Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Applications of T-Mobile US, Inc.	)	WT Docket No. 18-197
	)	
and	)	
	)	
Sprint Corporation	)	
	)	
Consolidated Applications for Consent to Transfer Control of Licenses and Authorizations	)	
	)	

PETITION TO DENY THE ABOVE-CAPTIONED APPLICATIONS AS CURRENTLY PROPOSED OF VOQAL

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August 27, 2018

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Voqal[1] respectfully petitions the Commission to deny the proposed merger of T-Mobile US, Inc. ("T-Mobile") and Sprint Corporation ("Sprint") (together, the "Applicants") as currently proposed.[2]

[1] Voqal is the collective trade name for five nonprofit organizations that hold licenses in the Educational Broadband Service (EBS): Chicago Instructional Technology Foundation (CITF), Denver Area Educational Telecommunications Consortium (DAETC), Instructional Telecommunications Foundation (ITF), Portland Regional Educational Telecommunications Corporation (PRETC), and Twin Cities Schools' Telecommunications Group (TCSTG). CITF is licensee of WLX-630, Chicago. DAETC is licensee of WHR-488, Denver. ITF is licensee of WHR-509, Indianapolis; WHR-527, Philadelphia; WHR-512, Sacramento; WHR-511, Kansas City; WLX-699, Salt Lake City; WLX-694, Las Vegas; and WLX-816, Phoenix. PRETC is licensee of WHR-522, Portland. TCSTG is licensee of WHR-487, Minneapolis. Though these five commenting organizations are separate, many of their activities are similar or are conducted together, a combination that tended to be confusing to users. Consequently, the five nonprofits adopted the trade name Voqal in common and are referred to collectively as Voqal in this pleading. The Voqal entities ("Petitioners") are lessors, and potentially sellers, of spectrum in the 2.5 GHz band, a market that will suffer anticompetitive harm as a result of the proposed merger, as explained in more detail herein. Consequently, Petitioners are parties in interest under Section 309(d)(1) of the Communications Act. *See* 47 U.S.C. § 309(d)(l).

I. Introduction and Summary

The proposed Sprint-T-Mobile merger raises a host of questions. But one that may not come immediately to mind is the impact on the development of 5G of the new company's ability and incentive to exercise market power over a wireless spectrum band at 2.5 GHz. This market power threatens anticompetitive effects both in the acquisition of spectrum and the sale of wireless broadband services.

The use of the 2.5 GHz spectrum band (referred to herein as the 2.5 band) will be critical in the coming years. As a matter of physics and as result of past regulatory policy, the 2.5 GHz spectrum is a "sweet spot" for developing 5G. Sitting in the "mid-band" of spectrum frequencies, the 2.5 band offers a unique combination of propagation and data capacity advantages. Not too low in frequency, not too high, it's just right for the deployment of 5G. The proposed merger would ensure that the merged entity ("New T-Mobile") would control virtually all of this key spectrum, resulting in the following anticompetitive harms.

First, Sprint has buyer power in the market for 2.5 spectrum—it controls the bulk of the band and other major wireless carriers control virtually none. As described in more detail below, Sprint's commanding position allows it to dictate the terms of its contracts with 2.5 spectrum lessors. The proposed merger would give the merged entity ("New T-Mobile") greater financial resources to exercise and expand this buyer power, and would create additional reasons for it to exploit that power to impose lower prices on sellers and lessors of 2.5 spectrum, most of which,

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[2] *See* Public Notice, WT Docket No. 18-197, T-Mobile US, Inc., and Sprint Corporation Seek FCC Consent to the Transfer of Control of the Licenses, Authorizations, and Spectrum Leases Held by Sprint Corporation and Its Subsidiaries to T-Mobile US, Inc., and the *Pro Forma* Transfer of Control of the Licenses, Authorizations, and Spectrum Leases Held by T-Mobile US, Inc., and Its Subsidiaries, DA 18-740 (July 18, 2018).

including Petitioners, are nonprofit or governmental entities that serve the public interest by using their spectrum for educational purposes.

Second, there is widespread acknowledgement that 2.5 spectrum is a crucial input for developing 5G. T-Mobile's low-band and high-band spectrum holdings, according to both the Applicants and outside commenters, complement Sprint's mid-band 2.5 holdings for the purpose of developing 5G. By combining, Sprint and T-Mobile would ensure that they, and only they, control the best, indeed perhaps the only, mid-band spectrum for nationwide 5G deployment. Deprived of access to the 2.5 band, competitors' efforts to develop 5G will be more costly and less effective, and wireless broadband customers will suffer as a result.

Third, the proposed merger will cause New T-Mobile to exceed the spectrum screen by a significant margin in many major geographic markets, and will convert an already concentrated four-firm wireless market to an even more concentrated three-firm market. Although the Applicants have contended in their submission in this proceeding that the merger will create procompetitive efficiencies that offset the presumptive anticompetitive harms arising from these outcomes, the Commission should reject that as a justification because the merger will inhibit the ability of competitors to provide the best nationwide 5G network.

For all of these reasons, the Commission should designate the proposed transaction for hearing, take action to prevent its consummation, and, failing that, require Sprint to divest a substantial portion of its 2.5 spectrum holdings in order to ensure the existence of a competitive 2.5 band market.

II. The 2.5 GHz Band Is a "Sweet Spot" for 5G and Constitutes an Appropriate Product Market

As Sprint has boasted[3] and the Commission[4] has recognized, the 2.5 GHz band is a "sweet spot" for developing 5G. And the importance of the 2.5 band has not been lost on other nationwide carriers also seeking to deploy 5G nationally. AT&T has told the Commission that EBS spectrum "has enormous potential value to the public today because it is highly suitable for terrestrial mobile wireless broadband services, especially next-generation 5G services."[5] Verizon has explained that "mid-band spectrum [such as 2.5 spectrum] could fill the critical gap between the high-band and low-band spectrum that will continue to serve as the foundation for network coverage and eventually fold into the 5G network architecture."[6]

Its unique combination of technical and practical advantages makes the 2.5 band highly desirable for developing a 5G network. Spectrum in the 2.5 band propagates better than high-band spectrum and poses fewer practical problems than low-band spectrum. 2.5 is used by several major international companies, which creates economies of scale and global synergy in manufacturing the equipment for both 4G and 5G. And the width and allocation of the 2.5 band means that, unlike with most other bands, it is possible to acquire wide, contiguous blocks of

[3] *See* Kevin Crull, Chief Strategy Officer, Sprint Corporation, Transcript of Remarks at 5G North America (Jul. 5, 2018) ("Sprint has a treasure trove of 2.5 GHz spectrum and it's particularly good for 5G because it sits in the perfect balance of speed and capacity and propagation, or distance and coverage"); Michel Combes, CEO, Sprint Corporation, Transcript of Remarks at J.P. Morgan Global Technology, Media and Communications Conference ("Combes Transcript") (May 6, 2018) ("Let's be clear once again and let's be fact based on this one. Mid band spectrum is the sweet spot for 5G mobile").
[4] Notice of Proposed Rulemaking ("Notice"), *Transforming the 2.5 GHz Band* ("*2.5 NPRM*"), WT Docket No. 18-120, FCC 18-59 (May 10, 2018).
[5] Comments of AT&T at 1, *2.5 NPRM*.
[6] Comments of Verizon at 3, *2.5 NPRM*.

spectrum, generating greater capacity and suitability for 5G.[7] Together, these characteristics mean that the sale and leasing of 2.5 spectrum should be treated as a relevant product market divided among local geographic markets.

A. The 2.5 GHz Band Has Distinct Technological Advantages Over Other Frequency Bands That Are Available for 5G Deployment

2.5 is uniquely suited for developing 5G. 2.5 waves are longer than those of high-band, "millimeter" wave frequencies,[8] resulting in better propagation and more effective in-building coverage than can be achieved with the millimeter band.[9] These characteristics are necessary for deploying 5G effectively, particularly in rural areas with low population densities.[10] AT&T[11] and Verizon[12] have both announced 5G plans hinging on millimeter wave spectrum, but it is widely acknowledged—including in Sprint and T-Mobile's submission in this proceeding[13]—that a base station's signal coverage at millimeter wave frequencies is much more limited than at 2.5. Consequently, the density and expense of constructing a 5G network would be much higher

[7] Description of Transaction, Public Interest Statement, and Related Demonstrations ("Statement") at 23-24, WT Docket No. 18-203 (June 18, 2018) (contiguous spectrum blocks increase bandwidth utilization and "allow for gains in statistical multiplexing").
[8] Millimeter frequencies are spectrum bands between 30 GHz and 300 GHz with wavelengths that can be measured in millimeters. Declaration of Dr. Kevin Gifford at ¶ 7.
[9] Declaration of Dr. Kevin Gifford at ¶ 8, 13.
[10] Declaration of Dr. Kevin Gifford at ¶ 13.
[11] *See* Melissa Arnoldi, "Ready to Launch: How 2 Years of 5G Trials is Preparing Us for Commercial Development," *AT&T Innovation Blog* (April 10, 2018), http://about.att.com/innovationblog/two_years_of_5g_tria.
[12] *See* John O'Malley, "What is millimeter wave technology?" (June 21, 2018), https://www.verizon.com/about/our-company/5g/what-millimeter-wave-technology; Monica Alleven, *FierceWireless*, "Verizon remains encouraged by millimeter wave propagation: analysts," (May 23, 2018), https://www.fiercewireless.com/wireless/verizon-remains-encouraged-by-millimeter-wave-propagation-analysts.
[13] Statement at 22 ("due to the propagation properties of th[e millimeter spectrum] . . . millimeter wave band coverage will be available only in limited areas").

at millimeter wave frequencies than at 2.5,[14] and the challenge of ubiquitous geographic coverage is far greater.[15] As the CEO of Sprint explained this spring, "[i]f you want to do coverage, a national coverage with millimeter way [sic] you will need one million sites."[16]

On the other hand, 2.5 waves are shorter than those of "low" frequency bands in the 600-800 MHz range.[17] As a result, 2.5 antennas are more physically compact than low-band antennas, making them particularly well-suited for implementing "massive MIMO" (multiple input, multiple output technology),[18] which Sprint[19] and T-Mobile[20] have identified as an integral component of 5G development. For example, unlike low-band antennas, 2.5 antennas are compact enough to be attached to such widely-available supporting structures as utility poles.[21] In addition, 2.5 band waves pose fewer signal interference problems than occur in the 600-800

[14] Dan Jones, "Sprint Says No to mmWave, Yes to Mobile 5G," *Light Reading* (Jan. 11, 2018), https://www.lightreading.com/mobile/5g/sprint-says-no-to-mmwave-yes-to-mobile-5g/d/d-id/739592 ("Sprint's CTO said Wednesday that he is not sure that using millimeter waves to deliver 5G services is a practical economic use of the high-band spectrum and that Sprint will be focusing on using its existing bandwidth to deploy 5G, at least initially").

[15] *See* Statement at 102 (a 5G network built on 2.5 spectrum will reach "far more customers across a much larger geographic area than either Verizon or AT&T could plausibly muster using only millimeter wave spectrum").

[16] Combes Transcript.

[17] Declaration of Dr. Kevin Gifford at ¶ 8.

[18] Joan Engebretson, "Sprint CTO: Not All Massive MIMO is Created Equal," *Telecompetitor* (June 22, 2018), https://www.telecompetitor.com/sprint-cto-not-all-massive-mimo-is-created-equal/ ("'Massive MIMO doesn't work well in low-band spectrum,' said Saw. Massive MIMO equipment operating in lower frequency bands would need to be quite large, making it difficult to install on existing cell towers, he said. '2.5 GHz or higher bands is where it makes sense,' he commented").

[19] Monica Alleven, "Sprint CTO explains how carrier plans to win the 5G race," *FierceWireless* (May 24, 2018), https://www.fiercewireless.com/wireless/sprint-cto-explains-how-it-plans-to-win-5g-race.

