Facebook, Inc. submits the following information in response to Ofcom's consultation entitled "Fixed Wireless Spectrum Strategy: Consultation on proposed next steps to enable future uses of fixed wireless links," published December 7, 2017.[1]

Facebook's mission is to give people the power to build community and bring the world closer together. And connecting people is a critical first step in executing this mission. Today, more than four billion people—53% of the people on the planet—are still not connected to broadband Internet.[2] Connecting these people—most of whom live in the developing world—is a complicated effort that requires not just bringing network infrastructure to more people, but involves addressing the regulatory environment. To do its part, Facebook, working with a range of partners, has launched several initiatives focused on connecting the unconnected and under-connected.

Spectrum policy and regulations affect both the affordability and availability of the Internet. Improving connectivity in the United Kingdom and around the world means pursuing spectrum policy that maximizes the utilization of this limited resource and promotes the expansion of both the capacity and coverage of wireless networks. Ofcom's proposals in its Fixed Wireless Spectrum Strategy have the potential to achieve these objectives in the UK, while also setting an example for the rest of the world. To this end, Ofcom should consider the following. *First*, as Ofcom considers

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1 https://www.ofcom.org.uk/__data/assets/pdf_file/0027/108594/Fixed-Wireless-Spectrum-Strategy.pdf ("Fixed Wireless Spectrum Consultation").

2 The Inclusive Internet Index: Bridging digital divides at 8 (citing ITU, Key ICT indicators for developed and developing countries and the world, 2005-2016) *available at* https://theinclusiveinternet.eiu.com/assets/external/downloads/3i-bridging-digital-divides.pdf.

making the 26 GHz and 37-40 GHz bands available to support mobile 5G deployments, it should allow for the continued development of fixed services in these bands, specifically high altitude platform stations ("HAPS"). HAPS deployed on unmanned solar platforms can be used to support backhaul for broadband and 5G services in underserved markets. *Second*, Ofcom should consider identifying additional licence-exempt spectrum available to foster innovation and investment in wireless technologies, particularly in the 6 GHz band. And *third*, Ofcom should move forward on its proposals to relax technical parameters for outdoor use of the 54-66 GHz band and extend licence-exempt access under the same parameters to the 66-71 GHz band. By doing so, Ofcom will position the UK to take advantage of new and innovative IEEE 802.11-based technologies currently in development across the 54-71 GHz band. These points are discussed with reference to the relevant consultation questions below.

1. **Ofcom should preserve a role for HAPS within the 5G ecosystem. (Questions 1 & 2)**

Facebook appreciates Ofcom's acknowledgment that HAPS could "extend coverage and capacity to areas where other technologies may not be available or suitable" and that HAPS use cases include the potential to extend the reach of backhaul and for emergency and disaster recovery situations.[3] As Facebook has noted in its past comments before Ofcom,[4] bringing connectivity to all in the UK and around the world will take a mix of technical solutions across multiple technologies and platforms.

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[3] Fixed Wireless Spectrum Consultation at 3.22 (18).

[4] *See* Comments of Facebook, Inc. in response to Fixed wireless spectrum strategy Consultation (11 Jul. 2016) https://www.ofcom.org.uk/__data/assets/pdf_file/0019/91702/Facebook-Inc.pdf.

Facebook and other companies are developing solar-powered, high-altitude unmanned fixed wing aircraft to deliver broadband fixed backhaul connectivity to extend the reach of broadband providers' networks.[5] A crucial part of Facebook's effort is progressing in the UK: a UK-based team is responsible for designing Aquila, Facebook's HAPS aircraft, which completed a full-scale test flight in 2017.[6]

Accordingly, as Ofcom further considers the 26 GHz band (24.5-26.5 GHz) in a separate consultation and considers the 37-40.5 GHz band in the future for mobile use to support 5G deployments, Ofcom should preserve a role for HAPS within the 5G ecosystem and for emergency communications.[7] As these bands are built out, more users will enjoy high-speed connectivity and broadband providers will have more traffic to backhaul. 5G will generate more demand for higher broadband speeds and IoT applications in underserved markets. And, within the 5G ecosystem, HAPS can help extend broadband networks with lower cost backhaul without degrading the 5G services. As noted by the United Nations Broadband Commission, "Developments in aeronautics and radio technologies have made HAPS a viable option to supplement existing network technologies and help bring broadband backhaul to unserved and

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5 https://www.theguardian.com/technology/2017/jul/02/facebook-drone-aquila-internet-test-flight-arizona.

6 https://code.facebook.com/posts/268598690180189/flying-aquila-early-lessons-from-the-first-full-scale-test-flight-and-the-path-ahead/.

