**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 |
| Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands | IB Docket No. 15-256 |
| Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band | RM-11664 |
| Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services | WT Docket No. 10-112 |
| Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0- 38.0 GHz and 40.0-40.5 GHz for Government Operations | IB Docket No. 97-95 |

# COMMENTS OF GOOGLE INC.

Austin Schlick
*Director, Communications Law*
Aparna Sridhar
*Counsel*
Megan Anne Stull
*Counsel*
GOOGLE INC.
25 Massachusetts Avenue NW
Ninth Floor
Washington, DC 20001

January 28, 2016

## Introduction

In its *Notice of Proposed Rulemaking* (*NPRM*), the Commission recognized that rules for very high frequency bands above 24 GHz should "encourage wireless innovation," "enable flexibility in the uses and technologies that might be deployed," and facilitate sharing among new and existing users.[1] Consistent with those findings, and to facilitate "emergence of a new and radically more capable generation of wireless mobile service"[2] in the millimeter wave bands, the Commission should (1) establish light licensing or unlicensed frameworks for the bands, using state-of-the-art sharing approaches to manage different classes of users, including but not limited to providers of 5G mobile services; (2) designate sufficient spectrum to support emerging and innovative services and platforms; and (3) in particular, expand opportunities for unlicensed use of the 57-71 GHz band.

### I. The Commission should allow expanded use of the millimeter wave bands on a lightly licensed or unlicensed basis, using sharing technologies to manage different types of users.

To make spectrum available to meet consumers' increasing demands for wireless data, the Commission has rightly pursued a balance between licensed and unlicensed allocations, as well as exclusive and shared access.[3] Primary access to licensed spectrum provides the certainty major operators need to make large, long-term

---

[1] *In the Matter of Use of Spectrum Bands above 24 GHz For Mobile Radio Services, et al.*, Notice of Proposed Rulemaking, 30 FCC Rcd. 11878, ¶¶ 2-3 (2015) (*NPRM*).

[2] *In the Matter of Use of Spectrum Bands above 24 GHz For Mobile Radio Services, et al.*, Notice of Inquiry, 29 FCC Rcd. 13020, ¶ 13 (2014).

[3] *See NPRM* ¶ 58 ("We believe that a balanced approach utilizing licensed, unlicensed, and hybrid mechanisms for authorizing service in the mmW bands will best accommodate a wide variety of services, providing multiple opportunities to put the spectrum to use, and encourage the development of different technologies and business models in these bands.").

investments in wide-area networks, while broad eligibility for access to unlicensed spectrum fosters widespread contributions to innovation and fast-paced investment in emerging technologies.

The principles articulated in the Commission's *NPRM* prioritize diversity in the applications and services to be offered over the millimeter wave bands.[4] Yet the *NPRM*'s detailed proposals for the 28, 37, and 39 GHz bands—three of the four frequency bands addressed—appear to be designed specifically to provide supplemental capacity for current commercial mobile networks.[5] Providing additional capacity for today's mobile broadband providers is an important goal. Continued implementation of a balanced spectrum policy, however, requires that the Commission ensure sufficient access to spectrum for innovative and emerging uses to thrive. Light licensing and unlicensed access are flexible frameworks that accommodate both traditional and new users.

Indeed, the millimeter wave bands have different propagation characteristics than the lower-frequency spectrum that is most often used for mobile broadband, which make the bands particularly well-suited to lightly licensed or unlicensed use. The propagation and atmospheric absorption characteristics of these bands typically require that higher-power operations rely on directional antennas to achieve significant range. The narrow beamwidths of the directional antennas reduce interference to other users, making high-power operations suitable for intensive geographic reuse so long as

[4] *See id.* ¶¶ 1-3.
[5] *See, e.g., id.* ¶ 99 (recognizing that the "proposed licensing model for the 28 GHz and 39 GHz bands will ensure that extensive spectrum is available for service provider deployments of 5G small cells"); *see also id.* ¶¶ 4, 9, 10.

users can coordinate with each other regarding the characteristics and directions of their beams. Low-power operation will be limited in range by the propagation characteristics of these bands, likewise allowing geographic reuse by many users as long as there is modest geographic separation. For these reasons, higher-power operations generally will be suited to non-exclusive light licensing, while lower-power operations feasibly can be unlicensed.