[20] Juan Pedro Tomas, "T-Mobile, Huawei test massive MIMO in Amsterdam," *RCR Wireless* (October 4, 2017), https://www.rcrwireless.com/20171004/5g/t-mobile-huawei-massive-mimo-tag23.

[21] Declaration of John Schwartz at ¶ 31.

MHz bands in densely built urban networks of the sort expected to be needed for 5G because they are better suited to serving the smaller cell sizes needed for dense network deployment.[22]

In practice (but not because of a regulatory requirement), wireless broadband transmissions in the 2.5 band in the United States employ Time Division Duplexing (TDD) rather than Frequency Division Duplex (FDD).[23] TDD is better suited for use with massive MIMO, which Sprint has announced will be an integral part of its 5G deployment.[24] FDD employs separate upstream and downstream channels that are often separated significantly in frequency; therefore significantly different wavelengths are received and transmitted through the same MIMO antennas.[25] MIMO antennas work less efficiently if they are fed a wide span of frequencies.[26]

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[22] Declaration of Dr. Kevin Gifford at ¶ 14.

[23] Declaration of John Schwartz at ¶ 29. FDD uses separate frequencies for upstream and downstream channels. TDD uses the same channel for both, assigning upstream signals certain time slots and downstream signals the remainder. Many engineers argue that TDD is inherently more efficient, as most slots can be assigned for downstream use, which matches demand as most internet traffic is downstream. In contrast, FDD configurations usually assign equal upstream and downstream capacity.

[24] Sean Kinney, "Sprint CEO says carrier will deliver first mobile 5G network 'potentially in the world,'" *RCR Wireless* (February 2, 2018), https://www.rcrwireless.com/20180202/business/sprint-ceo-mobile-5g-network-tag17 ("'Our path to 5G is going to be coming through massive MIMO,' Saw said. 'Because of our strong spectrum position…we're able to basically use half these antennas for LTE and simultaneously use the other half for 5G. Essentially you're killing two birds with one stone. You can turn on 5G with a software upgrade in a few months'").

[25] Joan Engebretson, "Sprint CTO: Not All Massive MIMO is Created Equal," *Telecompetitor* (June 22, 2018), https://www.telecompetitor.com/sprint-cto-not-all-massive-mimo-is-created-equal/ ("Saw also argued that Sprint's use of TD-LTE provides greater 'certainty' because, unlike with FDD-LTE, both transmit and receive functions occur on the same channels. Sprint is the only U.S. carrier using TD-LTE. Saw noted, though, that all carriers will use time division duplexing for 5G").

[26] Declaration of Dr. Kevin Gifford at ¶¶ 20-21; Declaration of John Schwartz at ¶ 31.

B. Regulatory Choices And The Existence Of Economies Of Scale Have Further Advantaged The Use Of The 2.5 GHz Spectrum For 5G Development

1. The 2.5 GHz Band Is Divided Into Big Blocks, Which Makes It Easier To Use For Wireless Broadband

Based on the size and structure of the 2.5 band and the current allocation scheme, it is possible to acquire wide blocks of spectrum in the 2.5 band. The 2.5 band consists of almost 200 MHz of contiguous spectrum; other comparable bands have substantially less contiguous spectrum, and are often saddled with gaps because they were designed for FDD instead of TDD use.[27] In many key markets, Sprint has assembled wide, contiguous blocks of spectrum.[28] Wireless carriers, including Sprint and T-Mobile, seek blocks wider than 100 MHz for their 5G channels. Such blocks are currently impossible to acquire below 2.5 in the United States, although very wide channels are available in the millimeter range; indeed Verizon has noted that "the 2.5 GHz band constitutes the single largest band of continuous spectrum below 3 GHz that could be used for 5G."[29] The availability of contiguous blocks makes 2.5 especially advantageous for 5G, in part because "[t]ransmission across wide channels provides for increased data throughput."[30]

2. Global Standardization Creates Economies Of Scale For 2.5 Transmission Equipment

Sprint is not the only wireless company to use 2.5—China also allows the band to be used for wireless broadband where China Mobile uses 2.5 with TDD transmissions. SoftBank

[27] Declaration of John Schwartz at ¶ 10.
[28] Declaration of John Schwartz at ¶¶ 24-27; *see* Exhibit M-3, Statement.
[29] Comments of Verizon at 1, *2.5 NPRM*.
[30] *Applications of AT&T Mobility Spectrum LLC and KanOkla Telephone Association For To Assign Licenses*, 30 FCC Rcd 8555, 8563-8564 (2015); Appendix J at 4 n. 10 ("The FCC has also recognized the benefits of continuity/seamlessness of services enable through commonality of spectrum with adjacent markets"); Declaration of Dr. Kevin Gifford at ¶ 14 ("The 2.5 band is also advantageous for 5G because large, contiguous sections of the band remain available, allowing for the creation of wide channels for cellular transmission.").

has deployed 2.5 TDD in Japan. Consequently, there is international standardization for 2.5 TDD equipment, and 2.5 base stations and handsets can be made relatively inexpensively due to economies of scale, which advantages wireless carriers.[31]

C. The Unique Advantages Of Mid-Band, 2.5 GHz Spectrum Render It Crucial For Nationwide 5G Deployment

The above characteristics of the 2.5 band render it well-designed to achieve the goals of 5G: increased data rates; massive machine-to-machine communications; and low-latency, ultra-reliable communications (LLURC).[32] 2.5 spectrum is particularly well-suited for bringing these advantages to non-urban areas, complementing the use of low-band spectrum in rural areas where the propagation benefits of long waves are particularly useful and high-band spectrum in densely populated urban areas where short waves pose less of a signal interference risk than long waves.[33] New T-Mobile will hold substantial spectrum of all three types[34] and will in particular control an overwhelming amount of 2.5 spectrum.[35]

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[31] John Saw, "CTO Blog: Sprint, Qualcomm Technologies and SoftBank Accelerate 5G for 2.5 GHz," (May 10, 2017), http://newsroom.sprint.com/sprint-qualcomm-technologies-and-softbank-accelerate-5g-for-25-ghz.htm ("Today 2.5 GHz TDD-LTE is one of the largest global wireless ecosystems used by some of the most influential operators in the world such as SoftBank and all of China's operators, including China Mobile. As one of the first proponents of 2.5 GHz and TDD-LTE for 4G, we understand the value of building a strong global ecosystem early on. This is why we are working with Qualcomm and SoftBank to develop the 3GPP 5G NR capabilities for 2.5 GHz. By doing so we are ensuring that Sprint's deep 2.5 GHz spectrum is an early first-mover in the 5G ecosystem. Not all spectrum bands have this kind of global support and economy of scale").

[32] Declaration of Dr. Kevin Gifford at ¶ 11.

[33] Declaration of Dr. Kevin Gifford at ¶¶ 11, 13.

[34] Statement at 32-33 ("From a spectrum standpoint, the merger yields . . . access to a complementary spectrum portfolio to deploy 5G, including a combination of low-, mid-, and high-band spectrum that offers options for wide area coverage and high capacity . . . The aggregate amount of spectrum available to New T-Mobile will allow it to dedicate spectrum in the 600 MHz, 2.5 MHz, and millimeter wave bands to 5G more rapidly").

[35] Declaration of John Schwartz at ¶ 24; *see generally* Appendix L-1, Statement and Appendix M-3, Statement.

D. 2.5 GHz Geographic Markets Are Defined By Their Local Service Areas

The FCC has typically allocated 2.5 spectrum on a local basis. For the EBS band, educational entities hold licenses—and lease their spectrum capacity—in specific "Geographic Service Areas" (GSAs) defined as "a circle with a radius of 35 miles from the license's reference point."[36] The reference point is typically near the center of a given metropolitan area.[37] BRS spectrum was originally allocated by GSA and, later, an auction of overlay licenses by "Basic Trading Areas" (BTAs).[38] Because allocation of 2.5 spectrum varies geographically, so do the competitive dynamics of the sale and lease of that spectrum, and it is therefore necessary for the Commission to examine the anticompetitive effects of the proposed transaction on a local basis. After all, a wireless carrier that wishes to procure 2.5 band capacity to serve customers in a particular geographic region must obtain it from holders of 2.5 spectrum in that same region—2.5 spectrum allocated to Sacramento is of no use to a wireless carrier that wishes to expand its network in Tennessee.

E. The Market For 2.5 Spectrum Is A Properly-Defined Product Market

Based on the characteristics of the 2.5 band described above, the Commission should treat the market for 2.5 spectrum as a properly-defined product market, and should consider the likely anticompetitive effects on this market in deciding whether to designate the proposed transaction for hearing. The market for 2.5 spectrum should be treated as a product market because its technical characteristics and regulatory treatment make it uniquely well-suited for 5G

[36] "Regulatory – Geographic Service Areas," *NEBSA* (Viewed August 27, 2018), https://nebsa.org/index.cfm/regulatory/geographic-service-areas/.
[37] Declaration of John Schwartz at ¶ 17.
[38] Declaration of John Schwartz at ¶ 3. The FCC assigns spectrum in a variety of geographic units, among them BTAs. In addition to BRS, for example, the millimeter-wave Local Multipoint Distribution Service (LMDS band) has been allocated according to BTAs. *See FCC Factsheet on Local Multipoint Distribution Service Auction* (viewed August 26, 2018), https://transition.fcc.gov/Bureaus/Wireless/Factsheets/lmds.html.

development. And the manner in which it is configured for use in the United States and other countries, and the fact that the Commission allocates 2.5 spectrum on a local basis, suggests that each geographic area for which a broadband license is allocated should be treated as a geographic market. As described further below, New T-Mobile's stranglehold on this spectrum would raise costs for competing wireless carriers, which would only burden their own nationwide deployment, and it would also lessen competition for the procurement of 2.5 spectrum from Petitioners and others.

III. Sprint Controls The Competitive Dynamics Of The 2.5 Band

A. Sprint Now Holds Large Market Shares In Important Local Markets For 2.5 Spectrum

The 2.5 band is divided into two sections: Educational Broadband Services (EBS) and Broadband Radio Services (BRS).[39] There is a total of 117.5 MHz assigned to EBS and 76.5 MHz assigned to BRS.[40] Currently, while BRS spectrum can be licensed to commercial entities, EBS spectrum must be licensed to non-profit or governmental entities.[41] However, commercial entities are allowed to lease EBS spectrum, subject to certain requirements and restrictions: (1) EBS lease terms can be no longer than 30 years; and (2) EBS licensees must preserve 5% of their holdings for educational use.[42] In addition, in many suburban, exurban, and rural areas EBS spectrum has not yet been allocated by the Commission.[43]

Sprint's holdings in both EBS and BRS are overwhelming. In urban areas, there is no other commercial lessee of EBS spectrum of any consequence, and Sprint also holds the lion's

[39] Declaration of John Schwartz at ¶ 2.
[40] Declaration of John Schwartz at ¶ 4; Exhibit I, Declaration of John Schwartz.
[41] Declaration of John Schwartz at ¶¶ 12-13; 47 C.F.R. § 27.1201(a).
[42] Declaration of John Schwartz at ¶ 14; 47 C.F.R. § 27.1214(b).
[43] Though it is less common, there are rural BTAs where BRS spectrum remains unallocated.

share of BRS licenses.[44] For example, Sprint controls 100% of the allocated EBS and BRS channels in such Cellular Market Areas (CMAs) as Chicago, Washington DC, Pittsburgh, Miami, Baltimore, Minneapolis-St. Paul, Denver, and Phoenix.[45] Sprint claims to hold an average of 160 MHz of 2.5 spectrum (out of a possible 194) in the top 100 markets—an average of 82% of the available 2.5 band spectrum.[46] Based on the Applicants' representations in Appendix L-1, in 125 out of the first 200 counties listed in Appendix L-1,[47] Sprint controls 80.7% of the 2.5 GHz spectrum (156.5 MHz), and in 187 out of the first 200 counties listed, Sprint controls at least 69.1% of the 2.5 GHz spectrum (134 MHz).[48] These market shares would correspond to HHIs of at least 4774.8 and 6512.5, respectively, both of which well exceed the DOJ/FTC Guidelines' threshold of a "Highly Concentrated Market."[49]

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[44] Declaration of John Schwartz at ¶ 13.

