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September 14, 2017

Innovation, Science, and Economic Development Canada
c/o Senior Director, Spectrum Licensing and Auction Operations
235 Queen Street, 6th Floor
Ottawa, Ontario K1A 0H5

Re: 'Consultation on Releasing Millimetre Wave Spectrum to Support 5G' (SLPB-001-17)
Canada Gazette, Part I, June 2017

Dear Sir or Madam:

Microsoft respectfully submits the following comments in response to Innovation, Science, and Economic Development (ISED) Canada's 'Consultation on Releasing Millimetre Wave Spectrum to Support 5G' ('Consultation'). Microsoft commends ISED for initiating the process for releasing spectrum in the 28 GHz, 37-40 GHz, and 64-71 GHz millimetre (mmWave) frequency bands that will position Canada at the leading edge of the digital transformation. Microsoft is pleased that ISED's consultation contemplates various mechanisms by which mmWave spectrum would be made available, including license, license-exempt, and shared spectrum use (where appropriate), to meet Canada's wireless broadband needs.

Question 4-1: Given the disruptive nature of 5G, will new business models and network applications develop that may require policy and regulatory consideration from ISED? Please describe potential new business models and network applications as well as their benefits to Canadians.

In comparison to 4G networks, 5G networks are anticipated to operate at much greater speeds, with lower latency, and with greater spectral efficiency. The Internet of Things is also associated with 5G, although not all IoT applications require high data rates and low latency.

Microsoft sees 5G networks developing along two paths. The first path is evolutionary – increasing the capacity of existing 4G services, most likely in high demand areas when and where it is needed. The second path is revolutionary new system capabilities that serve as a distinct break with the prior generation. Microsoft sees significant opportunities for the use of license-exempt and shared spectrum as part of the 5G ecosystem.

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Specifically, extending the existing 57-64 GHz ('60 GHz') band to 71 GHz will enable new business models and network applications that will benefit Canadian residents and businesses. These very high-bandwidth / low latency applications include very high-speed wireless docking, 'wireless fiber' connection between an optical fiber strung along a utility pole and one or more structures; multiple users of augmented reality devices in relative proximity on the factory floor, warehouse, retail space, etc.; and mobile robots that utilize machine vision and telemetry as inputs to cloud-based artificial intelligence.

These applications will all benefit from the IEEE 802.11ay[1] standard under development, which builds upon the current IEEE 802.11ad-2012[2] standard for Wide Local Area Networks operating in the 60 GHz band. The updated standard will allow up to four, 2.16 GHz-wide channels to be bonded to achieve transmission rates in the 10s of gigabits per second. The amended standard will also allow for licence-exempt operations at greater range. And while the 60 GHz band can indeed be used for alleviating spectrum congestion from carrier networks by enabling mobile data off-loading, there are enough significantly different use cases where licence-exempt operations in the 14 GHz of the extended 60 GHz band should be viewed as distinct from licence-exempt use in the 2.4 GHz and 5 GHz frequency bands.

Question 5-1: ISED is seeking comments on developing a flexible use licencing model for fixed and mobile services in the 28 GHz and 37-40 GHz frequency bands, and allowing licence-exempt use of the 64-71 GHz frequency band ahead of WRC-19 and before 5G technology standards are finalized.

Microsoft believes that ISED should develop a flexible use licencing model for fixed and mobile services in the 28 GHz and 37-40 GHz frequency bands ahead of WRC-19. Each of these frequency ranges are currently allocated for the fixed service and the mobile service on a co-primary basis.

[1] IEEE Task Group ay - Standard for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications-- Amendment: Enhanced throughput for operation in license-exempt bands above 45 GHz.

[2] IEEE Standard for Information Technology – Telecommunications and Information Exchange Between Systems –
Local and Metropolitan Area Networks – Specific Requirements – Part 11: Wireless LAN Medium Access Control
(MAC) and Physical Layer (PHY) Specifications – Amendment 3: Enhancements for Very High Throughput in the
60 GHz Band, December 2012.

