35 Mbps ⁽⁴⁾	10–12 Mbps	100 Mbps
UPGRADE COSTS	MODEST Only the fiber remains the same	HIGH Complete CPE & network change	LOW/HIGH Incremental upgrades until the satellite fails	HIGH Complete device & network change	MODEST Incremental upgrades in CPE and network
BROADBAND ARPU	\$69	\$42	\$61	\$59	\$51
PAYBACK PERIOD	60 months	38 months	12 months	21 months	11.5 months

Sources: Wisper ISP, National Rural Telecommunications Cooperative, and The Carmel Group.

Copyright 2017, Property of The Carmel Group. All Rights Reserved.

(1) This is a relative presentation comparing all of the technologies to BWA, which is set to an index value of 10. See above for explanation.

(2) Does not include the cost of satellites.

(3) Max speeds; most service providers are not yet offering max speed. For cable, the DOCSIS 3.0 standard is capable of 1 Gbps. For BWA, point-to-point links and millimeter-wave, point-to-multipoint connections can provide more than 1 Gbps to end users.

(4) Anticipated typical speed.

2 Spectrum trends favor fixed wireless

The BWA industry's ability to use unlicensed spectrum is another growth driver.

Unlicensed spectrum is free to its users. Licensed spectrum requires capital investments at high prices, which are ultimately passed on to consumers.

Another advantage is rapid deployment. There is no need to go through lengthy regulatory proceedings and auctions to acquire access to the airwaves. In addition, the recent introduction of LTE technology in certain bands opens up an enormous, global-standards-based ecosystem for equipment and carrier-aggregation technology, adding another boost to the speed, capacity, and economics of BWA deployments and upgrades.

The Carmel Group's extensive survey of BWA operators revealed that relatively few spectrum bands support today's BWA industry. (See Figure 7.) However, the FCC is

exploring new bands that are expected to be well-suited for BWA networks, including the Citizens Broadband Radio Service band (3550-3700 MHz, called CBRS), TV white spaces, and several extremely-high-frequency, millimeter-wave bands. Industry efforts are also underway to expand geographically licensed areas in the LTE-grade 2.5 GHz band.

The growing acceptance of spectrum sharing is further increasing availability and capacity for fixed wireless, with greater overall spectral efficiency.

It is important to realize that unlicensed spectrum is not *unregulated* spectrum. Even in unlicensed bands, the FCC regulates acceptable equipment, power limits, frequencies, and interference. BWA providers stay within those limits and use a variety of frequencies and network design features to overcome population density, terrain, and propagation obstacles.

FIGURE 7: Spectrum Bands Most Commonly Used by the BWA Industry

FREQUENCY	500-700 MHz	902-928 MHz	2.4 GHz	2.5 GHz	3.55 – 3.7 GHz	5.15- 5.85 GHz	28 & 39 GHz	>40 GHz
COMMON NAME	White Space	ISM	ISM/Wi-Fi	EBS/BRS, LTE Band 41	CBRS, LTE Band 42, 43 & 48	U-NII 5 GHz Wi-Fi Band 33	LMDS, TN	Millimeter Wave
LICENSE	ASA*	EXEMPT	EXEMPT	LICENSED	ASA, PAL or GAA	EXEMPT	LICENSED	VARIOUS
INTERFERENCE RISK	Medium	High	High	Low	Low, Medium	High	Low	Low
BAND SIZE	Varies by Location	26 MHz	83.5 MHz	194 MHz	150 MHz	580 MHz	1.2 GHz 1.4 GHz	6.2 GHz
NLOS ABILITY	Excellent	Excellent	Fair	Good	Fair	Poor	Poor	Poor
PRIMARY TECHNOLOGY	802.11af "Super Wi-Fi"	Proprietary TDD	Wi-Fi	LTE	Proprietary, WiMax and LTE	Wi-Fi, LTE-U	5G	5G