The additional capacity freed through these approaches—whether provisioned by mobile providers or others—can effectively complement the wide-area exclusive licenses over which mobile broadband has traditionally been delivered, just as unlicensed connectivity over Wi-Fi and lightly licensed microwave backhaul complement licensed access today. Increasing interest in offering Long-Term Evolution (LTE) over unlicensed 5 GHz frequencies and General Authorized Access (GAA) spectrum in the 3.5 GHz band shows that mobile broadband providers value and will take advantage of access to additional unlicensed or lightly licensed frequencies.[6] By contrast, merely extending the wide-area exclusive licensing approach employed in lower frequencies would establish a high barrier to entry and fail to "facilitate sharing among a wide variety of users and platforms."[7]

---

[6] *See, e.g.,* LTE-U Forum, www.lteuforum.org (describing efforts of Alcatel-Lucent, Ericsson, Qualcomm Technologies, Samsung, and Verizon to develop LTE technologies for use in the 5 GHz unlicensed bands); see also Petition for Reconsideration of Nokia Networks (d/b/a Nokia Solutions and Networks US LLC), GN Docket No. 12-354 (filed July 23, 2015), at 8 (referring to 3.5 GHz deployments using a License Assisted Access (LAA) configuration). LAA is a standard being developed as a part of 3GPP release 13 to enable the use of LTE in unlicensed spectrum.

[7] Compare *NPRM* ¶ 4 (proposing county-wide licenses for the 28 GHz and 39 GHz bands and for outdoor use of the 37 GHz band) with *NPRM* ¶ 2.

Even if the Commission were to determine that exclusive licenses, rather than light licensing or unlicensed approaches, provide superior benefits in some of the bands identified in the *NPRM*, it should not simply default to the county-wide exclusive licenses proposed.[8] Instead, the Commission should extend to these bands its Part 96 framework for intensive, three-tiered sharing. The Part 96 rules were adopted to enable wireless broadband use on a shared basis in the 3550-3700 MHz band.[9] The Commission established three tiers of users—incumbents, Priority Access, and GAA—and required the use of a spectrum access system to manage coexistence between those tiers.[10] The approach requires Priority Access and GAA services to avoid interference to incumbent military and non-governmental users, while Priority Access users receive protection from interference from third-tier operations licensed by rule.[11] If necessary, a similar approach can be successful in the millimeter wave bands.

In sum, lightly licensed and unlicensed approaches for shared uses of the millimeter wave bands will allow the most intensive use of this spectrum and "facilitate sharing among a wide variety of users and platforms."[12] Beyond this general observation, moreover, we highlight below three particular technologies—broadband delivery over aerial platforms, Wi-Gig and other emerging unlicensed communications

---

[8] *Id.* ¶ 4.
[9] *In the Matter of Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd. 3959 (2015).
[10] *Id.* ¶ 4.
[11] *Id.*
[12] *NPRM* ¶ 2.

technologies in the 60 GHz band, and innovative use of field disturbance sensors—that the Commission should specifically consider in its rulemaking.

## II. The Commission should ensure sufficient spectrum is available for innovative communications services such as broadband from aerial platforms.

In addition to providing additional capacity for terrestrial mobile broadband,[13] the millimeter wave bands could be useful for a variety of non-traditional uses that do not already enjoy reserved spectrum. As noted, the technical suitability of highly directional antennas for these bands allows communications between lightweight devices over significant distances. The wider channels available at higher frequencies further allow for higher data rates in environments constrained by power or signal-to-noise ratios. The bands could, for example, be useful for offering broadband access via aerial platforms such as high-altitude balloons or unmanned aerial vehicles, where deployment of terrestrial networks is uneconomic. Indeed, the International Telecommunication Union (ITU) has an identification for high altitude platforms (HAPS) in the 27.9-28.2 GHz band,[14] and its members agreed at the 2015 World Radio Conference to study use of the 21.4-22.0, 24.25-27.5, and 38-39.5 GHz bands for HAPS as well.[15] In making this decision, participants in the 2015 World Radio Conference

[13] *See, e.g., id.* ¶¶ 12-13.

[14] The frequencies authorized for fixed service over HAPS by the ITU are 6440-6520 MHz, 6560-6460 MHz, 27.9-28.2 GHz, 31.0-31.3 GHz, 47.2-47.5 GHz, and 47.9-48.2 GHz. *See* International Telecommunication Union (ITU), Radio Regulations art. 5.457, 5.537A, 5.543A, 5.552A. Although the 47.2-47.5 GHz and 47.9-48.2 GHz bands are not addressed in the *NPRM*, the ITU's endorsement of HAPS use in these bands indicates the suitability of deploying HAPS at higher frequencies.