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As ISED is aware, ITU-R[3] is not conducting sharing and compatibility studies on the 28 GHz band for potential identification as a globally harmonized spectrum band for 5G. The U.S. has technical and service rules in place. Microsoft understands that several other nations are considering regulatory frameworks that will allow for mobile service in the 28 GHz band. Therefore, Microsoft believes ISED can and should move forward now with developing a flexible use licencing model for 28 GHz band in Canada.

ISED should also move forward with developing a flexible use licencing model for fixed and mobile services in the 37-40 GHz spectrum band. The ITU-R is conducting sharing and compatibility studies on the 37-43.5 GHz frequency range for potential identification for IMT 2020. Parts of the band are also being studied for other radiocommunication services.

It is impossible to predict the outcome of the ITU-R sharing and compatibility studies or what, if anything, WRC-19 will decide. If WRC-15 is a guide, then it would not surprise Microsoft if the meeting deadlocks on identifying additional spectrum for IMT-2020 in certain frequency bands. If ISED harmonizes the Canadian regulatory framework for the 37-40 GHz band to the greatest extent feasible with the United States, then Canadian consumer and businesses can benefit from the economies of scale created – and not have to wait.

Microsoft believes that ISED should act in advance of WRC-19 and extend the licence-exempt 57-64 ('60 GHz') frequency band to 71 GHz under the same technical rules. ITU-R was directed by WRC-15 to conduct sharing and compatibility studies in the 66-76 GHz band for potential identification for IMT 2020. In Question 4, Microsoft described benefits to Canadian consumers for creating a 14 GHz-wide block of licence-exempt spectrum for very high-speed low-power wireless data transmission over relatively short distances, higher-power last-mile broadband access and backhaul, and the offloading of wireless networks, among other uses. Microsoft considers Canadian consumers will be best served if ISED allows licence-exempt use across the entire 57-71 GHz frequency range in Canada. Several countries, including most recently the United Kingdom, are also considering licence-exempt use of the 64-71 GHz band in advance of WRC-19.

Question 6-3: ISED is seeking comments on its proposal to adopt the band plan (as shown in figure 3 above) in the 28 GHz band.

ISED needs to balance the objective of harmonizing the Canadian band plan for 28 GHz with the U.S. band plan for 28 GHz, with the objective of fostering domestic competition in 5G services. A '5G' data rate can be achieved using less than 425 MHz of spectrum.

[3] International Telecommunication Union Radiocommunication Sector

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Question 7-1: ISED is seeking comments on the proposal to implement flexible use licensing in the frequency band 37-40 GHz, including the consequential changes to CTFA footnote C51, while continuing to allow for fixed-satellite service (space-to-Earth) in the band.

Microsoft supports ISED's proposal to implement flexible use licensing in the 37-40 GHz frequency band. We believe that the proposed change to CTFA footnote C51 is necessary for ISED to implement its flexible use licensing approach in this frequency range.

Question 7-3: ISED is seeking comments on the proposal to adopt the band plan as shown in figure 7 for the frequency band 37-40 GHz.

Microsoft supports ISED's proposed band plan for the 37-40 GHz frequency band. We understand why ISED is leaving the band plan for 37.0-37.6 GHz 'to be determined'. The FCC issued a Further Notice of Proposed Rule Making to address several questions regarding the sharing of U.S. Federal and non-Federal users in the 37.0-37.6 frequency range. The FCC is considering a 100 MHz channel size and allowing up to 6 channels to be aggregated at one location. While 3GPP is looking at 100 MHz-wide channels for 5G, Wi-Fi devices currently utilize 20, 40, 80, and 160 MHz channel depending on the amount of spectrum available. It is anticipated that most commercial use of the 37.0-37.6 GHz band will occur indoors. As we will discuss in our response to Question 9, ISED might consider preserving the frequency range as a single band, where a software-based Spectrum Access System (SAS) manages access to the spectrum and maximizes the spectrum utilization of the band at that location and time through variable-size channels to meet demand.

Question 8-1: ISED is seeking comments on its proposal to designate the band 64-71 GHz for licence-exempt operations on a no-protection, no-interference basis.