* Authorized Shared Access
Source: The Carmel Group

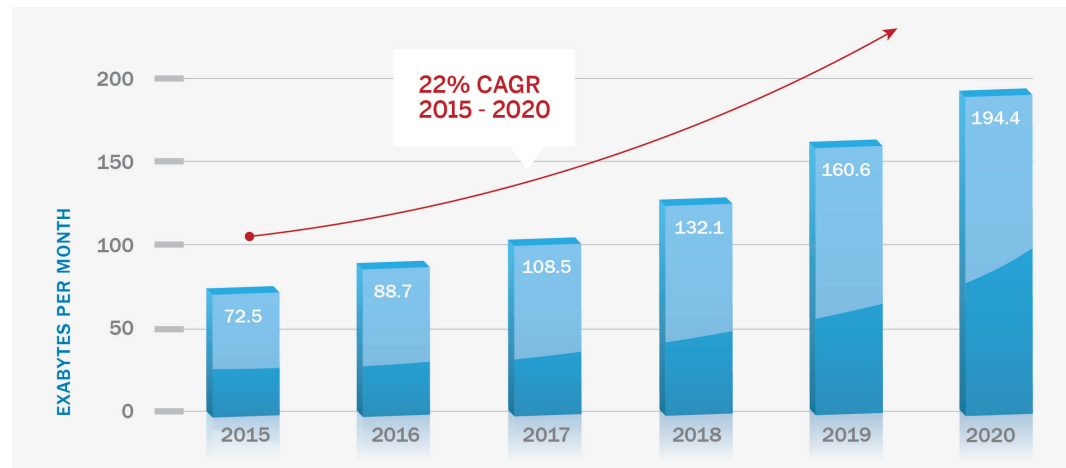
Copyright 2017, Property of The Carmel Group. All Rights Reserved.

3 Video is fueling overall growth in demand for broadband

The demand for broadband access to the internet is growing at an exponential rate. Figure 8 presents Cisco's 2016 assessment and forecast of overall internet traffic mea-

sured in gigabits per second (Gbps). Consumers are defining their internet access needs in terms of both speed and throughput.

FIGURE 8: Rising Global Internet Traffic



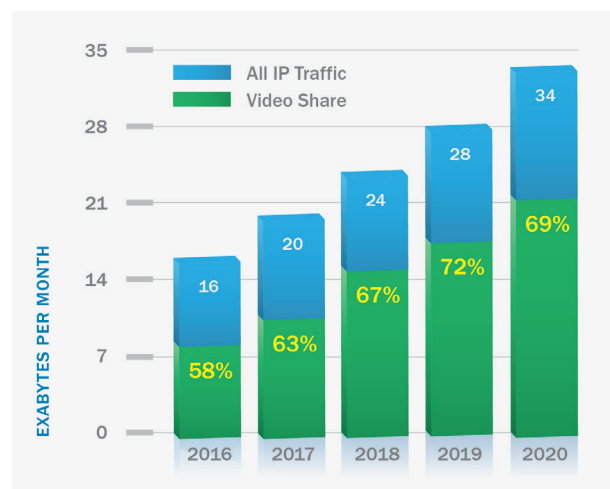
Source: Cisco Visual Networking Index 2016

Video is a major driver of broadband demand. Figure 9 presents Cisco's 2016 assessment on how video will drive broadband demand in terms of quantity (exabytes) of data moved.

Video accounts for a rapidly growing share of internet traffic. Cisco projects a 22% compound annual growth in overall internet traffic between 2015 and 2020, but it expects video traffic alone to grow 31% annually over the same time frame.

The reasons for this are clear. A growing number of consumers are unbundling from pay TV services and replacing expensive programming bundles with less expensive "over the top" (OTT) access via broadband. BWA providers make this cost-saving option – once available only to urban dwellers – available to rural and exurban customers.

FIGURE 9: OTT is Driving Internet Growth



Source: Cisco Visual Networking Index June 2016

We do not expect this trend will slow. If anything, we expect unbundling will accelerate as more consumers embrace Internet-based programming and watch programs on wireless devices at times of their choosing.

