Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services	)	GN Docket No. 14-177
3.5 GHz SAS and ESC Applications	)	GN Docket No. 15-319
Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz	)	GN Docket No. 17-183
Promoting Investment in the 3550-3700 MHz Band	)	GN Docket No. 17-258

COMMENTS OF APPLE INC., BROADCOM INC., CISCO SYSTEMS, INC., FACEBOOK, INC., GOOGLE LLC, HEWLETT PACKARD ENTERPRISE, INTEL CORPORATION, MARVELL TECHNOLOGY GROUP, MICROSOFT CORPORATION, QUALCOMM INCORPORATED, AND RUCKUS NETWORKS, AN ARRIS COMPANY

Pursuant to the Spectrum Pipeline Act, the Commission has requested comment on proposals to promote and identify additional spectrum bands that can be shared between incumbent users and new licensed and unlicensed services between 6 GHz and 57 GHz.[1] The 5925-7125 MHz frequency range (the 6 GHz band) presents a unique opportunity to significantly expand the nation's unlicensed spectrum inventory by more than 1 Gigahertz. Opening this band is essential to addressing a growing unlicensed spectrum shortfall and promoting the development of new technologies. The 6 GHz band offers contiguous spectrum proximate to

[1] *Wireless Telecommunications Bureau and Office of Engineering and Technology Seek Comment Pursuant to the Spectrum Pipeline Act of 2015*, Public Notice, DA 18-841, GN Docket Nos. 14-177, 15-319, 17-183, and 17-258 (rel. Aug. 10, 2018).

today's most heavily used unlicensed bands, meaning that companies can readily adapt existing chips and equipment designs to operate in these frequencies, and operators can re-use existing network topologies and infrastructure, which will accelerate investment and deployment. Furthermore, because of the band's incumbent environment, unlicensed devices can avoid harmful interference to licensees through rigorous FCC technical rules that combine the unlicensed operations parameters from the nearby 5725-5850 MHz band with targeted mitigations for the 6 GHz band, but without the need for some of the sophisticated solutions required in the 3.5 GHz band.

The 6 GHz band demonstrates the importance of sharing rules tailored to protect the specific incumbents operating within a band rather than porting rules from other bands that were designed to protect different incumbents. Although the Commission should seek an appropriate degree of consistency between bands and build on past regulatory successes, it should also not artificially suppress investment or efficiency by importing regulations that may be necessary in one band but not in another. A comparison of the 6 GHz band with the 3.5 GHz band, where incumbent military systems use the shared spectrum on undisclosed frequencies from undisclosed locations, reveals many important differences, particularly the need in the 3.5 GHz band to manage aggregate interference, ensure that client devices communicate frequently with a central spectrum management system, account for but conceal the position of mobile federal incumbents, and share data between separate implementations of a spectrum sharing system. The Commission's 3.5 GHz rules serve an important role in facilitating investment and preventing harmful interference in those frequencies, but imposing those rules on the 6 GHz band would significantly and unnecessarily limit investment and innovation.

I. THE 6 GHZ BAND IS CRITICAL TO ADDRESSING THE NATION'S UNLICENSED SPECTRUM GAP

The United States faces a significant shortfall in the availability of unlicensed spectrum, with an estimated deficit ranging from 500 megahertz to multiple gigahertz.[2] The 6 GHz band presents a unique opportunity to address that shortfall, offering the potential to unlock as much as 1.2 gigahertz of new unlicensed spectrum while protecting incumbents. Moreover, the 6 GHz band is adjacent to the 5 GHz band, which is the workhorse band for unlicensed operations today. This means that manufacturers could design products that use a single radio to tune across both the 5 GHz and 6 GHz bands, reducing costs and jump-starting investment. In fact, standards bodies are already developing standards for unlicensed 6 GHz operations.

Just as important as the quantity of available spectrum is the fact that the 6 GHz band offers an opportunity for unlicensed operations governed by strict technical rules, but without the need for a complicated sharing mechanism or overregulation. As the Commission has seen

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[2] *See, e.g.*, Steve Methley & William Webb, Quotient Associates, *Wi-Fi Spectrum Needs Study* 29 (Feb. 2017) ("[B]etween 500 MHz and 11 GHz of new spectrum will be needed in 2025 to satisfy the anticipated busy hour."); *Expanding Flexible Use in Mid-band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, 32 FCC Rcd. 6373, Statement of Commissioner Mignon L. Clyburn at 6390 (2017) ("There is no question that the demand for wireless broadband services is increasing at a very fast clip."); Commissioner Michael O'Rielly, *A Mid-Band Spectrum Win in the Making*, FCC Blog (July 10, 2017, 2:30 PM), https://www.fcc.gov/news-events/blog/2017/07/10/mid-band-spectrum-win-making ("Study after study has shown that the U.S. is going to need multiple gigahertz of licensed and unlicensed spectrum just to keep up with current growth patterns."); Commissioner Jessica Rosenworcel, *Bringing the Connected Future to All Americans*, May 11, 2012 – Jan. 3, 2017, FCC Blog (Dec. 30, 2016, 5:30 PM), https://www.fcc.gov/news-events/blog/2016/12/30/bringing-connected-future-all-americans-may-11-2012-%E2%80%93-january-3-2017 ("Moreover, as any wireless user can attest to, the airwaves used for Wi-Fi today are getting crowded—putting a premium on identifying additional spectrum for unlicensed growth."); Chairman Ajit Pai, *Bridging the Digital Divide*, FCC Blog (July 13, 2017, 2:25 PM), https://www.fcc.gov/news-events/blog/2017/07/13/bridging-digital-divide ("Increasingly, meeting the connectivity needs of all Americans—no matter where you live—means freeing up spectrum to meet the growing demand for wireless broadband.").