Microsoft strongly supports ISED's proposal to designate the band 64-71 GHz frequency band for licence-exempt operations on a no-protection, no interference basis. The availability of an additional 7 GHz of licence-exempt spectrum contiguous to the existing licence-exempt 60 GHz band will enhance existing uses and enable new uses that require very high throughputs. Additionally, the extension of the licence-exempt 60 GHz band permits an increase in the number of simultaneous high-bandwidth users.

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Pursuant to the IEEE 802.11ad-2012 and IEEE 802.15c-2009[4] standards and the internationally harmonized channelization scheme[5], three non-overlapping 2.16 GHz – wide channels can operate in the 7 GHz wide 60 GHz band. The international harmonization of channel sizes will accelerate the extended band's usage and growth. Licence-exempt WiGig®[6] devices using the 60 GHz band are just beginning to be marketed and the global ecosystem is developing rapidly.

Extending the 60 GHz band to 71 GHz will double the size of the band and double the number of non-overlapping channels available. As 60 GHz operations are line-of-sight and the current indoor power levels allow for in-room use, doubling the number of channels can increase the number of simultaneous users, for example, of augmented reality devices on a factory floor, warehouse, retail space, etc.

The IEEE 802.11ay standard under development will allow up to four, 2.16 GHz channels to be combined as well as allow for MIMO antenna use. The increase in channel size will allow additional capacity to be provided either to a single user or to simultaneous users.

There are oxygen absorption lines that limit the range of the two lowest frequency 60 GHz channels. The uppermost channel in the current 60 GHz frequency band and the proposed three additional channels in the extended 60 GHz band will be sufficiently removed from the oxygen absorption lines where outdoor use over limited distances becomes feasible. The most discussed of these applications is coupling into an optical fiber strung between utility poles and transmitting a high-bandwidth signal wirelessly to one or more buildings.

Question 9-1: ISED is seeking comments on:

A. Whether flexible use access in these bands should be exclusively licenced or licence-exempt.

Microsoft supports ISED authorizing flexible use access in the 37.0-37.6 GHz frequency band that is shared between licensed Canadian government systems and licence-exempt commercial devices. As in the 64-71 GHz frequency range, the licence-exempt operations would be on a no-protection, no-interference basis. In

[4] IEEE Standard for Information Technology – Telecommunications and Information Exchange Between Systems –
Local and Metropolitan Area Networks – Specific Requirements – Part 15.3: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications for High Rate Wireless Personal Area Networks (WPANs)
– Amendment 2: Millimeter-wave based Alternative Physical Layer Extension.

[5] Recommendation ITU-R M.2003-1, *'Multiple Gigabit Wireless Systems in frequencies around 60 GHz'*, Radiocommunication Sector of the ITU (ITU-R), January 2015.

[6] WiGig is a registered trademark of the Wi-Fi Alliance

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this way, the expanded set of potential future Canadian federal users would be protected.

B. **Whether a licence-exempt dynamic access using data base should be implemented in all, or portions of the 28 GHz, 37-40 GHz, particularly in the band 37-37.6 GHz.**

Licence-exempt dynamic spectrum access using a data base should be implemented across the 37-40 GHz band. ISED should adopt a use-or-share policy whereby a licence-exempt user can opportunistically access the spectrum of a flexible use licensee operating in the 37.6-40 GHz frequency range in those areas where it has yet to build out and commence operations. The database would also ensure that the required exclusion zone is established to protect various satellite services. A data base could provide this information to so-enabled licence-exempt devices.

Within the 37.0-37.6 GHz frequency range, a data base can ensure that license-exempt users can operate on a non-interference basis to Canadian Federal users. The database can also be used to maximum the spectrum utilization at a given location. Rather than having specified channels, Federal and non-Federal devices can request the amount of spectrum it requires at that time and place to complete its communication. Once the Federal use requirement is met, the SAS can determine based on the protection requirements and the amount of spectrum required. Currently, it is anticipated that commercial use of the 37.0-37.6 GHz frequency range will occur indoors. But once the spectrum is made available under ISED's technical rules, Canadian innovators will have to opportunity to explore different opportunities.