4 Standards-based technologies give providers more choices

Every significant advancement in mobile technology is paying dividends in the fixed wireless arena as well. For example, standards-based LTE technology, which originated in mobile standards bodies, is being deployed in fixed networks to give BWA providers greater speed, capacity, and credibility as service providers.

The benefits of unlicensed spectrum are so powerful that many mobile carriers are planning to augment licensed networks with LTE over unlicensed spectrum.

The WISP industry started with consumer and enterprise-class technology. These technologies were sometimes cumbersome to manage and upgrade. But because of rising world demand, today's BWA providers have an array of suppliers and technologies. Indeed, carrier-class technology is rapidly gaining share among BWA providers. This competition, together with enhanced global research and development and related investments, is enabling the technologies and services to improve more rapidly.

5 Capital availability and government support are growing

As noted in this report, BWA providers generally do not hold licenses for the spectrum they use. The lack of a tangible medium such as fiber, copper, or licensed spectrum has deterred financial institutions from investing in BWA providers. Other investor concerns have included low barriers to entry by competitors, signal interference, and alleged "unreliability" of unlicensed spectrum.

However, more than a decade of successful operations, validation from new entrants, recent standards-based equipment deployments, and the advance of successful consolidators like Rise Broadband have all improved capital availability. Today, the financial markets are beginning to recognize the favorable economics of fixed wireless and BWA providers. The validity of licensed spectrum at 2.5 GHz is also emerging, as illustrated by larger BWA providers such as Michigan-based SpeedConnect.

Meanwhile, the federal government is considering regulatory changes that could open up more opportunities for BWA providers. For example, the FCC and U.S. Department of Agriculture are eyeing plans to make broadband subsidy programs less oriented to incumbent telecom providers, more technology-neutral, and more focused on cost-effectiveness and speed of deployment. Spectrum sharing initiatives are underway to provide additional unlicensed and affordable spectrum licenses to service providers. And the new chairman of the FCC, Ajit Pai — having himself grown up in rural America — has developed a 'Digital Empowerment Agenda' to prioritize expanded access to broadband in under-served areas of the United States.

6 New entrants are validating the business model

The arrival of major new entrants is signaling a wave of growth in fixed wireless and the BWA sector. Google, AT&T, Verizon, Windstream, and other carriers have recently announced plans to deploy more fixed wireless, generally as an extension of their wired services. Many of these efforts target rural areas and are supported by the federal Connect America Fund. Other efforts target multi-dwelling units

(MDU) and commercial customers in urban and suburban areas.

These new entrants will further validate the business model and lend BWA providers greater credibility in capital markets and the halls of government. Long term, these companies could pose a competitive threat or present exit opportunities for smaller providers.

7 New markets and service categories = more opportunities

To date, fixed wireless technology has been most successful in rural America, where it offers high-grade service in areas with limited alternatives, locally based customer service, and superior economics compared to other broadband options.

However, BWA providers are beginning to enter higher-density markets due to the new technologies available, the faster deployments possible, and the improving access to capital. For example, industrial parks, residential communities, and government or institutional facilities are often found on the fringes of urban areas. Urban enterprise zones often have aging infrastructure and indifferent incumbent providers. We see growth in urban deployments utilizing 5G millimeter-wave technologies, which deliver high-capacity, high-speed services, albeit at shorter distances.

For all the reasons described in this report, BWA providers are well positioned to compete in these neglected markets as well. The Carmel Group expects these higher-density markets could grow to represent 30 percent or more of industry revenues in the five- to ten-year time horizon.

On another front, the advances in equipment are enabling wireless networks to dramatically reduce latency, i.e., the delay between transmitting and receiving data. Broadband applications that depend on speed, reliability, and low latency – such as gaming, video-on-demand, the Internet of Things (IoT), and data backup for business and government – are among the most robust segments in the broadband market.