7 Fixed Wireless Spectrum Consultation at 4.20-4.24 (23)

underserved regions of the world, particularly remote and rural areas of developing countries."[8]

Furthermore, Facebook believes that HAPS would be well-suited to facilitating critical emergency communications links during natural disasters. HAPS have the potential to be deployed rapidly during emergencies yet remain in place for long periods of time. The United Nations Broadband Commission report concluded that HAPS would be a "valuable alternative" in natural disasters, which "can often overload traditional networks, and ground-based infrastructure is itself vulnerable to damage."[9]

Currently, the International Telecommunication Union (ITU) is studying how to facilitate access to broadband applications delivered via HAPS, such as the unmanned solar plane Facebook is developing.[10] The HAPS WRC-19 agenda item requires the ITU to study possibly modifying the existing identification for HAPS.[11] Facebook has assisted in preparing studies for the ITU-R, which show that HAPS—treated as an

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8 United Nations Broadband Commission for Sustainable Development, Report "Working Group on Technologies in Space and the Upper-Atmosphere: Identifying the potential of new communications technologies for sustainable development," (Sep. 2017) at 30, *available at* http://www.broadbandcommission.org/Documents/publications/WG-Technologies-in-Space-Report2017.pdf.

9 *Id*. at 47.

10 *See* Resolution 160 (WRC-15) *at* https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000C0015PDFE.pdf

11 Resolution 160 resolves that the ITU-R will study the existing HAPS identification of 27.9-28.2 GHz (paired with 31.0-31.3 GHz) as appropriate 38-39.5 GHz. In addition, in Region 2, the ITU-R will study 21.4-22 GHz and 24.25-27.5 GHz. *See id.*

application in the terrestrial-fixed service at the ITU—can co-exist with mobile, fixed and fixed satellite in these bands.

Therefore, as Ofcom continues to examine making spectrum available for mobile use, particularly in the 26 GHz and 37-40 GHz bands, Facebook encourages Ofcom to consider options that would preserve a role for HAPS. Specifically, Ofcom should allow for flexible use across platforms within the bands and consider licensing schemes that would enable HAPS to be used in the band in support of backhaul for 5G applications and services and emergency services.

2. Ofcom should consider identifying additional mid-frequency band spectrum for licence-exempt use, such as the 6 GHz band. (Question 3)

Facebook believes that Ofcom should further consider identifying additional mid-frequency band spectrum for both indoor and outdoor licence-exempt use, such as the 6 GHz band (5925-7125 MHz). Ensuring sufficient licence-exempt spectrum is available will be critical for the growth of 5G as well as supporting existing, growing demand for RLANs. As Ofcom notes, "[t]here is increasing interest at the International level in finding new spectrum for RLANs," and CEPT has begun to study the feasibility of RLAN use at 6 GHz.[12]

Allocating additional mid-band spectrum for licence-exempt use is critical. The propagation characteristics of the 6 GHz band and its proximity to the 5 GHz band make it well-suited to meet the needs of Wi-Fi and support 5G networks. The next generation of Wi-Fi, IEEE 802.11ax is currently under development and could support 6 GHz

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[12] Fixed Wireless Spectrum Consultation at 4.14 (22).

operations.[13] Economies of scale in equipment development are possible as both United States and Europe have already initiated proceedings to explore the possibility of licence-exempt operations in the 6 GHz band.[14] Facebook, as part of a broad coalition of mobile operating system providers, semiconductor manufacturers, content providers, and access point equipment manufacturers, has worked collaboratively to support an engineering analysis showing that unlicensed services could coexist with satellite, microwave, and mobile incumbents in the band in the United States.[15]

Ofcom should further consider licence-exempt use of the 6 GHz band. In addition to addressing growing demand for licence-exempt spectrum, allocating the 6 GHz band for licence-exempt use would create opportunities to spur additional innovation and investment in wireless technologies in the UK.

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[13] *See* Rich Kennedy, Abstract, IEEE P802.11 Wireless LANS; P802.11ax PAR Modification (July 12, 2017), https://mentor.ieee.org/802.11/dcn/17/11-17-0913-02-00ax-parmodification-to-support-6-ghz-band.docx.

[14] In August 2017, the Federal Communications Commission issued a Notice of Inquiry on a range of mid-band spectrum issues including how spectrum in the 5925 to 7125 MHz or 6 GHz band should be licensed. *See Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz*, Notice of Inquiry, FCC 17-104 (rel. Aug. 3, 2017), at https://apps.fcc.gov/edocs_public/attachmatch/FCC-17-104A1_Rcd.pdf. In February 2017, the CEPT ECC issued a document that considered the potential of the 6 GHz band (5925 MHz to 6700 MHz) to offer spectrum opportunities to accommodate WAS/RLAN and suggested that the issue should be studied by December 2018. *See* Proposed studies on Wireless Access Systems including Radio Local Areas networks in 6 GHz band, Doc. ECC(17)012R(2), (Feb. 22, 2017).