[45] Declaration of John Schwartz at ¶ 26 & n. 21 (explaining Sprint's holdings of 2.5 spectrum); Exhibit M-3, Statement.

[46] Mike Dano, "Sprint promises to launch nationwide mobile 5G Network in first half of 2019," *FierceWireless* (February 2, 2018), https://www.fiercewireless.com/5g/sprint-promises-to-launch-nationwide-mobile-5g-network-first-half-2019-and-to-raise-unlimited.

[47] Although Sprint and T-Mobile do not indicate the method by which Appendix L-1 is ordered, it appears that it is arranged by membership in CMAs, which are in turn arranged in order of population. For example, the first 17 counties listed in Appendix L-1 are part of the New York/New Jersey CMA, the most populous CMA in the country.

[48] Sprint's method for reporting its 2.5 spectrum holdings in Exhibit L-1 appears to differ from that used in reports Sprint has made in other fora.

[49] *See* DOJ/FTC 2010 Horizontal Merger Guidelines at 19 ("Highly Concentrated Market" defined as one with an HHI above 2500). Sprint and T-Mobile do not calculate HHIs in their submission because they note that "The FCC has traditionally used Number Resource Utilization Forecast ("NRUF") data to calculate HHIs for the purposes of the HHI screen. That data is usually only made available to applicants pursuant to protective order after the filing of the proposed Transaction." Statement at 135. Petitioners provide the above HHI calculations on a provisional basis. The Commission has, of course, used HHI calculations in past transaction reviews. *See, e.g., In The Matter of Level 3 Communications* at ¶ 49 & nn. 179-180, (October 30, 2017), https://www.fcc.gov/document/fcc-approves-centurylink-level-3-transaction. And it is a critical part of the review of this transaction, as the moving parties recognize. Statement at 132-133.

B. Sprint Has Buyer Power In Important Local Markets For 2.5 Spectrum

Sprint's substantial holdings in 2.5 spectrum markets across the country result in buyer power in those markets. As explained in the attached Declaration of John Schwartz, 2.5 EBS practitioners have observed firsthand that prices and contract terms have gotten worse after Sprint took control of the 2.5 band. From 2003 to 2008, Sprint competed with Clearwire, a wireless broadband company that operated exclusively in the 2.5 GHz band, for leases of EBS spectrum. However, in 2008, Sprint and Clearwire combined their spectrum holdings and Sprint acquired majority ownership in Clearwire, after which the terms of spectrum agreements for 2.5 spectrum became much less favorable for lessors.[50]

It is instructive to examine how 2.5 spectrum in the Miami area was valued in 2014, compared with the valuations of AWS-3 spectrum in the Miami area during the same time period. AWS-3 spectrum and EBS spectrum are not substitutes, and they have different performance characteristics. However, comparing their respective prices can, in a rough sense, provide insight into the difference between competitive and non-competitive spectrum markets. And, indeed, there is an enormous difference in the prices paid for the use of these bands that is best explained by the presence of buyer power in the 2.5 band.

The 2.5 band part of this comparison is provided by Broward County Public Schools ("Broward County"), licensee of two EBS systems covering not only its home county, but also portions of Miami-Dade and Palm Beach Counties. After rejecting offers in 2010 and 2012, Broward County accepted Sprint's spectrum leasing offer in October 2014 of $0.25 per MHz/Pop NPV—a hard-won and unusually favorable price for EBS. But when the FCC conducted a competitive auction for the purchase of AWS-3 spectrum in 2014, two-way

[50] Declaration of John Schwartz at ¶ 40. In 2013, Sprint bought 100% ownership of Clearwire. *Id.* at ¶ 21.

frequencies in the AWS-3 auction for the Miami-Fort Lauderdale area sold for *more than 12 times* the unit price of the Broward County School board lease value. The most likely explanation for the size of this price difference is Sprint's market power in the 2.5 spectrum market.[51]

C. New T-Mobile Is Likely To Have Increased Opportunities to Exercise Its Buyer Power In 2.5 Markets

The Commission has recently issued a Notice of Proposed Rulemaking (NPRM) regarding EBS regulation that includes proposals that would substantially alter the competitive dynamics in the band.[52] It proposes to eliminate the 30-year limit on EBS lease terms, eliminate the 5% educational use requirement for current EBS licensees, make unallocated EBS spectrum available for commercial use through competitive bidding, and allow the sale of EBS licenses to for-profit entities like New T-Mobile.[53] The Notice also contemplates opening up portions of the 2.5 band to Tribal Nations located in rural areas.[54] If these proposals are adopted, New T-Mobile would be well-positioned to exploit its buyer power to acquire the additional, newly-deregulated 2.5 spectrum at below-competitive prices, as well as use its control over existing EBS spectrum locked up in long-term leases to buy licenses at artificially depressed prices.

D. But For New T-Mobile Buyer Power In The 2.5 GHz Band, Other Users Would Seek Its Use

Sprint is scarcely the only company to recognize the benefits the 2.5 band offers for providing wireless services. WISPs such as Rise Broadband have expressed interest in acquiring

[51] Declaration of John Schwartz at ¶ 41 – 46.
[52] Notice, *2.5 NPRM*.
[53] Declaration of John Schwartz at ¶ 12; Notice, *2.5 NPRM*.
[54] Notice at 12-13, *2.5 NPRM* (proposing priority filing window for Tribal Nations to seek licenses for 2.5 spectrum made available pursuant to the Notice).

2.5 spectrum in order to provide fixed LTE wireless coverage in rural areas.[55] SpeedConnect has recently begun using both EBS and BRS spectrum to launch its "LTEXtreme internet service."[56] RedZone Wireless, the fifth-largest holder of licensed EBS spectrum leases in the U.S., is preparing to expand its "5Gx Fixed Wireless Broadband" service beyond Maine.[57] Major wireless carriers and other capable competitors would naturally be expected to seek mid-band spectrum as part of their nationwide deployment of 5G, yet they have failed to obtain a toehold.[58] As well, Sprint is accused of warehousing 2.5 spectrum in rural areas.[59]

IV. The Proposed Merger Will Cause Anticompetitive Effects And Harms To Sellers And Lessors Of 2.5 Spectrum And Will Threaten Harm To Other Companies That Wish To Use The 2.5 Band For 5G Deployment

As discussed above, Sprint currently holds an overwhelming spectrum position in the 2.5 band—vastly more than any other wireless provider. And there is evidence that Sprint enjoys and exploits buyer power over sellers and lessors of 2.5 spectrum. The proposed merger would exacerbate these anticompetitive market conditions in three ways: it would amplify the economic incentives for New T-Mobile to exercise its buyer power, augment New T-Mobile's financial capacity to acquire even more 2.5 spectrum, and combine T-Mobile's 600 MHz advantages with Sprint's control of the 2.5 band. The result: New T-Mobile would impose below-competitive prices on sellers and lessors of 2.5 spectrum, many of which are nonprofit educational entities, and would be able to raise the costs borne by its wireless rivals. In other words, Sprint's current

[55] Monica Alleven, "Editor's Corner—Sprint isn't the only one with 2.5 GHz aspirations," *FierceWireless* (June 26, 2017), https://www.fiercewireless.com/wireless/editor-s-corner-sprint-isn-t-only-one-2-5-ghz-aspirations
[56] *Id.*
[57] *Id.*
[58] Declaration of John Schwartz at ¶ 24.
[59] Declaration of John Schwartz at ¶ 27.

holdings inevitably lessen competition even for future leases or transfers because other wireless carriers do not want to acquire isolated spectrum positions.[60]

The Applicants have made clear that they believe that the proposed merger will allow them to develop a high-quality nationwide 5G network.[61] In particular, Sprint has emphasized the importance of the 2.5 band to its 5G development.[62] By its own admission, then, in order to accomplish the putative pro-competitive outcome of developing high-quality 5G, New T-Mobile would be incentivized to acquire additional 2.5 spectrum as it becomes available. As noted above, 2.5 spectrum may be made available in the near future through the NPRM, both in new geographic markets and via the purchase of existing EBS licenses. It can reasonably be expected that New T-Mobile would leverage its buyer power to acquire this newly-available spectrum at below-competitive prices, or exact favorable, non-price-related concessions. Furthermore, New T-Mobile would have greater financial capacity to acquire 2.5 spectrum (and spectrum on other bands) than would either Applicant by itself if the merger did not occur. Finally, New T-Mobile's exercise of buyer power to achieve below-competitive prices would be especially harmful because most holders of EBS spectrum are nonprofit, educational entities that depend on the royalties from leasing these frequencies to fund their operations. For example, Voqal relies on EBS royalties to support most of their work, which includes such activities as providing unlimited wireless broadband service at low cost to educational institutions, nonprofit organizations, and social welfare agencies.[63]

[60] Declaration of John Schwartz at ¶ 32-33.
[61] Statement at 15-50 (asserting that merger will serve public interest by letting New T-Mobile rapidly deploy a robust, nationwide 5G network).
[62] *See supra* nn. 4, 20, 25.
[63] Declaration of John Schwartz at ¶ 25.

As the Department of Justice has observed, the use of buyer power to corrupt the competitive process is just as dangerous as the use of market power by sellers to harm buyers.[64] Here, the danger is palpable. As described above, lessors of EBS spectrum and sellers of BRS spectrum are already experiencing the consequences of Sprint's buyer power in the 2.5 market. The merger would exacerbate this already competitively restricted situation.

V. The Proposed Merger Will Cause Anticompetitive Effects And Harms To Wireless Users

By common indicia, the proposed merger poses serious risks of anticompetitive harms in the markets for broadband services. Specifically, the merger will cause New T-Mobile to exceed the Commission's "spectrum screen" in a number of large geographic markets, and 4-3 mergers are generally recognized to pose serious risks of enhancing post-merger unilateral and coordinated effects.

Applying what is known as a "spectrum screen," the Commission undertakes a more detailed competitive review of any transaction that will cause one of the parties to hold one third or more of the spectrum in a geographic area available for mobile telephone/broadband services.[65] Sprint's existing spectrum holdings in many key geographic areas are barely below the one-third threshold established by the screen. Based on data submitted by Sprint and T-Mobile to the Commission, New T-Mobile would exceed the spectrum screen by a margin of 10% or more in 100% of the first 400 counties listed in Appendix L-1 and 65.4% of all 3228

[64] Plaintiffs' Supplemental Memorandum on the Buy-Side Case at 2, 4, *United States v. Anthem, Inc.*, No. 16-1493(ABJ) (D.D.C. Dec. 19, 2016).
[65] *Policies Regarding Mobile Spectrum Holdings*, 29 FCC Rcd 6133, 6156 (2014) (reaffirming "continued use of a spectrum screen triggered at aggregations of approximately one third or more of the spectrum suitable and available for mobile telephony/broadband").

U.S. counties.[66] Presumptively, New T-Mobile's prospective holdings in these markets merit closer scrutiny for potential anticompetitive effects.

To head off concerns regarding the extent to which New T-Mobile will exceed the spectrum screen, Applicants contend that the merger is nevertheless justified by the procompetitive efficiencies the merger will achieve—including the benefit of a "world-class, high-capacity, nationwide 5G network."[67] However, Sprint and T-Mobile do not (and cannot) address implications of the fact that post-merger, New T-Mobile will hold the overwhelming majority of 2.5 band spectrum, which is ideally suited for 5G development. Without competitive opportunities to acquire portions of this key spectrum, New T-Mobile's rivals will be hampered in their efficient deployment of a nationwide 5G network.