BWA operators interviewed for this report also noted that home security and automation systems are ancillary services that can be conveniently packaged with fixed wireless broadband.

These growth drivers are not yet factored into our current growth forecast, which means the BWA outlook could have even more upside than that projected here.

Fixed Wireless Versus Other Technologies

The various telecommunications technologies have “pros and cons” that affect their suitability for various market requirements. The gaps in any one technology present clear opportunities for the others. Fixed wireless competes well with many of the alternatives. (See Figure 6.)

VERSUS MOBILE/CELLULAR

Mobile/cellular networks were developed for mobile voice service; data-intensive applications came much later. In the mobile arena, customers typically buy a quantity of data per month and face extra charges or service restrictions if they exceed data caps.

Mobile carriers typically use licensed spectrum in the 700 MHz to 2.5 GHz range, which they buy at FCC auctions or on the secondary market. These costs are passed through to consumers. On top of spectrum costs, the equipment needed to run mobile networks costs substantially more to own and operate than fixed wireless equipment.

Fixed wireless BWA systems do not provide for mobility. However, they can ensure high reliability and efficient carriage of large volumes of data for customers in fixed locations through the use of large, outdoor, directional antennas.

The mobile/cellular industry also spreads supply, operations, and maintenance among a dizzying array of consumer electronics companies, equipment vendors, and telephone companies.

In contrast, fixed wireless providers typically do it all. They buy, install, and maintain everything in their network, from the “backhaul” into the system base, to the towers, to the fiber, to the consumer premises equipment both inside and outside their customers’ buildings.

VERSUS DSL, FIBER, CABLE AND SATELLITE

A remarkable 74% of American households have only one local provider of broadband connections that can meet the FCC’s broadband speed standard of 25 Mbps download and 3 Mbps upload – consistently and at attractive prices. This fact alone indicates the need for policies to encourage more investment and competition.

Fixed wireless BWA systems do not provide for mobility. However, they can ensure high reliability and efficient carriage of large volumes of data for customers in fixed locations.

In the mobile arena, tiny antennas that fit inside of a handheld device and transmit signals on-the-go are the norm. Sadly, customers can do little but accept spotty connections and dropped calls caused by poor reception on the handheld device.

In areas where consumers have two or more options, telco-provided Digital Subscriber Line (DSL) service is often the only competitor to fixed wireless. However, DSL is comparatively slow and costs considerably more to deploy and upgrade than other technologies.

Many of the BWA leaders interviewed for this report said fiber-to-the-home (FTTH) tends to be their fiercest rival in those limited areas where FTTH is available. Previously-deployed-but-unused fiber provides good throughput and tends to be cost-competitive to the consumer. The economics of new fiber tend to limit it to higher-density markets and higher-traffic tower links.

Cable tends to be limited to more densely populated areas, and many cable systems still deliver services via aging infrastructure. State-of-the-art cable tends to be limited to the most profitable markets. Thus, BWA providers enjoy several advantages over cable broadband in terms of reaching more far-flung customers with reliable, speed-competitive service, even in urban and suburban environments.

The relatively high latency of satellite broadband limits its use for gaming and other low-latency applications. BWA providers, cable, fiber, and mobile are all better suited for latency-sensitive applications.

Data caps among satellite providers further reflect the relative scarcity of today's satellite broadband capacity. Conversely, data caps among BWA providers are quite rare.

However, it is worth noting that BWA providers may occasionally team up with satellite broadband providers to offer broadband where typical terrestrial wireless services are not available.

BWA Providers Face Challenges

While the outlook for the BWA industry is highly positive, there are a number of challenges:

- Across the telecommunications and media industries, there are intense competitive pressures and aggressive efforts by all kinds of service providers to attract and retain customers.
- Policymakers at all levels are less familiar with BWA providers and fixed wireless than they are with larger incumbents using traditional technologies. Hence, there tends to be a lack of policy support for BWA providers and, indeed, there are many policies that tend to favor incumbent competitors.
- Detractors raise concerns about the sustainability of unlicensed spectrum and spectrum sharing.
- Several of the largest broadband competitors – specifically telcos and cable companies – have acquired significant interests in content companies, giving them the ability to offer consumers attractive service packages that feature their favorite networks and shows. As mostly small businesses, BWA providers cannot compete with large, vertically integrated companies in this arena.
- The industry's comparatively small size, especially on an average individual company basis, together with its lack of scale and consolidation, affect its ability to educate investors, legislators, regulators, media, and the general public.