elsewhere, deployment in otherwise promising bands can be stymied with overly complex requirements that increase costs and effectively reduce the available spectrum or geography. This need not be the case in the 6 GHz band. By far the most widely deployed incumbents, the terrestrial fixed service (FS) and the fixed-satellite service (FSS) present important but straightforward sharing needs. Because FS systems are high power, employ high quality directional antennas, and operate outdoors, the Commission can prevent harmful interference to FS licensees by adopting a system that either ensures that devices operate at sufficiently low power levels to avoid harmful interference or keeps unlicensed devices from operating in affected channels within exclusion zones, calculated based on publicly available technical characteristics for each FS system. A comprehensive study submitted by RKF Engineering demonstrated that, even in the absence of *any* interference mitigation techniques, these zones are sufficiently limited so that unlicensed operations would be extremely unlikely to cause harmful interference to an FS system.[3] Nonetheless, our companies have proposed careful belt-and-suspenders FCC technical rules to protect incumbents further.

For FSS systems, the vast majority of 6 GHz operations are high-powered uplink transmissions. This means that there is no need for widespread exclusion zones to protect terrestrial FSS receivers. And the RKF Study concluded that there is little risk of interference to satellite-based receivers generally, due to the wide mismatch between the high transmit power of fixed-satellite uplink transmissions and the very low transmit power of unlicensed devices, even

[3] RKF Engineering Services, *Frequency Sharing for Radio Local Area Networks in the 6 GHz Band* 54–56 (Jan. 2018) ("RKF Study"), *as attached to* Letter from Paul Margie, Counsel, Apple Inc., Broadcom Corporation, Facebook, Inc., Hewlett Packard Enterprise, and Microsoft Corporation, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183 (filed Jan. 26, 2018).

when aggregated across a satellite's field of view.[4] In fact, RKF concluded that these aggregate emissions would be far weaker than those that satellites receive today from existing FS systems.[5]

Therefore, with the exception of a small number of systems in limited parts of the 6 GHz band, licensed incumbents in this band are not mobile, and remain relatively constant from week to week, or even month to month. There is, therefore, no need to impose complex and burdensome sharing techniques designed to address a far more dynamic incumbent landscape. Governed by rigorous but straightforward Commission rules, unlicensed devices can leverage 6 GHz spectrum without causing harmful interference, and without requiring consumers to pay increased costs for devices and networks that comply with a complex regulatory regime.

The Commission also sought comment on whether it should pursue additional licensed operations between 6 GHz and 57 GHz. Licensed mobile services, in contrast to unlicensed operations, would face far greater challenges using 6 GHz spectrum for mobile broadband communications. The presence of numerous FS incumbents would make it challenging to auction this spectrum as impairments would vary significantly across frequency and geography, creating uncertainty that would depress overall auction participation and, therefore, reduce efficiency of use. These uncertainties would be compounded by the fact that use of the 6 GHz band continues to grow and change as new FS links come online and other FS licenses are terminated or allowed to expire. The only alternative to coping with such uncertainty would likely be to clear the band of most, if not all, other terrestrial incumbents and freeze the issuance of new licenses. But this would clearly be unacceptable due to the large number of active users of the band, and the lack of readily available alternative frequencies for those incumbents. As described above, unlicensed

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4 *Id.* at 44–46.

5 *Id.* at 43.

operations, in contrast, can meet these challenges without any impact on incumbent licensees' operations.

II. THE 3.5 GHZ BAND'S SHARING APPROACH IS INAPPROPRIATE FOR THE 6 GHZ BAND

Due to the particular combination of incumbents in the 3.5 GHz band, the Commission created a unique sharing regime for the Citizens Band Radio Service (CBRS). The 3.5 GHz band must accommodate a far different group of incumbents than found in the 6 GHz band, including: (1) grandfathered users operating under Part 90 Subpart Z; (2) FSS receive earth stations, which are potentially subject to harmful aggregate interference; and (3) federal users, such as Navy radar systems, which may come and go from portions of the band but must be detected and rapidly protected from harmful interference when they are present.[6] Moreover, the 3.5 GHz band includes both auctioned (PAL) and license-by-rule (GAA) operations in the same band, but the specific channels assigned to each may vary from market to market, as well as over time as the amount of available spectrum changes due to, e.g., the presence of a protected federal user in part of the band. In addition, the 3.5 GHz band supports far higher transmit power levels than currently contemplated in the 6 GHz band—as much as 47 dBm/10 MHz.[7]

This difficult environment led the Commission to adopt the sophisticated Spectrum Access System (SAS) in the 3.5 GHz band with band-specific capabilities. For example, the 3.5 GHz SAS may control maximum power levels for 3.5 GHz client devices on the fly to reduce power levels as devices get nearer to protected contours, or to control aggregate interference.[8]

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6 47 C.F.R. §§ 96.15, 96.17, 96.21.