The Applicants' submission extols the virtues of the 2.5 band for developing 5G, as do Sprint officers' public statements over the past year promoting its planned 5G development. In fact, they claim that any 5G network that does not rely heavily on 2.5 spectrum cannot achieve the quality and reach of a 2.5-based 5G network.[68] Taking these claims at face value, the merger would disrupt 5G development because competitors to the combined entity would lack essential spectrum with the essential blend of propagation characteristic and capacity. In other words, if it is in fact true that "New T-Mobile's nationwide 5G network will enable it to offer true 5G service to far more customers across a much larger geographic area than either Verizon or AT&T could plausibly muster using only millimeter wave spectrum,"[69] then if New T-Mobile controls

[66] *See* Statement, Appendix L-1. Petitioners have calculated these numbers based on the quantity of 2.5 spectrum Sprint and T-Mobile represent that they will control in the first 400 counties listed in Appendix L-1.
[67] Statement at 135.
[68] *See supra* nn. 15-17.
[69] Statement at 102.

most or all of 2.5—a crucial input for 5G—in most geographic markets, the costs of deployment of other 5G nationwide networks will be anticompetitively raised.

VI. At A Minimum, The Commission Should Impose A Condition That Creates Competitive Opportunities In The 2.5 Band

An adequate remedy for competitive harm to both spectrum lessors and wireless users must start by incorporating the technical needs of wireless broadband providers. In its comments in the 2.5 NPRM, AT&T stressed spectrum acquirers' demand for "large blocks of spectrum covering broad geographic areas . . ."[70] Competition for 4G and 5G wireless broadband service would thus be increased markedly by making large blocks of contiguous 2.5 GHz spectrum available to one or more capable competitors to New T-Mobile.

Thus, the Commission should require divestiture of no less than one third of Sprint's 2.5 GHz spectrum in each CMA *in a contiguous block*, unless that configuration is not available locally. In the event that lesser contiguity is available within a CMA, Sprint should be required to divest the greatest available quantity of contiguous spectrum, plus sufficient other nearly-contiguous spectrum to constitute at least one third of its CMA holdings as measured by MHz/Pops. Below are three possible remedies that could meet the above criteria, each of which requires the divestiture of some of Sprint's current EBS holdings.

Divestiture Option #1: Upper Band. One possible remedy could combine divestiture of Sprint's BRS spectrum holdings and G-group EBS leases to create a contiguous block. Divestiture of BRS, which is licensed directly, is less complex than divestiture of EBS, which will involve assigning lease interests and may require the consent of many different lessors.

Divestiture Option #2: Lower Band. A more complex but still feasible remedy would require Sprint to divest its EBS spectrum interests in all or part of the A, B, C, and D channel

[70] Comments of AT&T at 2, *2.5 NPRM*.

groups. This would require multiple lease divestitures in a given CMA. There is evidence to suggest that a large collection of EBS leases would find a capable buyer. For instance, in 2012 and 2013, when Clearwire was considering an offer from Sprint to purchase full ownership, other parties came forward to offer to acquire parts of its 2.5 GHz spectrum rights. DISH Network, for instance, offered to buy approximately 11.4 billion MHz-POPs in December, 2012.[71] In April of the following year, "Party J" offered to acquire a package of spectrum leases.[72] Stock analysts opined at the time that Party J was Verizon.

Divestiture Option #3: Mixed Upper and Lower Band. Combining the advantages of the first two options, Option #3 would require divestiture of upper band spectrum (BRS and EBS G Block) in roughly half of top CMAs, and divestiture of lower band spectrum (EBS A through D blocks) in the remainder. This would ensure that Sprint and any major competing spectrum user would have roughly equal positions, and that each would possess both directly licensed and leased spectrum in major markets. In addition, it would create greater opportunities for EBS entities to lease spectrum or sell spectrum to at least two entities. The Petitioners recommend Option #3 to the Commission as the best choice for leveling the field between New T-Mobile and a competitor, as well as fostering competition in demand for EBS spectrum.

[71] Clearwire, Form PRER14A at 27 (April 12, 2017) ("The Preliminary 2012 DISH Proposal contemplated a purchase price of approximately $2.2 billion in net proceeds to the Company for approximately11.4 billion MHz-POPs and an option for DISH to purchase or lease an additional 2 MHz of spectrum nationwide").

[72] *Id.* at 38 ("On April 8, 2013, the Company received an unsolicited, non-binding written proposal from Party J, a strategic buyer, in which Party J offered to acquire Clearwire spectrum leases generally located in large markets that cover approximately 5 billion MHz-POPs at a gross price of approximately $1.0 to $1.5 billion, less the present value of the spectrum leases which could be substantial").

VII. Conclusion

For the reasons stated herein, petitioners Voqal respectfully petition the Commission to deny the proposed merger of T-Mobile and Sprint as currently proposed.

Respectfully submitted,

/s/John Schwartz

John Schwartz
Chief Executive
Voqal
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August 27, 2018

DECLARATION

The foregoing has been prepared using facts of which I have personal knowledge or upon information provided to me. I declare under penalty of perjury that the foregoing, except for those facts for which official notice may be taken, is true and correct to the best of my information, knowledge and belief.

Executed on August 27, 2018.

/s/John Schwartz

John Schwartz
Chief Executive
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EXHIBIT A

DECLARATION OF JOHN SCHWARTZ

DECLARATION OF JOHN SCHWARTZ
Chief Executive, Voqal

Background and Qualifications

1. My name is John Schwartz. In 1983, I established five non-profit organizations that hold Federal Communications Commission licenses in the Educational Broadband Service (EBS). Those organizations have since adopted Voqal as their joint trade name. I have served as chief executive of the five Voqal entities since their founding. During the past 35 years, I have observed the evolution of EBS and the frequency band where it is located, commonly referred to as the 2.5 GHz band, or simply the 2.5 band. I have had extensive contact with EBS licensees, attorneys and engineers representing EBS licensees, and commercial users of 2.5 GHz spectrum. I have negotiated many spectrum usage contracts over the decades, beginning in the mid-1980s with contracts that contemplated pay TV usage and later those that were based on wireless broadband. In addition to negotiating spectrum agreements on behalf of the Voqal entities, I have done so on behalf of a Voqal-owned entity known as Independent Spectrum (IS). Independent Spectrum and its affiliates have entered into or brokered more than 30 2.5 GHz band spectrum transactions, including the purchase of four EBS systems, the purchase of one Broadband Radio Service (BRS) system, and the leasing and subleasing of EBS capacity in many markets, ranging in size from Paragould, Arkansas to Minneapolis, Minnesota. The 2.5 GHz capacity acquired or brokered by Independent Spectrum was leased or subleased to Clearwire, and, later, to Sprint. IS negotiated and concluded such transactions during a period that spanned from 2006 through 2015. I am closely familiar with the business environment of the 2.5 GHz band as it has evolved over the years, as well as the regulation and educational uses of EBS spectrum.

General Context for the Market for 2.5 GHz Spectrum

2. The 2.5 GHz Band is divided into Educational Broadband Service (EBS) and Broadband Radio Service (BRS),[1] as indicated in Exhibit I to this Declaration, entitled "BRS-EBS Band Plans: Pre-Transition at 2500-2690 MHz & Post-Transition at 2495 – 2690 MHz."[2] The top band plan shows the alignment of EBS and BRS spectrum prior to a reorganization first mandated by the Commission in rules promulgated in 2004 and later tweaked on reconsideration.[3] The bottom (post-transition) band plan is current.
3. The transition from the top band plan to the bottom band plan was effected separately in each Basic Trading Area (BTA) on different schedules, often as determined by a private-sector "proponent" who paid transition expenses for EBS licensees. Band plan transitions for certain major markets were completed in 2007 and the process was concluded nationwide by late 2010, with isolated exceptions.
4. The post-transition 2.5 GHz plan extends from 2496 MHz to 2690 MHz (excluding the one MHz guard band occupying 2495-2496 MHz). As one can see in Exhibit I, the 2.5 GHz band is divided into three segments: the lower band segment (2496 – 2568 MHz), the middle band

[1] BRS is a commercial radio service operating in the 2.5 band that is essentially identical to EBS in its technical characteristics.
[2] This document was prepared by the Commission.
[3] The EBS/BRS band plan transition occurred pursuant to the requirements of a report and order released in 2004 and then revised in certain respects on reconsideration. *See* Report and Order and Further Notice of Proposed Rulemaking, *Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands*, 19 FCC Rcd 14165; Order on Reconsideration and Fifth Memorandum Opinion and Order and Third Memorandum Opinion and Order and Second Report and Order, *Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands*, 21 FCC Rcd 5606 (2006).

segment (2572 – 2614 MHz),[4] and the upper band segment (2618 – 2690 MHz). These segments are intuitively abbreviated LBS, MBS, and UBS. The Commission's original thinking was that traditional high-power video transmission could occur in the MBS, where this use would be isolated from low-power two-way wireless broadband transmission in the LBS and UBS.[5] Both 4G and 5G service operate at relatively low power and are incompatible with local high-power video use on the same frequency.

5. To enhance the separation of high and low power transmission, the FCC mandated that two 4 MHz wide blocks of spectrum on each side of the mid-band segment serve as guard bands. The lower of these two chunks is designated the J block and the upper is designated the K block. Small slices of the J block are licensed to the entities that hold licenses in the A, B, C, and D group EBS channels of the lower band segment. Small slices of the K block are licensed to entities that hold E, F, and H BRS channels in the upper band segment, as well as G group EBS channels in the upper band segment.[6]
6. High power use of EBS spectrum (e.g., video transmission) has now ceased in almost all major metropolitan areas. Hence, it is feasible to use MBS, J-block, and K-block spectrum for such purposes as 4G and 5G almost anywhere 2.5 GHz spectrum is allocated nationwide.
7. In practice, the carriers transmitted over EBS and BRS spectrum are wider than the underlying licensed channel frequencies, so they overlap multiple channels. According to engineering measurements Voqal has undertaken with fellow EBS licensee North American

[4] The term "middle band segment" refers to its placement in the middle of the EBS band. This term is not the same as so-called midband spectrum, a phrase which is commonly used but does not have a universal definition; midband spectrum can be applied to spectrum that is greater in frequency than 1 GHz and in some cases as high as 6 GHz.
[5] *See* 47 USC 27.55(a)(4).
[6] *See* 47 USC 27.5(i). Officially, the J block is part of the LBS and the K block is part of the UBS. LBS and UBS main channels are each 5.5 MHz wide and the corresponding J and K block channels are one third of a MHz wide.

Catholic Educational Programming Foundation (NACEPF), Sprint is currently deploying 20 MHz carriers for 4G LTE. In markets where we measured, where Sprint deployed two 20 MHz LTE carriers side-by-side, it used BRS UBS spectrum only; in those where Sprint deployed three adjacent 20 MHz channels, it used BRS spectrum and adjacent EBS spectrum in the UBS. Based upon our limited sample, it appears that Sprint uses three carriers in top markets and two carriers in mid-sized markets, as it deployed two 20 MHz channels in the York, Pennsylvania area and three in Philadelphia and Minneapolis. In a regulatory filing, Sprint confirmed that its practice is to aggregate either two or three 20 MHz channels at "nearly every Sprint 2.5 GHz site."[7]

8. Our engineering measurements pertained to transmissions from Sprint's "macro" cell sites, and Sprint's regulatory filing appears to do so too. Sprint also deploys LTE via small cells and so-called "Magic Boxes," which reportedly operate at low power and use different 2.5 frequencies than the macro network as a means to avoid self-interference.
9. Although the 2004 reorganization of the EBS/BRS band plan created greater contiguity of both EBS spectrum and BRS spectrum, the two services' frequencies remain intertwined and interdependent for deployment of very wide carriers.
10. The greatest extent of contiguous spectrum for either EBS or BRS is to be found in the EBS spectrum in the LBS, J block (which is assigned exclusively to EBS licensees in the LBS), and the bottom five channels of the MBS. This swath is 112 MHz from bottom to top. The greatest extent of contiguous BRS spectrum is 55.5 MHz; all of this spectrum is located in the UBS, and it extends from the bottom of channel BRS-2 to the top of BRS channel H3.