Conclusion

The Carmel Group believes that the fixed-wireless-based, Broadband Wireless Access industry will continue to experience robust growth in revenues, subscribers, and investment, as well as increasing recognition in the United States' telecommunications regulatory scheme – all primarily because of the many favorable conditions and trends described above.

Telecommunications industry stakeholders, investors, and policymakers can look forward to exciting days ahead for the BWA industry.

Appendix

As part of the extensive research conducted for this report, in Q4 of 2016 The Carmel Group received survey results from 169 Broadband Wireless Access (BWA) operators, who answered 80 questions on a variety of business issues. The response rate was an above-average 30% of the entire survey sample. An additional BWA manufacturer/vendor survey was also completed.

Topic areas of the Operator Survey included current subscribers, future subscribers, customer service, equipment, services, competition and competitive advantages, and business issues.

The BWA operators' answers to four of the 80 survey questions are provided below. These charts show that:

Subscribers: Many BWA operators experienced robust growth in the number of new

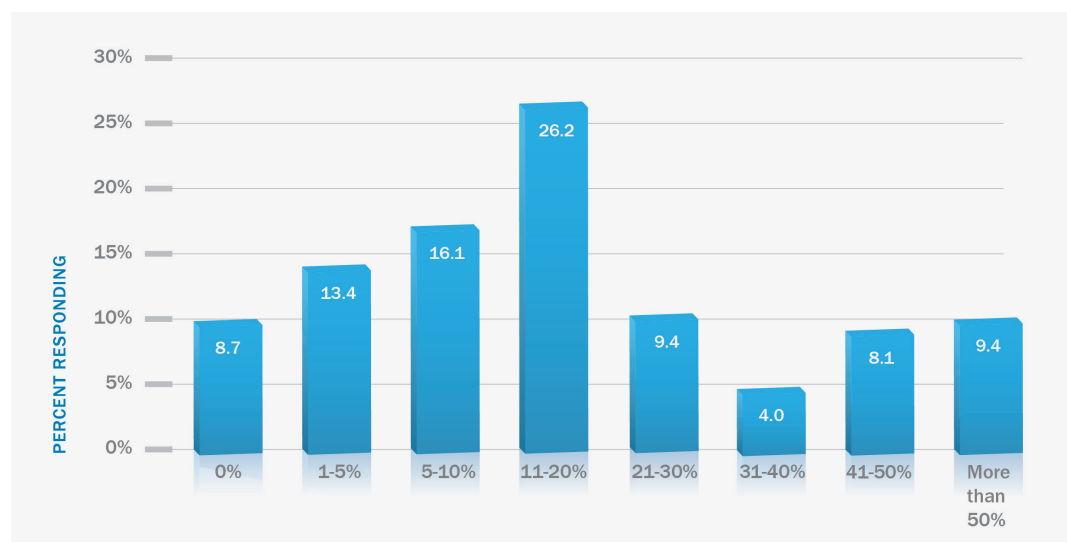
residential subscribers from 2015 to 2016, with roughly half reporting growth of 11% or more.

SAC: Most of the respondents reported Subscriber Acquisition Costs (SAC) in the range of \$200 to \$400, which compares quite favorably to the SAC reported by cable, telco, and satellite providers for delivery of their video and broadband service.

ARPU: Most respondents reported average revenue per unit (ARPU) in the range of \$40 to \$70, with the highest number of respondents having an ARPU in the \$51-60 range.