[15] International Telecommunication Union, Provisional Final Acts World Radiocommunication Conference (WRC-15), Resolution COM6/21 (Geneva, 2015), available at https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-WRC.11-2015-PDF-E.pdf. The study of the

recognized that frequencies above 20 GHz may be suitable for deploying "broadband connectivity . . . in remote areas" with "minimal ground network infrastructure."[16] The Commission should build on these efforts and consider whether any of the bands identified in the *NPRM* would be suitable for innovative aerial applications.

## III. The Commission should expand unlicensed use of the 57-71 GHz bands.

Unlicensed devices and services "complement licensed services," "serve a wide range of consumer needs," and deliver "economic and consumer benefits, including greater broadband innovation and increased access for broadband services."[17] To improve access to unlicensed spectrum and foster those benefits, the Commission should authorize unlicensed use of the frequencies between 64 and 71 GHz, and it should allow fixed and mobile field disturbance sensors to operate alongside other communications services between 57 and 71 GHz.

### A. Expanding access to the 64-71 GHz band will enable the next generation of unlicensed technologies.

Google supports the Commission's recommendation to authorize operation in the 64-71 GHz band under Part 15 of the Commission's rules.[18] As the Commission and other commenters recognize, "authorizing Part 15 operations in the 64-71 GHz band will allow this band to be used in conjunction with the existing 57-64 GHz band to double the spectrum available for the next generation of unlicensed wireless broadband

21.4-22.0 and 24.25-27.5 GHz bands is limited to ITU region 2, which encompasses both North and South America. *See id.*

[16] *Id.*

[17] *In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd. 6567, ¶ 271 (2014).

[18] *NPRM* ¶ 58.

technologies such as ultra-high-speed audiovisual content streaming and WiGig connectivity."[19] Machine-to-machine applications will also rely on this band for backhaul, hub-to-device, or device-to-device communications. Equally importantly, harmonized rules for the frequencies between 57 and 71 GHz will allow economies of scale and other efficiencies, thereby facilitating rapid and widespread deployment of unlicensed devices.

### B. The Commission should revisit its restrictions on the operation of field disturbance sensors in the 57-64 GHz band and authorize their use across all the frequencies between 57 and 71 GHz.

In 1995, the Commission barred use of field disturbance sensors between 59 and 64 GHz[20] (a band later extended to include 57 to 59 GHz)[21] based primarily on concerns that high-powered vehicular radar could cause harmful interference to data communications.[22] Accommodating vehicular radar in these frequencies also would have required a split band plan, which was thought likely to impede the "development of

---

[19] *Id.*; *see also id.* ¶ 56 (citing supportive comments of Ericsson, IEEE 802, InterDigital, Qualcomm, SiBeam, Wi-Fi Alliance, and T-Mobile).

[20] *In the Matter of Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications*, First Report and Order and Second Notice of Proposed Rulemaking, 11 FCC Rcd. 4481, ¶ 14 (1995) (*Above 40 GHz First Report & Order*).

[21] In 2000, the Commission made the 57 to 59 GHz band available for unlicensed use pursuant to the technical rules governing 59 to 64 GHz. *See In the Matter of Amendment of Part 2 of the Commission's Rules to Allocate Additional Spectrum to the Inter-Satellite, Fixed, and Mobile Services and to Permit Unlicensed Devices to Use Certain Segments in the 50.2-50.4 GHz and 51.4-71.0 GHz Bands*, Report and Order, 15 FCC Rcd. 25264, ¶ 2 (2000).

[22] *See In the Matter of Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications*, Memorandum Opinion and Order and Fourth Notice of Proposed Rulemaking, 12 FCC Rcd. 12212, ¶ 3 (1997) (*MO&O and Fourth NPRM*). *See also* Petition for Reconsideration of Cutler-Hammer, ET Docket No. 94-124, RM-8308, at 4 (filed May 2, 1996) (stating that while a "number of parties expressed concern about suggestions that vehicle radar be permitted to use the 60-61 GHz band . . . no party objected to operations by other types of field disturbance sensors.").

important new applications."[23] On reconsideration, the Commission tailored the ban—currently set forth section 15.255(a)(2)[24]—so that it covered only mobile field disturbance sensors,[25] which were deemed to have unpredictable radiation patterns and interference potential.[26] The Commission thought this approach would promote efficient spectrum use "without hampering the development of new products and services."[27]