[7] Comments of Sprint at 3, *Transforming the 2.5 GHz Band* ("*2.5 NPRM"*), WT Docket No. 18-120 (August 8, 2018) ("Sprint Comments").

BRS channels F4 and E4 are separated from this 55.5 MHz swath by the K block, part of which is assigned to the licensee(s) of the EBS G group.

11. There are isolated parts of EBS and BRS in the band. The EBS G group is isolated at the top of the UBS and it also contains one 6 MHz channel in the MBS, separated from the rest of the G group by BRS-2 and BRS channel groups E, F, and H.[8] Channel BRS-1 is located at the very bottom of the LBS, separated from the rest of BRS spectrum by 112 MHz of EBS.

License Eligibility in the 2.5 GHz Band

12. With rare exceptions, FCC rules provide that EBS licenses are to be issued only to accredited educational institutions, governmental organizations engaged in the formal education of enrolled students, and nonprofit organizations whose purposes are educational and include providing educational and instructional service to such accredited institutions and governmental organizations.[9] An FCC rulemaking is now in progress under which the Commission is studying revisions of its rules governing EBS. In the pertinent Notice of Proposed Rulemaking (NPRM), the FCC proposed to abolish the educational set-aside contained in 47 CFR § 27.1201(a).[10]

[8] Reflecting the value of spectrum contiguity, the fact that the G group is adjacent to commercial channels is considered to give it greater value. *See* Comments of The Wireless Communications Association International (WCAI) at 33, *2.5 NPRM*. WCAI avers that the "G1-3 channels are far more valuable to a commercial operator that already is licensed to the E and F group BRS spectrum than a lower band channel (A, B, C, or D Groups)." *Id.*

[9] *See* 47 USC 27.1201(a).

[10] Notice of Proposed Rulemaking ("Notice") at ¶ 20, *2.5 NPRM,* WT Docket No. 18-120, (rel. May 10, 2018).

13. BRS licenses can be awarded to any type of licensee, for-profit or nonprofit. In practice, with rare exceptions, BRS licenses are held by for-profit entities. The bulk of BRS licenses in urban areas of the United States are licensed to subsidiaries of Sprint.[11]

14. The FCC requires EBS licensees to reserve at least 5% of their spectrum capacity for educational use and to deploy no less than 20 hours per channel per week for education.[12] There is no such holdback or usage requirement for BRS spectrum.

A Short History of EBS

15. Before the 2004 re-regulation by the FCC, EBS was known as the Instructional Television Fixed Service (ITFS). The FCC originally allocated the 2.5 band for ITFS in 1963.[13] Pursuant to FCC rules, ITFS transmitted one-way analog video to locations like school classrooms and all ITFS use was required to be educational in nature. For the first two decades, ITFS was little deployed, largely due to the expense of the technology and lack of funding.

16. Partly in response to demand from pay television interests for greater channel capacity, in 1983 the Commission reassigned some ITFS channels to a commercial service then known as the Multi-channel Multipoint Distribution Service (MMDS---later renamed BRS).[14] The

[11] Description of Transaction, Public Interest Statement, and Related Demonstrations ("Statement"), WT Docket No. 18-203 (June 18, 2018), Exhibit M-3 at 136-270.
[12] See Section 27.1214(b) of the FCC's rules.
[13] *See* Report and Order, *Amendment of Parts 2 and 74 of the Commission's Rules and Regulations to Establish a New Class of Educational Television Station of the Transmission of Instructional and Cultural Material to Multiple Receiving Locations on Channels in the 1990-2110 Mc/S or 2500-2690 Mc/S Frequency Band*, 39 F.C.C. 846 (1963), *on recon.* 39 F.C.C. 873 (1964).
[14] Report and Order, *Amendment of Parts 2, 21, 74 and 94 of the Commission's Rules and Regulations in regard to frequency allocation to the Instructional Television Fixed Service, the Multipoint Distribution Service, and the Private Operation Fixed Microwave Service*, 94 F.C.C.2d 1203 (1983).

Commission also decided to permit ITFS licensees to lease some of their capacity for commercial purposes, which at the time was pay TV—a service that came to be known, oxymoronically, as wireless cable. The advent of leasing led to the rapid expansion in ITFS licensing, with commercial operators often sponsoring school districts and other eligible entities to apply.

17. Over the subsequent decades, the Commission took steps to expand ITFS licensees' interference protection. Currently, that protection is based upon a circular area with a 35-mile radius around a geographic centerpoint.[15] MMDS interference protection grew in tandem with ITFS's, but in 1996 the Commission concluded an "overlay" MMDS spectrum auction by which it sold MMDS spectrum by BTA. Those newly-auctioned spectrum rights excluded the then-existing protected zones of MMDS stations, which the FCC had previously licensed in numerous markets, including substantially all major metropolitan areas. Wireless cable companies were the chief buyers in the 1996 MMDS overlay auction.

18. Between 1983 and the late 1990s, the wireless cable industry emerged, operated, and, ultimately, went out of business.

19. Despite the fact that wireless broadband and wireless cable are very different services, many characteristics of the 2.5 band can be traced to its video origins. It was important for wireless cable operators to obtain as many MMDS and ITFS channels as possible, since they needed a comparable number of channels as their conventional cable TV competitors. Typically, a

[15] In cases where EBS stations are licensed within 70 miles of each other, their circular service areas overlap, creating a football-shaped area where originally both had interference rights. Because those overlaps essentially froze the use of the spectrum within them, the FCC later decided to bisect the footballs and assign half exclusively to the closest licensee. There are many cases of such "split footballs" in the licensed area of EBS stations. Possibly again extending the geographic reach of EBS stations' licensed service areas is a topic in the WT Docket 18-120 rulemaking now pending before the FCC.

local wireless cable operator would lease or purchase as many MMDS channels it could—with BTA rights, if possible—as well as lease as many ITFS channels as feasible. A wireless cable operator would seek to place all local ITFS and MMDS transmission facilities at a single centrally-located site—such as a tall tower, a mountaintop, or a downtown skyscraper—so that a customer could pick up the signal with a single rooftop receiving antenna.

20. Over time, wireless cable companies merged into a relatively small number of larger firms. These companies became sizable enough that they sold their stock on public markets. Because of channel capacity limitations and continued technical innovation by competitors, the large wireless cable companies became financially distressed. At least three publicly-traded firms---CAI Wireless Systems, Wireless One, and Heartland Wireless Communications[16]—went into bankruptcy. Fellow wireless cable firms ran short of cash and neared bankruptcy. Sensing a spectrum opportunity, WorldCom purchased the assets of CAI Wireless Systems and other teetering wireless cable companies. These purchases entailed acquiring MMDS (now BRS) licenses, and ITFS (now EBS) lease rights. Sprint purchased a different cohort of distressed wireless cable firms, including their spectrum rights. WorldCom went into bankruptcy three years after it acquired 2.5 GHz spectrum rights. WorldCom's rights were purchased from its bankruptcy estate by Nextel, which also bought Nucentrix's spectrum assets from bankruptcy. Like ever-larger fish consuming each other in the food chain, in 2005 Sprint and Nextel merged, leading to a combination of their already-extensive 2.5 spectrum portfolios.

[16] Heartland was later renamed Nucentrix Broadband Networks.

21. This pattern of spectrum consolidation was disrupted when newcomer Clearwire began accumulating 2.5 GHz spectrum through ITFS leasing and MMDS license purchases. Clearwire began amassing 2.5 spectrum in 2001, and in 2003 was acquired by a firm controlled by Craig McCaw, the pioneering wireless entrepreneur. There ensued a period of rivalry to acquire spectrum assets, which grew intense between 2003 and 2008. That rivalry ended in 2008 when Sprint and Clearwire combined their 2.5 spectrum rights into Clearwire, and Sprint acquired majority ownership in Clearwire. In mid-2013, Sprint bought 100% ownership of Clearwire. Almost immediately thereafter, Softbank bought a controlling interest in Sprint.

22. As part of the 2004 re-regulation of the 2.5 GHz band, EBS and BRS spectrum leasing was brought under the Commission's omnibus "secondary markets" spectrum leasing rules. The maximum term for EBS leases was extended from 15 years to 30 years, and *de facto* transfer leasing became the norm.[17]

23. Because of this history, almost all 2.5 GHz spectrum is allocated in any former wireless cable market, including all major markets. During the wireless cable period, the bulk of channels operated from a single location, and given that the FCC provides EBS interference protection in a 35-mile radius from a given spot, the geographic centerpoints of various EBS licenses in a given area are usually the same.

[17] *De facto* transfer leases assign control of most aspects of the leased spectrum to the lessee. Because that means a transfer of control within the meaning of the Communications Act, such leases require advance FCC approval. EBS leases that originated before 2004 were grandfathered, meaning that they were exempted from the *de facto* transfer approval process and allowed to expire in the normal course. Many grandfathered leases were written with one-way video usage in mind, and did not confer spectrum rights for wireless broadband. Almost all grandfathered EBS leases have now expired, and any remaining will expire by 2019.

24. The vast majority of 2.5 GHz spectrum rights in a given market tended to be held by the same entity. And because of a series of combinations of wireless operators, Sprint ultimately acquired an overwhelming position in essentially all major US cities. As Sprint's most recent SEC 10-Q indicates, it has "spectrum holdings of more than 160 MHz of 2.5 GHz spectrum in the top 100 markets in the U.S."[18] Note that to control more than 160 MHz of 194 MHz in the 2.5 GHz band is to control 82% of it. Clearwire's SEC filings contained more details about its spectrum holdings than Sprint's do now. According to Clearwire's December 31, 2012 10-K filing—its last annual report—it controlled over 47 billion MHz-POPs of 2.5 spectrum. Of that total, almost 60% was leased from third parties and the average remaining lease term was then 23 years.[19]

25. In a recent FCC filing, Sprint reported that it "utilizes over 1000 BRS licenses (both site-based and wide-area geographic auctioned licenses) and leases approximately 1500 EBS licenses (over 67% of all EBS licenses at 2.5 GHz) to provide its service to customers."[20] EBS licensees rely on royalty payments from spectrum leases to support their operations,[21] as well as access to the Sprint LTE network to deliver wireless broadband service to educational end users.

26. For both historical and business reasons, Sprint controls different amounts and configurations of spectrum in top metropolitan areas. For instance, it controls all of the allocated EBS/BRS channels in such Cellular Market Areas (CMAs) as Chicago, Washington DC, Pittsburgh,

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[18] Sprint, Form 10-Q at 42 (2018), https://www.sec.gov/Archives/edgar/data/101830/000010183018000037/sprintcorp6-30x1810q.htm.

[19] Clearwire, Form 10-K at 18 (2012), https://www.sec.gov/Archives/edgar/data/1442505/000144250513000015/clwr1231201210-k.htm.

[20] Sprint Comments at 3, *2.5 NPRM*.

[21] Voqal derives the majority of its revenue from such royalties, for instance.