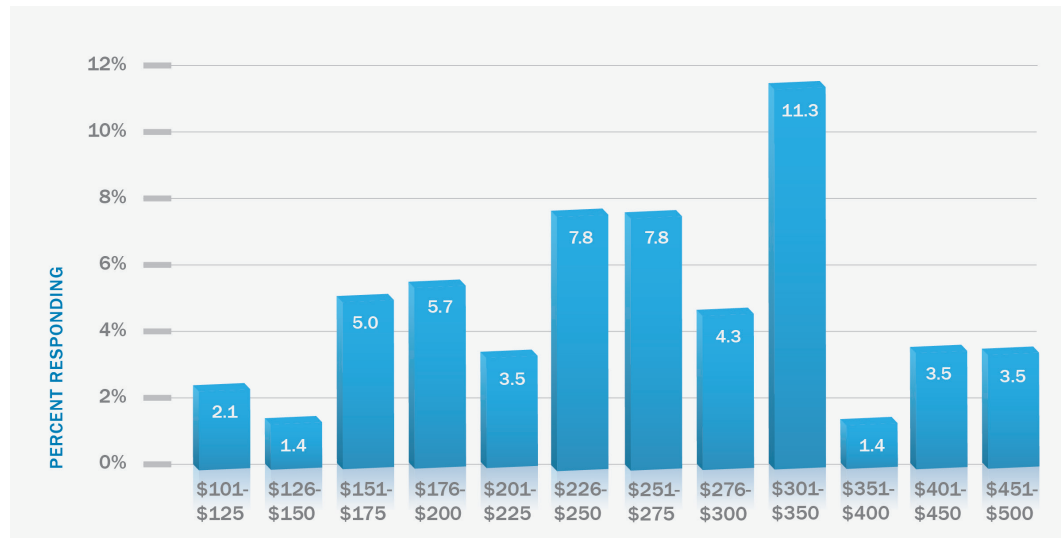
Churn: Most responding BWA operators experience low subscriber turnover relative to the competitors mentioned above, suggesting that those providers produce and deliver a highly satisfactory broadband product.

FIGURE 10: What was your actual or best estimate of the annual residential subscriber growth percentage rate for your company during the past year?



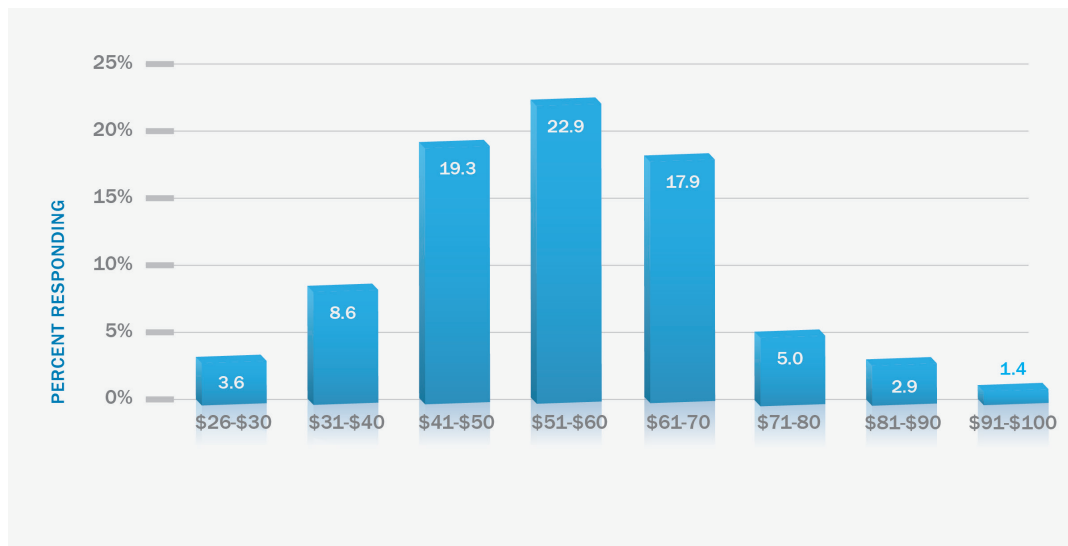
Source: The Carmel Group
Copyright 2017. All Rights Reserved. Property of The Carmel Group

FIGURE 11: What is your company's average Subscriber Acquisition Cost (SAC) for a new residential customer?