7 *Id.* § 96.41(b).

8 *Id.* §§ 96.41(c), 96.53(c).

The SAS is also responsible, in certain respects, for maximizing the efficiency of channel assignments in the band as well as protecting both SAS-controlled and non-SAS-controlled licensees from harmful interference.[9]

This system is in place because the 3.5 GHz landscape is fundamentally different from that of the 6 GHz band. While federal incumbents are expected to enter and exit portions of the 3.5 GHz band without notice, the incumbent landscape in the 6 GHz band is essentially stable from week to week. Likewise, RKF has demonstrated that unlike in the 3.5 GHz band, there is no risk of aggregate interference to any 6 GHz incumbent. This dramatically reduces complexity by eliminating the need for a spectrum management system to monitor and control unlicensed device operations on an ongoing basis. Indeed, FS incumbents—by far the most numerous licensed terrestrial users of the 6 GHz band—do not seriously contend that there is any risk of harmful aggregate interference to their operations.[10]

Furthermore, unlike in the 3.5 GHz band, there is no need to require devices to register with a central coordinator in the 6 GHz band, because unlicensed 6 GHz devices would not be entitled to protection from any other 6 GHz user. This means that potentially independent implementations of a 6 GHz frequency coordination system need only take into account relatively slow-changing incumbent data, and need not synchronize with one another to capture 6 GHz device registrations. By contrast, the various 3.5 GHz SAS operators must share data seamlessly to ensure, among other things, that PAL users are properly protected.[11]

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9 *Id.* § 96.59.

10 *See* Letter from Apple Inc. et al to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183, at iii (filed May 14, 2018).

11 47 C.F.R. § 96.63.

III. THE COMMISSION SHOULD AVOID OVERREGULATION AND MAINTAIN A POLICY OF CAREFULLY TAILORING SHARING APPROACHES TO EACH BAND'S NEEDS

The significant difference between the sharing needs of the 6 GHz and 3.5 GHz bands highlights the importance of the Commission tailoring sharing rules to each band. It should avoid inappropriately applying rules from bands with established sharing regimes to new situations where they are unnecessary. As discussed above, for example, although there were good reasons for the Commission to require aggregate interference management in the 3.5 GHz band, requiring this in the 6 GHz band would dramatically increase complexity and costs in the absence of any identified need.

In addition to increasing the cost of devices, transferring unnecessary sharing requirements from one band to another would reduce efficiency and investment by increasing regulatory burdens on manufacturers and prospective operators of spectrum sharing systems. Such changes may make the implementation of a sharing system in hardware or software unnecessarily challenging, require greater ongoing costs, delay deployment, or limit the ability to scale.

Finally, unnecessary sharing regulations effectively reduce the amount of available spectrum and spectrum utilization. This is most obvious in cases where geographic exclusion areas or guard bands are larger than they need to be, excluding users from frequencies and locations where they could have operated without a risk of harmful interference. Low-power indoor devices in the 6 GHz band present an especially clear example. Since at low-power, indoor devices can protect incumbents without additional frequency coordination, subjecting them to the same exclusion zones required for other devices would needlessly bar devices from operating in large areas where they could have brought significant benefits to consumers.

Other restrictions, such as unnecessarily frequent database check-ins, also encumber the use of spectrum because they may require devices to switch off prematurely if they cannot reach the database at the prescribed time. For example, if new licensees only begin operations on a weekly or monthly basis, but devices are required to cease operations if they cannot contact the database every hour, the enforcement of this rule would effectively result in artificially reduced availability of spectrum, because devices would be precluded from using frequencies in places and at times when there was no true risk of harmful interference. Such an outcome would by definition constitute inefficient spectrum use.

IV. CONCLUSION

The 6 GHz band presents a unique opportunity to address the nation's growing unlicensed spectrum shortfall and support the deployment of new technologies. The Commission can open the band without applying the sophisticated sharing regime that governs the 3.5 GHz band because of important differences in the two bands' incumbent populations. Accordingly, in the report to Congress required by the Spectrum Pipeline Act, the Commission should identify the 6 GHz band as a priority for sharing between incumbents and new unlicensed operations, and find that rigorous technical rules, but not the CBRS sharing regime, are appropriate for these frequencies.

Respectfully submitted,

Apple Inc.
Broadcom Inc.
Cisco Systems, Inc.
Facebook, Inc.
Google LLC
Hewlett Packard Enterprise
Intel Corporation
Marvell Technology Group
Microsoft Corporation
Qualcomm Incorporated
Ruckus Networks, an ARRIS Company

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