Today, lower-power field disturbance sensors are useful for mobile as well as fixed applications that were not contemplated in 1995. Such sensors have much smaller fields of influence than vehicular radars, greatly lessening their potential for interference. While current average and peak EIRP limits for automotive field disturbance sensors are 50 dBm and 55 dBm, respectively,[28] which is ten times higher

---

[23] *Above 40 GHz First Report & Order* ¶ 14.
[24] *See* 47 C.F.R. § 15.255(a)(2).
[25] *MO&O and Fourth NPRM* ¶ 11.
[26] *Id.* ¶¶ 7, 11 (noting, but not challenging, Cutler-Hammer's observation that "mobile field disturbance sensors are very difficult to predict due to the inherently variable nature of the system, which results in unpredictable radiation patterns and potentials for causing and receiving interference."). The Commission also limited very wideband fixed field disturbance sensors to power levels of 10 dBm EIRP or less based on evidence that such levels would suffice in supporting meaningful applications. *See id*. ¶¶ 8, 10-11. *See also* 47 C.F.R. §§ 15.255(b)(2)-(3) (setting forth limits on operation of field disturbance sensors from 57-64 GHz); *In the Matter of Revision of Part 15 of the Commission's Rules Regarding Operation in the 57-64 GHz Band*, Report and Order, 28 FCC Rcd. 12517, ¶ 8 (2013) (converting the "emission limits for all 60 GHz devices in terms" of EIRP).
[27] *See In the Matter of Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications*, Third Report and Order, 13 FCC Rcd. 15074, ¶ 1 (1998). *See also NPRM* ¶ 307.
[28] *See In the Matter of Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band, et al.*, Report and Order, 27 FCC Rcd. 7880, ¶ 14 (modifying Section 15.253 to "amend the emission limits for vehicular radars to specify the average and peak radiated emission limits as both EIRP and a power density limit of 88 μW/cm$^2$ at 3 m (average EIRP of 50 dBm) and 279 μW/cm$^2$ at 3m (peak EIRP of 55 dBm), respectively").

than the limits for communication devices presently operating at 57-64 GHz,[29] power limits for very short-range applications can be less than 10 dBm EIRP. Even longer-range applications, such as in-room activity tracking, can be supported with average and peak EIRP limits of approximately 40 dBm and 43 dBm, equal to those of communication devices operating in the band.[30] The interference profile of these field disturbance sensors does not exceed that of other communications devices currently authorized for use in the 57-64 GHz band. Given present characteristics of useful field disturbance sensors, heavy constraints on their use at 57-64 GHz are no longer appropriate. Rather, such sensors should be subject to the general technical requirements for communications devices operating in the 57-64 and 64-71 GHz bands.

Eliminating outdated restrictions on the EIRP and conducted power of field disturbance sensors would create the "flexible regulatory environment for the next generation of wireless services" sought by the Commission in this proceeding.[31] For instance, the sensors used in Google's Project Soli allow users to interact with devices a short distance away with merely a wave of their hand, without needing to touch the device itself.[32] Thus, not only should the Commission decline to extend section 15.255's restrictions on field disturbance sensors at 57-64 GHz to the 64-71 GHz band, it should do away with them entirely.

---

[29] Compare 47 C.F.R. § 15.253(d)(1)-(2) with 47 C.F.R. § 15.255(b)(1)(i) (establishing average and peak limits in the 57-64 GHz bands of 40 dBm and 43 dBm respectively).
[30] *See* 47 C.F.R. § 15.255(b)(1)(i).
[31] *NPRM* ¶ 1.
[32] *See* Project Soli, https://www.google.com/atap/project-soli/.

## Conclusion

The Commission's stated goals in this proceeding are to "accommodate a wide variety of services, provid[e] multiple opportunities to put the spectrum to use, and encourage the development of different technologies and business models in these bands."[33] To meet these goals, the Commission should consider more than traditional wide-area exclusive licensing. It should use regulatory innovation—such as sharing among incumbent, lightly licensed, and unlicensed users, making spectrum available for aerial platforms, and accommodating emerging use cases in the 57-71 GHz band—to encourage technological advances. A heterogenous, creative approach will best "accommodate a wide variety of current and future technologies"[34] in the millimeter wave bands and drive innovation and investment in next generation wireless services.

Respectfully submitted,

Austin Schlick
*Director, Communications Law*
Aparna Sridhar
*Counsel*
Megan Anne Stull
*Counsel*
GOOGLE INC.
25 Massachusetts Avenue NW
Ninth Floor
Washington, DC 20001

January 28, 2016

[33] *NPRM* ¶ 58.
[34] *Id.*