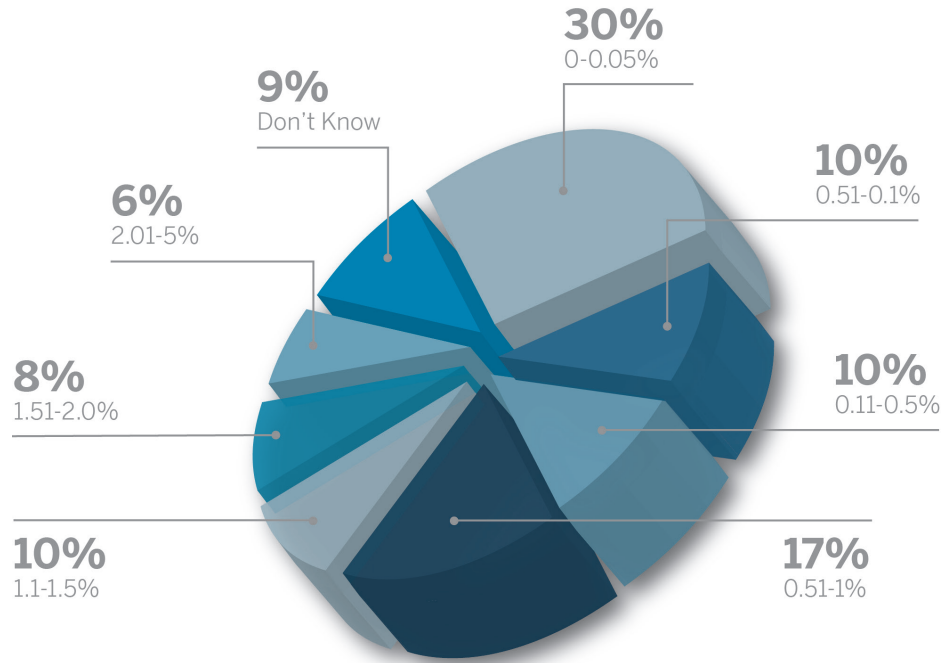
Source: The Carmel Group
Copyright 2017. All Rights Reserved. Property of The Carmel Group

FIGURE 12: What is your company's most recent figure for average revenue per unit/subscriber (ARPU) for only residential users?



Source: The Carmel Group
Copyright 2017. All Rights Reserved. Property of The Carmel Group

FIGURE 13: What is your company's average monthly churn (or turnover) rate for the past year (take your average number of disconnected subscribers in a given month and divide that by your subscriber base at the beginning of month)?



Source: The Carmel Group
Copyright 2017. All Rights Reserved. Property of The Carmel Group

Exhibit 2

List and Summary of Selected Experimental Authorizations in the 3550-3650 MHz Band

Digis LLC (Call Sign WI2XKN) – Operating as Rise Broadband, the country’s largest WISP with approximately 200,000 customers, Digis is conducting a market trial in Utah County, Utah to “inform its business, investment, technology and deployment decisions as it plans for expansion of its broadband networks” and to determine “the value and utility of PALs.” The trial is currently providing service to more than 200 customers.

SkyWerx Industries (Call Sign WU2XTF) – SkyWerx is a WISP serving rural Colorado. Its trial purpose is “to determine the financial and technical viability of the CBRS band and assess consumer acceptance at various speeds and price points.”

Speedwavz LLP (Call Sign WI2XOC) – Speedwavz, a WISP based in rural Richwood, Ohio, explained that “[w]e want to test the feasibility of connecting LTE Access Points to SAS database in the new proposed 3.5 band. This will provide broadband in rural underserved areas. We plan to run tests in collaboration with the manufacturer so that they can ensure their equipment operates as designed, and plan to obtain permanent PAL license when that becomes available.”