Miami, Baltimore, Minneapolis-St. Paul, Denver, and Phoenix,[22] whereas it has lesser control over the 2.5 GHz band in such CMAs as New York City and Las Vegas, NV. [23]

27. On average, Sprint has lesser 2.5 GHz spectrum positions in small-market CMAs.[24] However, even in these locations, its level of control is anti-competitive. In a recent FCC filing, The Wireless Internet Service Providers Association—a trade group of rural wireless entities—wrote that "Sprint, by far the largest holder of EBS lease rights, generally has not been willing to assign or sublease its EBS spectrum, even in rural markets where it has not deployed commercial service and may not deploy service for several years."[25] Idaho's Coeur D'Alene Tribe offered similar observations in the same EBS-related proceeding.[26]

Favorable Technical Characteristics of the 2.5 GHz Band

28. As the Commission observed in the pending 2.5 GHz NPRM, the "2.5 GHz band (2496-2690 MHz) constitutes the single largest band of contiguous spectrum below 3 gigahertz and has been identified as prime spectrum for next generation mobile operations, including 5G uses."[27] 3 GHz was traditionally considered to be the upper bound of spectrum suitable for mobile purposes. This makes the 2.5 GHz band prime territory for the deployment of wide carriers for purposes such as 5G. Press reports this year have indicated that Sprint is

[22] Statement, Exhibit M-3. In some of these Cellular Market areas, Sprint lacks access to one or more channels in what appear to be exurban portions of the CMA. Exhibit M does not report Sprint's control over channels licensed to the University of Colorado in the Denver CMA, but according to a recent FCC filing it has leased that capacity.
[23] Statement, Exhibit M-3.
[24] *Id.*
[25] Comments of The Wireless Internet Service Providers Association at 5, *2.5 NPRM*.
[26] Comments of Coeur D'Alene Tribe at 1, *2.5 NPRM* ("Often, commercial telecommunications companies will hoard licenses without serving customers, sometimes refusing to negotiate with tribes to access them").
[27] Notice at ¶ 1. In its comments in the same proceeding, Verizon makes a nearly identical comment: "the 2.5 GHz band constitutes the single largest band of contiguous spectrum below 3 GHz that could be used for 5G." Comments of Verizon at 1, *2.5 NPRM*.

planning to deploy carrier width greater than 100 MHz for 5G purposes.[28] Because of the way that other relevant spectrum bands below 3 GHz are organized by the FCC, it would not be possible to deploy 100 MHz carriers there—or even carriers of somewhat lesser width.[29]

29. Though not required by regulation, wireless broadband transmissions in the 2.5 band in the United States employ Time Division Duplexing (TDD). TDD transmissions use the same frequencies for upstream and downstream purposes;[30] the network assigns certain time slots for upstream use and others for downstream use. Advocates for TDD point out that greater numbers of slots can be assigned for upstream or downstream traffic, as required. Because, on average, more traffic is downstream than upstream in wireless networks today, more TDD time slots are usually assigned for downstream purposes.

30. 2.5 GHz spectrum is allotted for wireless broadband purposes not only in the United States, but also in such major telecommunications markets as China and Japan. The standards body for LTE has recognized the use of 2.5 spectrum and designated it as Band 41. Because of economies of scale, there is a robust ecology of both network equipment and wireless devices in the 2.5 GHz band. In the T-Mobile – Sprint merger application, the parties indicated that

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[28] Sprint CEO John Saw is quoted as saying: "Sprint is the only carrier that doesn't have to compromise what 5G can deliver because we can deliver super wide channels of more than 100 MHz while still delivering mid-band coverage characteristics…" Mike Dano, "Sprint promises to launch nationwide mobile 5G Network in first half of 2019," *FierceWireless* (February 2, 2018), https://www.fiercewireless.com/5g/sprint-promises-to-launch-nationwide-mobile-5g-network-first-half-2019-and-to-raise-unlimited.

[29] The layout and control of numerous wireless spectrum bands is set forth in the T-Mobile/Sprint FCC merger application, Exhibit M. This information demonstrates that comparable configurations of spectrum are not available, except in very high-frequency "millimeter wave" bands.

[30] In mobile networks, upstream refers to transmission from a mobile device like a cellphone to the base station. Downstream refers to the path from the base station to the mobile device. The other principal architecture uses different frequencies for upstream and downstream transmissions. This architecture is known as Frequency Division Duplex, or FDD. Though this varies, in many bands regulatory bodies allot equal amounts of paired upstream and downstream frequencies—a practice that is well suited for voice traffic, but not for data traffic.

the post-merger entity ("New T-Mobile") plans to devote all of its 2.5 spectrum to 5G purposes.

31. A cutting-edge wireless technology known as known as Multiple-In Multiple-Out (MIMO) antennas favors both TDD and 2.5 GHz spectrum. MIMO antennas contain multiple transmitting/receiving antennas in a single housing. The use of MIMO produces higher data rates and improved signal coverage. Very large arrays of MIMO antennas (128 antennas per housing in a current design) produce even greater improvements; they are referred to as Massive MIMO. TDD is more suited for MIMO because antennas work best the closer the signal is to the center frequency of an antenna. Because FDD involves separating frequencies into upstream and downstream bands with an often-large guard band in between, its frequencies tend to be organized in a less compact fashion than TDD.[31] 2.5 spectrum is more suited to multiple antenna arrays because 2.5 GHz wavelengths are relatively short, and antennas are usually built as one wave in length (or a fraction of a wavelength, such as half). Longer wavelengths (such as 700 or 800 MHz, which are commonly used for wireless broadband in the United States) force Massive MIMO antenna housings to be prohibitively large for deployment on typical supporting structures. Because 5G will entail very dense coverage, antennas are expected to be placed on ubiquitous items like utility poles. Small supporting structures require small antennas.

<u>Anticompetitive Harm Traceable to Sprint's Current Position in the 2.5 Band Spectrum Market - Harm to Competition in the Sale and Leasing of 2.5 GHz Spectrum</u>

[31] Consider AWS spectrum in the United States, for instance, where paired channels are separated by approximately 400 MHz.

32. Only Sprint has a national portfolio of 2.5 GHz spectrum holdings in U.S. urban markets. In the wake of the 2004 rule changes, the standard EBS lease term extended from 15 to 30 years. Almost all 15-year leases have now expired. The first 30-year leases were executed in 2004, and thus will not expire until 2034. Other wireless carriers do not want to acquire isolated spectrum positions, and there is no longer frequent opportunity to take advantage of lease expirations. Ownership of BRS licenses is also highly concentrated. For all these reasons, Sprint has no significant competition for new or renewing 2.5 GHz spectrum leases in major US markets.

33. If the FCC follows through with proposed changes in the eligibility to hold EBS licenses, Sprint will be the only major buyer for EBS spectrum, as it has massive lease holdings and thereby encumbers approximately 1500 existing licenses with leases that average about 20 more years in duration.

34. This extensive level of control over so much 2.5 spectrum has not always existed. From approximately 2003 to 2008, Clearwire and Sprint competed for rights to use 2.5 GHz spectrum. A significant amount of EBS spectrum was available during this period. Not only was there unleased spectrum, but also because the FCC-imposed maximum length of EBS leases was 15 years prior to 2004, during 2003 - 2008 a significant number of key EBS leases expired.[32] As well, some BRS spectrum was then available for sale, most notably Bell

[32] A third acquirer of EBS and BRS spectrum also was active during part of this period: NextWave Broadband. Though NextWave never operated commercial networks using the 2.5 GHz band, it had substantial financial resources. NextWave's successors still hold 2.5 GHz spectrum assets in such markets as New York, San Francisco, and Las Vegas.

South's portfolio in the Southeast. Clearwire purchased BellSouth's 2.5 spectrum rights from AT&T in 2007 for $300 million.[33]

35. Virtually all EBS leases and BRS purchase contracts contain confidentiality clauses that prohibit the disclosure of their terms. Thus the bulk of examples of EBS leases that are available to the public are those that are concluded by governmental entities in states that require disclosure under sunshine statutes. Voqal and Independent Spectrum are non-governmental entities, and thus their contracts with Clearwire and Sprint remain confidential.[34]

36. Notwithstanding spectrum lessees' efforts to hide transactions under a blanket of confidentiality, over the years I have received numerous accounts of deal-making trends from a community of people involved in 2.5 GHz spectrum negotiations and transactions. In this declaration I am relying solely on information that is either public or that I received absent an agreement of confidentiality with the source and that is not subject to any confidentiality requirement as far as I know.

37. Because the proposed T-Mobile – Sprint merger is subject to consideration by a variety of federal authorities, regulators have the opportunity to obtain the record of transactions that is largely hidden from the public. I am confident as to what the FCC, Department of Justice, or other regulators will find if they investigate the history of transactions in the 2.5 band.

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[33] *Reuters*, "AT&T To Sell Wireless Spectrum to Clearwire for $300 Milllion," (last updated August 5, 2010), https://www.cnbc.com/id/17240864. BellSouth's 2.5 assets included both BRS licenses and EBS leases.

[34] Independent Spectrum has concluded spectrum agreements with a number of public bodies to lease or purchase their 2.5 GHz spectrum. Certain of those agreements between IS and governmental entities are public documents in that their disclosure is required under pertinent state law. IS was also involved in bidding unsuccessfully for spectrum licensed to governmental entities, sometimes pursuant to public processes.

38. Voqal and its Independent Spectrum affiliates were involved in negotiating wireless broadband spectrum agreements for a period beginning about 1999 and extending well into 2015. We and others involved in 2.5 band transactions observed marked changes in the spectrum leasing environment over those years.

39. As I gathered it, Sprint initially did not take Clearwire's 2.5 GHz spectrum acquisitions very seriously. However, as Clearwire amassed an increasing position in the 2.5 band, around 2006 Sprint began to bid vigorously for spectrum leasing opportunities and BRS spectrum purchases. Competition for EBS spectrum appeared to hit an apex around 2007. After Sprint and Clearwire combined their spectrum holdings in a 2008 transaction, average pricing for 2.5 GHz spectrum declined markedly. Post-2008, Independent Spectrum lowered its EBS leasing offers in some cases. It was clear that most EBS licensees' leasing opportunities had dimmed substantially.

40. Both the economic and non-economic terms of spectrum agreements concluded during the period of competition between Sprint and Clearwire (and, during certain years, NextWave as well) are much more favorable to lessors on average than those that were concluded after Sprint and Clearwire consolidated their 2.5 spectrum interests in 2008. With regard to such matters as royalties paid, I strongly expect that regulators will be able to identify a statistically verifiable pattern of lower compensation after the end of significant competition.

41. It is instructive to compare EBS lease pricing following the Sprint/Clearwire combination with pricing derived in partly comparable bands. For example, interesting data are available due to the public process of The School Board of Broward County, Florida in leasing the

capacity of its two EBS systems covering all of Broward County, as well as parts of Palm Beach and Miami-Dade Counties.[35]

42. As compared with typical EBS licensees, Broward County enjoyed significant advantages. It held multiple licenses—one for the B channel group and one for the coveted G-group[36]—in a major urban area where Clearwire (and later Sprint) needed more spectrum. Including J and K Block spectrum, these two licenses cover a total of 47 MHz. Broward County was advised by sophisticated legal and business counsel, including Select Spectrum, a firm that markets wireless spectrum in a variety of bands, including EBS. One would expect that Broward County would drive an unusually hard bargain and obtain an unusually good deal. I believe that it did both—as far as one can in the post-2008 environment. According to data presented to the School Board, in response to an RFP from Broward County Public Schools, Clearwire offered a lease valued at a net present value of $0.16 per MHz/Pop in 2010. That offer was rejected. In 2012, Clearwire made an unsolicited offer for $0.13 per MHz/Pop NPV. That second offer was also rejected. In June 2014, Sprint made an initial offer of $0.18 per MHz/Pop NPV. After a multiple-bid process followed by two months of negotiations, Sprint delivered a final offer of $0.25 per MHz/Pop NPV in October, 2014.[37] Broward County Public Schools accepted that $0.25 offer.