[15] *See* Letter to Marlene H. Dortch, Secretary, FCC from Paul Margie, Counsel to Apple, Inc., Broadcom Corporation, Facebook Inc., Hewlett Packard Enterprise, and Microsoft Corp., *Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz*, GN Docket 17-183 (Jan. 25, 2018) *at* https://ecfsapi.fcc.gov/file/10126878417951/6%20USC%20Ex%20Parte%20Final.pdf.

3. Facebook strongly supports Ofcom's proposals to relax the technical parameters of the 57-66 GHz band for outdoor use and urges Ofcom to extend the same parameters to the 66-71 GHz band.

a. Questions 4 & 5

Facebook strongly supports Ofcom's proposal to change the authorisation regime in the 64-66 GHz band to licence-exempt to create a common authorisation approach across the 57-66 GHz band.[16] In addition, Facebook strongly supports Ofcom's proposal to facilitate new outdoor use cases in the 57-66 GHz band such as "point to multipoint/mesh use cases"[17] on a licence-exempt basis.

In the 60 GHz band (57-66 GHz), new services have developed ranging from outdoor wireless links that extend the reach of fiber networks to personal networking technologies based on the WiGig standards 802.11ad and 802.11ay that deliver multi-Gigabit speeds between devices. And more is yet to come. The huge demand for network capacity is driving investment in 60 GHz licence-exempt technologies for wireless backhaul and other uses, particularly as the technology is evolving to allow for non-line-of-sight applications. For example, Facebook's Terragraph project, a low-cost high-throughput (multi-Gigabit) multi-node mesh wireless network for dense urban topologies could provide fiber-like reliability for access and backhaul at a lower upfront cost.[18] Ofcom's proposed technical adjustments will provide greater flexibility to deploy

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16 Fixed Wireless Spectrum Consultation at 5.17 (33).

17 *Id.* at 5.30 (39).

18 Deutsche Telekom and Facebook take on mmWave in new Telecom Infra Project group, https://www.mobileeurope.co.uk/press-wire/deutsche-telekom-and-facebook-take-on-mmwave-in-new-telecom-infra-project-group

technologies like Terragraph in the UK.

Whilst initial implementations of Terragraph operate within an average eirp of 40 dBm and peak eirp of 43 dBm, in the future, there are deployment scenarios (*e.g.*, Terragraph node links between a rooftop and pole) that would require higher power. Facebook recommends that for outdoor fixed deployments, Ofcom allow power limits to be higher if higher gain antennas are used as the United States has done.[19] Accordingly, Facebook recommends modifying the limits proposed in Table 6 of the Consultation to the following Table 1:

Table 1

Transmit eirp	Requirement	Note
≤ 40 dBm (average) ≤ 43 dBm (peak)	Minimum antenna gain of 20 dBi	Indoor/Outdoor
≤ 82 dBm (average) ≤ 85 dBm (peak)	Both average and peak limits shall be reduced by 2 dB for every dB the antenna gain is less than 51 dBi	Outdoor-only, Fixed

b. Question 6

Ofcom should extend licence-exempt access to additional adjacent bands, such as the 66-71 GHz band, along the same terms for outdoor use as proposed above. Doing so would increase opportunities for the new and innovative technologies that are developing in the 60 GHz band. In fact, the latest IEEE 802.11-2016 standard defines six 2160 MHz channels including three that require access to spectrum in the 64-71

[19] 47 C.F.R. Part 15.255.

GHz band.[20] For these reasons, the United States has recently made the 64-71 GHz band available for unlicensed use, and Canada has also proposed to do so.[21] By adjusting technical parameters for outdoor use as noted in Table 1 above and extending those parameters throughout 54-71 GHz, Ofcom will position the UK to take full advantage of new wireless technologies based on IEEE 802.11ad and –ay standards today and in the long term. When applied outdoors, these new technologies have the potential to extend the multi-Gigabit capacity of fiber networks wirelessly. These technologies are poised to deliver high-speed broadband at low cost, which in turn could enable more affordable broadband access in the UK.

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[20] Table E-1, US Operating Class 34 and/or Table E-4, Global Operating Class 180.

[21] Federal Communications Commission (FCC), Report and Order (R&O) and Further Notice of Proposed Rulemaking (FNPRM), *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al,* FCC 16-89 (July 2016) https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-89A1.pdf; Innovation, Science and Economic Development (ISED) Canada, Consultation on Releasing Millimetre Wave Spectrum to Support 5G, SLPB-001-17 (June 2017) at 21-23, https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/slpb-001-17-5G.pdf/$file/slpb-001-17-5G.pdf.