CellTex Networks, LLC dba ZipLink (Call Sign WI2XYI) – ZipLink is a WISP based in South Texas that obtained an experimental license to test LTE equipment manufactured by different companies. In the trial, ZipLink plans to determine the best balance of cost and performance to inform its financial modeling and to assess consumer acceptance at various performance and price points.

First Step Internet, LLC (Call Sign WI2XYD) – First Step, a fixed wireless broadband provider in rural Idaho, plans to conduct an experiment to gain information on future expansion and network investment plans. First Step also has proposed to serve identified unserved areas that are funded through the Commission’s rural broadband experiment program.

Plexicomm, LLC (Call Sign WI2XVY) – Plexicomm, a fixed wireless broadband provider, describes its planned experiment as a way to quantify any differences in customer satisfaction between the Cambium PMP450 and its existing WiMAX connections. Note that this trial does not include LTE equipment.

ExteNet Systems, Inc. (Call Sign WI2XKQ) – ExteNet, a neutral host service provider, obtained an experimental license “to test and demonstrate prototype high-speed wireless data infrastructure communications equipment that will operate in the 3.5GHz Band” at its indoor facilities.

SpiderCloud Wireless, Inc. (Call Sign WI2XXS) – SpiderCloud Wireless is a startup company that is designing 3G/4G small cells for outdoor enterprise applications.

Broadcast Sports International (multiple call signs) – The licensee is a video production company that provides video for broadcast, satellite broadcast and cablecast of sporting and other

events. It explains that “the spectrum usage in many major cities and the limited available spectrum for these events makes it necessary to make coordinated, temporary use of additional channels in the vicinity of 3.6 GHz.

The Walt Disney Corporation (Call Sign WI2XTG) – Disney is testing equipment at its Disneyland and Disney World venues in California and Florida.

Rice University (Call Sign WI2XLO) – Rice University is conducting a trial on its campus to test “a first-of-its-kind multi-cell wireless network research platform capable of massive MIMO” pursuant to a National Science Foundation grant.

Exhibit 3
Proposed Rule Section 96.41(e)(1)

(1) General protection levels. Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by the SAS to CBSDs, the conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) for a 10 MHz or narrower operating channel shall not exceed -13 dBm/MHz within 0-10 megahertz above the upper SAS-granted channel edge and within 0-10 megahertz below the lower SAS-granted channel edge. At all frequencies greater than 10 megahertz above the upper SAS-granted channel edge and ~~less~~ greater than 10 MHz below the lower SAS-granted channel edge for a 10 MHz or narrower operating channel, the conducted power of any emission shall not exceed -25 dBm/MHz. For an operating channel wider than 10 MHz, the conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 100% of the assigned bandwidth above the upper SAS-granted channel edge and within 100% of the assigned bandwidth below the lower SAS-granted channel edge, but not to exceed 40 MHz from either channel edge. At all frequencies whose distance from the operating channel edge is greater than the assigned channel bandwidth, or more than 40 MHz from the operating channel, the conducted power of any emission shall not exceed -25 dBm/MHz. The upper and lower SAS-granted channel edges are the upper and lower limits of any channel granted to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

CERTIFICATE OF SERVICE

I, Sharon Krantzman, hereby certify that on this 24th day of July, 2017, a copy of the foregoing “Comments of the Wireless Internet Service Providers Association” was sent by first class, postage prepaid mail to the following:

Steven B. Sharkey
John Hunter
Christopher Wieczorek
T-Mobile USA, Inc.
601 Pennsylvania Avenue, NW, Suite 800
Washington, DC 20004

Thomas C. Power
Scott K. Bergmann
Brian M. Josef
Kara D. Romagnino
CTIA
1400 16th Street, NW, Suite 600
Washington, DC 20036

/s/ Sharon Krantzman
Sharon Krantzman