[35] This data can be found in a background paper submitted to the Broward County Board of Education for its consideration of a proposed EBS lease: http://bcpsagenda.browardschools.com/agenda/01006/Item%20II-1%20(17099)/SUPP_DOCS/Exhibits/Doc3.pdf , last accessed August 20, 2018 ("Broward Lease Background Paper").

[36] The call letters of these EBS systems are KTZ22 and KLC80.

[37] Broward Lease Background Paper.

43. At essentially the same time that Broward County was concluding its 2.5 GHz negotiations, the FCC began to auction a total of 65 MHz in the AWS-3 band.[38] Unlike the Broward County negotiations, which entailed only one major carrier, AT&T, Verizon, T-Mobile, and DISH Network affiliates all bid extensively in the AWS-3 auction. Tellingly, Sprint did not bid for AWS-3 spectrum. Except for undesirable upstream-only channels, all frequencies sold in the AWS-3 auction for the Miami-Fort Lauderdale area sold for *more than 12 times* the unit price of the Broward County School board lease value. Nationwide, paired upstream/downstream spectrum sold for an average of $2.71 per MHz/Pop in the AWS-3 auction, whereas the upstream-only channels went for an average of $0.52 per MHz/Pop.[39]

44. Spectrum in all AWS band channels lacks the key characteristics of the 2.5 GHz band, some of which have grown more salient with recent technological advances such as the establishment of 5G standards. AWS cannot be assembled to create nearly as many contiguous frequencies as EBS. The AWS band is designed for FDD purposes, whereas 2.5 is usable for TDD and TDD is better suited to Massive MIMO. AWS does not have the same equipment manufacturing ecology as 2.5 TDD, although AWS is a widely used band. Most of the foregoing factors favor EBS over AWS. However, AWS-3 spectrum has advantages of its own. It has propagation characteristics that are better than EBS's because the frequencies are lower. The FCC sold most AWS-3 spectrum with Economic Areas (EAs) as the geographic unit—much larger units than EBS GSAs—that major spectrum purchasers usually prefer. Another distinction between the AWS-3 auction results and the Broward

[38] FCC Auction 97, which opened on November 13, 2014 and closed on January 29, 2015.
[39] Phil Goldstein, "AWS-3 AUCTION RESULTS: AT&T leads with $18.2B, Verizon at $10.4B, Dish at $10B and T-Mobile at $1.8B," *FierceWireless* (January 30, 2015), https://www.fiercewireless.com/wireless/aws-3-auction-results-at-t-leads-18-2b-verizon-at-10-4b-dish-at-10b-and-t-mobile-at-1-8b.

County lease results is that the AWS-3 auction allotted licenses directly to winning bidders, whereas the winner of the Broward County spectrum received instead a 30-year lease. Most carriers would prefer to hold spectrum licenses directly.

45. The FCC broke AWS-3 spectrum into a six different packages for the purposes of the auction, two of which were upstream-only.

AWS-3 channel A1 is 5 MHz of unpaired upstream-only spectrum occupying 1695-1700 MHz.

AWS-3 channel B1 is 10 MHz of unpaired upstream-only spectrum occupying 1700-1710 MHz.

AWS-3 G channels are 10 MHz of paired spectrum occupying 1755-1760 and 2155-2160 MHz. The lower frequencies in this pair were assigned to upstream use and the upper frequencies were assigned to downstream use (an FDD configuration). It was auctioned by Cellular Market Area (CMA) as the geographic unit. Of the AWS-3 geographic units, CMAs are the closest in size to EBS service areas.

AWS-3 H and I channels are 10 MHz of paired spectrum occupying 1760-1765 and 2160-2165 MHz (H channels) and 1765-1770 and 2165-2170 MHz (I channels). The lower frequencies in these pairs were assigned to upstream use and the upper frequencies were assigned to downstream use (FDD). This spectrum was auctioned by Economic Area (EA) as the geographic unit---a substantially larger size than EBS service areas.

AWS-3 J channels are 20 MHz of paired spectrum occupying 1770-1780 and 2170-2180 MHz. The lower frequencies in this pair were assigned to upstream use and the upper

frequencies were assigned to downstream use (FDD). This spectrum was auctioned by Economic Area (EA) as the geographic unit.

46. As compared with the $0.25 per MHz/Pop valuation of the Broward County School Board's EBS spectrum, here are the results for the Miami-Fort Lauderdale AWS-3 auction results: [40]

AWS-3 Channel(s)	Use	Winning Bidder	Winning Bid per MHz/POP
Channel A1	Upstream-only	Northstar Wireless	$ 0.09
Channel B1	Upstream-only	2014 AWS Spectrum Bidco	$ 0.39
G Channels	FDD two-way	Northstar Wireless	$3.72
H Channels	FDD two-way	T-Mobile	$3.19
I Channels	FDD two-way	AT&T	$3.08
J Channels	FDD two-way	AT&T	$3.96

47. Upstream-only spectrum clearly was much less attractive in this auction than two-way FDD spectrum. However, only Sprint's market power can account for the bulk of the gap between AWS-3 two-way spectrum and EBS valuations, notwithstanding that they are not substitutes and that they have different characteristics, as described above.

Anticompetitive Harm Traceable to Sprint's Current Position in the 2.5 Band Spectrum Market - Harm to Competition in 4G and 5G Wireless Broadband Service to Consumers

48. Harm in the market for 4G and 5G wireless broadband service to consumers derives from Sprint's overwhelming position in 2.5 GHz spectrum. As Sprint executives frequently

[40] See https://www.fcc.gov/document/auction-97-aws-3-winning-bidders for a listing of AWS-3 winning bids. See FCC Public Notice DA 14-1018, Attachment A for a listing of all channels on auction, population, frequencies, and other key bidding information.

remark, there is no other band that combines the abundance of contiguous spectrum with the signal propagation and other technical advantages of 2.5. If competing providers are denied access to adequate amounts of 2.5 spectrum, they will be forced to rely on less effective spectrum bands. Hence they will be impeded in their ability to compete with the New T-Mobile in 4G service, and, especially, 5G.

Available Remedies and Their Practicality

49. If one wishes to apply remedies to both forms of competitive harms, one needs to start by considering the technical needs of wireless broadband providers. In a recent filing pertaining to the rules governing EBS, AT&T stressed spectrum acquirers' demand for "large blocks of spectrum covering broad geographic areas."[41] Competition for 4G and 5G wireless broadband service would thus be increased markedly by making large blocks of contiguous 2.5 GHz spectrum available to one or more capable competitors to New T-Mobile.

50. I recommend that the Commission require divestiture of no less than one-third of Sprint's 2.5 GHz spectrum in each CMA *in a contiguous block*, unless that configuration is not available locally; in the event that lesser contiguity is available within a GSA, Sprint should be required to divest the greatest available quantity of contiguous spectrum, plus sufficient other nearly adjacent spectrum to constitute at least one-third of its CMA holdings as measured by MHz/Pops.

51. One way to accomplish such a goal would be to require divestiture of Sprint's BRS spectrum holdings combined with G-group EBS leases. BRS is licensed in larger geographic units because of the fact that the FCC carried out the 1996 MMDS overlay auction. Divestiture of

[41] Comments of AT&T at 2, *2.5 NPRM*. It is clear that AT&T would prefer to own 2.5 spectrum rights than lease them. See *id*. at 4-5 n.6.

spectrum that is licensed directly is less complex than divestiture in the form of assigning lease interests, as leases may require consent of the lessors.

52. More complex, but also feasible, would be to require Sprint to divest its EBS spectrum interests in all or part of the A, B, C, and D channel groups. This would require multiple lease divestitures in a given CMA, and AT&T, for one, has made clear that it would prefer to hold commercial licenses rather than lease from educational entities. However, the combination of this large volume of contiguous spectrum over large swaths of territory covered by Sprint's present leases would meet AT&T's expressed criterial of "large blocks of spectrum covering broad geographic areas." I believe that a large collection of EBS leases would find a capable buyer. For instance, in 2012 and 2013, when Clearwire was considering an offer from Sprint to purchase full ownership, other parties came forward to offer to acquire parts of its 2.5 GHz spectrum rights. DISH Network, for instance, offered to buy approximately 11.4 billion MHz-POPs in December, 2012.[42] In April of the following year, "Party J" offered to acquire a package of spectrum leases.[43] Stock analysts opined at the time that Party J was Verizon.

53. I recommend requiring divestiture of upper band spectrum in roughly half of top CMAs, and requiring divestiture of lower band spectrum in the remainder. This would ensure that Sprint and any major competing spectrum user would have roughly equal positions, and that each

[42] Clearwire, Form PRER14A at 27 (2013) ("The Preliminary 2012 DISH Proposal contemplated a purchase price of approximately $2.2 billion in net proceeds to the Company for approximately 11.4 billion MHz-POPs and an option for DISH to purchase or lease an additional 2 MHz of spectrum nationwide").

[43] *Id.* at 38 ("On April 8, 2013, the Company received an unsolicited, non-binding written proposal from Party J, a strategic buyer, in which Party J offered to acquire Clearwire spectrum leases generally located in large markets that cover approximately 5 billion MHz-POPs at a gross price of approximately $1.0 to $1.5 billion, less the present value of the spectrum leases which could be substantial").

would possess directly licensed and leased spectrum in major markets. As well, it would create greater opportunities for EBS entities to lease spectrum or sell spectrum to at least two entities.

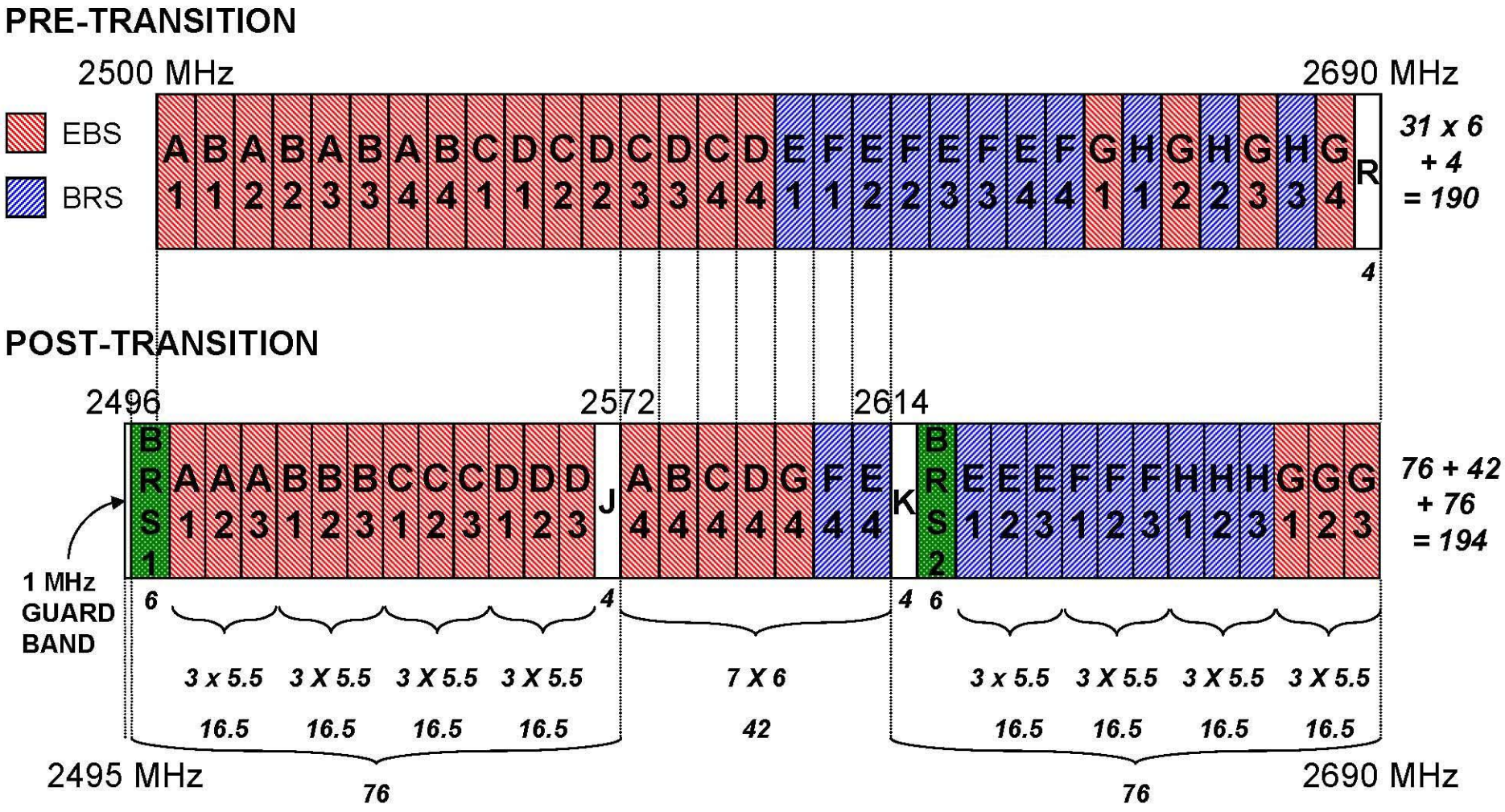
54. I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed on August 27, 2018.

/s/ John Schwartz

John Schwartz
Chief Executive
Voqal

EXHIBIT I

BRS-EBS BAND PLANS: PRE-TRANSITION AT 2500–2690 MHz & POST-TRANSITION AT 2495–2690 MHz

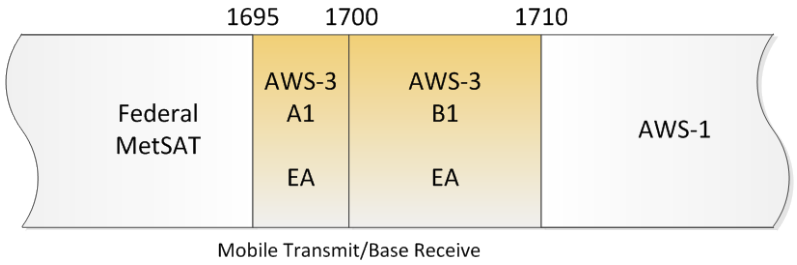


FCC
2/10/05

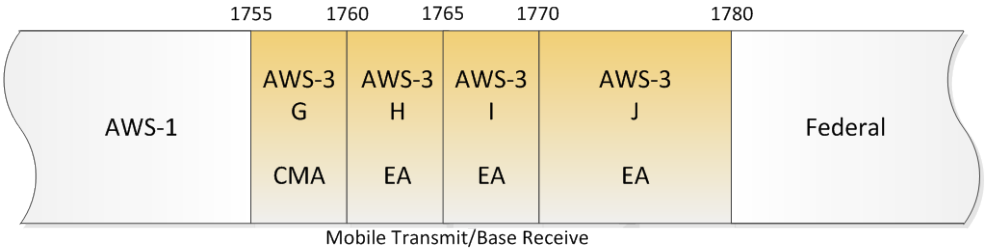
EXHIBIT II

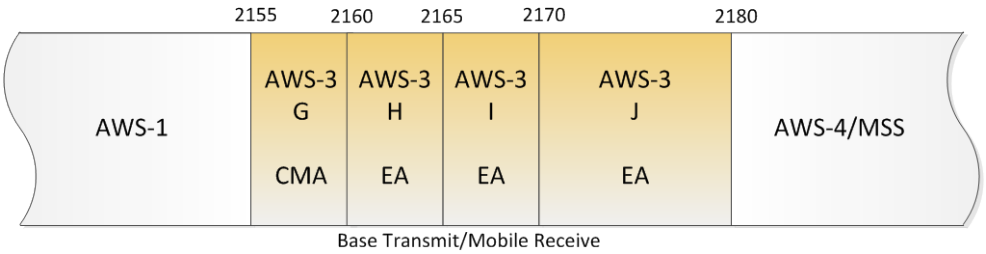
AWS-3 Band Plans

1695-1710 MHz



1755-1780 and 2155-2180 MHz





AWS-3 Frequency Block / License Summary

Block	Frequencies	Bandwidth	Pairing	Geographic Area Type	Number of Licenses
A1	1695-1700 MHz	5 MHz	unpaired	EA	176
B1	1700-1710 MHz	10 MHz	unpaired	EA	176
G	1755-1760/2155-2160 MHz	10 MHz	2 x 5 MHz	CMA	734
H	1760-1765/2160-2165 MHz	10 MHz	2 x 5 MHz	EA	176
I	1765-1770/2165-2170 MHz	10 MHz	2 x 5 MHz	EA	176
J	1770-1780/2170-2180 MHz	20 MHz	2 x 10 MHz	EA	176

EXHIBIT B

DECLARATION OF DR. KEVIN GIFFORD

DECLARATION OF DR. KEVIN GIFFORD, Ph.D.
Scholar in Residence, University of Colorado

I. Biographical Information

1. My name is Kevin Gifford. I hold masters and doctorate degrees in engineering from the University of Colorado at Boulder. Since 2004, I have served as a Senior Research Associate and Scholar in Residence at the University of Colorado, where I focus on a broad variety of topics related to wireless communications.

2. My activities and accomplishments in the field of wireless network communications include:

a. I am the lead Project Investigator for (a) the CU Boulder Wireless Testbed; and (b) the NASA Wireless Testbed at the National Institute for Standards and Technology (NIST) Table Mountain Radio Quiet Zone in northern Boulder County, Colorado, with an emphasis in 4G/LTE/5G wireless communications research, verifications and protocol interoperability testing. NIST is a unit of the U.S. Department of Commerce.

b. Leading the teams that were the very first to fly the Linux operating system on both the Space Shuttle (1996) and on the International Space Station (2000).

c. In 2012, I was a lead member of the NASA Disruption Tolerant Networking (DTN) team that established the first two Interplanetary Internet nodes

onboard the International Space Station, enabling Internet-based communications in the vast and harsh environment of space.

d. In 2013, I composed the NASA Institutional DTN deployment plan, and in 2015 DTN service provision was a seminal NASA-provided space communications service available for all International Space Station partners.

e. I am the Working Group chairman of the Wireless Working Group for the International Organization for Standardization (ISO) affiliated Consultative Committee on Space Data Systems (CCSDS).

f. I served as a volunteer member of the Location Based Services (LBS) for the Public Safety Communications Research (PSCR) program at NIST and the NIST PSCR Data Analytics Working Group.

3. I hereby make this declaration.

4. I am familiar with wireless technologies in general, including the technologies associated with the potential deployment of 5G. 5G is predicted to offer considerably faster speeds of transmission, as well as various other advantages to consumers, over current wireless broadband. 5G deployment and transmission necessarily requires access to wireless spectrum, and the efficacy of any 5G network will be impacted by the characteristics of the wireless spectrum over which its signals are transmitted.

II. Technical Characteristics of Wireless Spectrum Bands

5. Certain parts of the electromagnetic spectrum—"radio spectrum"—can be used for a variety of telecommunication purposes, including transmission of cellular telephone signals.

6. Radio spectrum is divided into "bands": contiguous intervals of spectrum bounded by a lower and upper frequency. Bands are further divided into spectrum "channels" which are generally set aside for one purpose in particular (e.g. transmission of cellular telephone signals).

7. Bands are often referred to as "low," "mid," and "high" frequency bands, corresponding to the rate at which the electromagnetic fields that generate their waves oscillate. Frequency is measured in Hertz (Hz), defined as one cycle per second. A radio wave with a frequency of 10 Hz would oscillate 10 times in one second. Although usage varies, in general, low frequency bands are those with frequencies below 1 gigahertz (GHz), mid frequency bands are those with frequencies between 1 and 6 GHz, and high frequency bands are those with frequencies above 6 GHz. High frequency bands above 30 GHz are known as "millimeter" frequencies because their wavelengths can be measured in millimeters.

8. The length of a radio wave is inversely proportional to its frequency. Low frequency bands have (relatively) long waves, and high frequency bands have (relatively) short waves. Mid frequency bands also have wavelengths in between those in high and low frequency bands.

9. The long waves of low frequency spectrum generally propagate better and penetrate walls more effectively than the short waves of high frequency spectrum. Conversely, the short waves of high frequency spectrum pose fewer signal interference problems because

short waves are less likely to propagate into a neighboring area serviced by a different transmission station. In addition, longer waves require longer antennas for transmission, which are physically cumbersome, especially for mobile devices like smartphones. Antennas transmitting the shorter waves on high frequency spectrum can be more compact.

10. Although spectrum from all bands can be used to transmit 5G communications, mid-band spectrum is especially important and desirable because it both propagates well and does not cause undue interference, and because the antennas required for the transmission of 5G are relatively compact.

11. The three design drivers of 5G technology are (1) Increased data rates (> 10 Gbps peak rates); (2) Massive Machine-to-Machine (M2M) Communications (supporting > 1 M connections / km^2); and (3) Low-latency, ultra-reliable (LLUR) communications (supporting < 1 milli-second latency). While it is true that high-band mmWave spectrum will be required to support dense urban deployments with very high user density, the benefits of the 5G network architecture to minimize network latency and to provide for increased M2M device density are applicable in the low (600-800 MHz) and mid (2500 MHz) spectrum bands. Simply due to user density, a strategy of utilizing low-band for rural, mid-band for suburban, and high band for dense urban environments is appealing from an engineering and cost perspective.

III. Technical Characteristics of the 2.5 GHz Band

12. The 2.5 GHz band is generally classified as mid-band spectrum, and it exemplifies the advantages that mid-band spectrum offers for the development of 5G.

13. 2.5 waves are longer than those of high-band, "millimeter" frequencies, resulting in better propagation and more effective in-building coverage than can be achieved with the millimeter band. This can be particularly important in areas with lower-density populations, including rural areas.

14. 2.5 band waves pose fewer signal interference problems than occur in the 600-800 MHz bands in densely built urban networks of the sort expected to be needed for 5G because they are better suited to serving the smaller cell sizes needed for dense network deployment. Because the networks for 5G will be so densely deployed, the longer waves of 600-800 MHz bands will be more likely to accidentally propagate into a neighboring cell.

15. The 2.5 band is also advantageous for 5G because large, contiguous sections of the band remain available, allowing for the creation of wide channels for cellular transmission. Transmission across wide channels provides for increased data throughput.

16. Mid-band spectrum, including the 2.5 band, is also well-suited for the implementation of "MIMO" antenna technology.

17. "MIMO" refers to "multiple input, multiple output" technology. MIMO allows for the transmission (and receipt) of more than one data signal simultaneously over the same radio channel. Generally, these multiple signal paths are made possible by the installation of multiple antennas at the transmission site.

IV. Technical Characteristics of Time Division Duplex

18. Transmission of radio waves can be accomplished through either Time Division Duplex (TDD) or Frequency Division Duplex (FDD). In TDD, information is conveyed by

varying the length of time for which a wave is transmitted. In FDD, information is conveyed by varying the frequency at which a wave is transmitted.

19. TDD is better suited than FDD for use with massive MIMO. FDD employs separate upstream and downstream channels that are often separated significantly in frequency; therefore, significantly different wavelengths are received and transmitted through the same MIMO antennas, which can increase cost and decrease efficiency.

/s/ Kevin Gifford

Kevin Gifford, Ph.D.
Scholar in Residence
University of Colorado

CERTIFICATE OF SERVICE

I, John Schwartz, hereby certify that on August 27, 2018, I caused true and correct copies of the foregoing to be served by electronic mail upon the following:

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Sincerely,

/s/John Schwartz
John Schwartz
Chief Executive
Voqal