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DSA
DYNAMIC • SPECTRUM • ALLIANCE

February 16, 2017

Innovation, Science, and Economic Development Canada
c/o Director
Spectrum Regulatory Best Practices
235 Queen Street
Ottawa, Ontario K1A 0H5
Canada

Re: 'Consultation on the Spectrum Outlook 2018 to 2022' (SMSE-006-17);
Canada Gazette, Part I, October 6, 2017

Dear Sir or Madam:

The Dynamic Spectrum Alliance (DSA) commends Innovation, Science, and Economic Development (ISED) Canada for initiating its 'Consultation on the Spectrum Outlook 2018 to 2022' (the Consultation) that will lead to the release of spectrum for commercial mobile services, licence-exempt applications, satellite services and wireless backhaul over this period. We concur with ISED that "consumer demand for broadband services with faster data rates and more sophisticated applications has been driving an increase in the spectrum requirements for commercial mobile, satellite, and backhaul services, as well as licence-exempt applications",[1] and that these trends show no signs of abating.

The DSA is a global organization advocating for laws and regulations that will lead to more efficient and effective spectrum utilization. Our membership spans multinationals; small- and medium sized enterprises; and academic, research and other organizations from around the world, all working to create innovative solutions that will increase the amount of available spectrum to the benefit of consumers and businesses alike. Our primary goals are to close the digital divide by reducing the cost of deploying last-mile wireless networks, enabling the Internet of Things, and alleviating the spectrum crunch.[2]

The DSA's responses to select questions are provided below.

Q1 – What future changes, if any, should ISED examine with regard to the existing licensing regime to better plan for innovative new technologies and applications and allow for benefits that new technology can offer, such as improved spectrum efficiency?

The DSA agrees with ISED that the availability of new dynamic spectrum technologies and techniques will create new opportunities for optimizing the use of spectrum and promise to make it increasingly feasible to allocate, assign, and access shared spectrum in real time between multiple different services. Application of these dynamic spectrum technologies and techniques will enable ISED to consider shared use of bands first when assessing potential changes to spectrum allocations and when prioritizing spectrum releases.

[1] See the Consultation at paragraph 9
[2] For more on the DSA, please visit www.dynamicspectrumalliance.org

Q2 –Do you agree with the above assessment on demand for commercial mobile services in the next few years? Is there additional information on demand, which is not covered above, that should be considered? If so, please explain in detail.

Canadian consumers access wireless data and services on devices while they are mobile/moving (mobile use) and stationary / moving very slowly in proximity to a fixed broadband connection (nomadic use). The DSA concurs that in the next few years the overall demand for wireless data and services in Canada will continue to increase, driven in large part by the sustained growth in wireless video. Commercial mobile services can be delivered over a combination of licensed and licence-exempt spectrum. Consequently, to meet this continuing growth in mobile data, ISED will need to identify spectrum resources to release on a licensed, license-exempt, and shared basis to support commercial mobile services.

Q5 – Do you agree with the above assessment of demand for licence-exempt spectrum in the next few years? Is there additional information regarding demand, which is not covered above, that should be considered? If so, please explain in detail.

The DSA agrees with ISED's assessment that there will be continued demand for spectrum in the licence-exempt bands in Canada, due to the expansion of Wi-Fi, expected growth of in the number of IoT devices, and adoption of augmented reality / virtual reality devices in the enterprise and the home. In 2017, the Wi-Fi Alliance[3] commissioned Quotient Associates to conduct a spectrum needs study for Wi-Fi use in years 2020 and 2015 under the present (more likely) 'busy hour' demand-growth scenario and (a less likely but possible) 'upper bound' demand-growth scenario for the United States, Europe and Japan, and China.[4] The study concludes that in all scenarios there will be a spectrum shortfall ranging from a few hundred MHz to over 1700 MHz.

Q6 – What new technologies and/or sharing techniques are expected to aid in relieving traffic pressures and addressing spectrum demand for licence-exempt applications? When are these technologies expected to become available?

In the Consultation, ISED states that dynamic spectrum technologies and techniques will create new opportunities for optimizing the use of spectrum and promise to make it increasingly feasible to allocate, assign, and access shared spectrum in real time between multiple different services. Software defined radio and cognitive radio techniques and technologies exist and are being applied today in spectrum management.

For example, in the United States 3550-3700 MHz frequency band, a software-based Spectrum Access System (SAS) will manage access to spectrum across the band and ensure that incumbent and Priority Access Licensees will be protected from receiving harmful interference. The calculation engine relies on FCC's technical rules, on inputs from component technologies including a database, spectrum analyzers, and environmental sensing capability; and on the geographic coordinates of each base station. Here, the SAS provides dynamic channel authorization for the Priority Access License holders.

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[3] Wi-Fi®, the Wi-Fi logo, the Wi-Fi CERTIFIED logo, Wi-Fi Protected Access® (WPA), WiGig®, the Wi-Fi Protected Setup logo, Wi-Fi Direct®, Wi-Fi Alliance®, WMM®, Miracast®, and Wi-Fi CERTIFIED Passpoint®, and Passpoint® are registered trademarks of Wi-Fi Alliance. Wi-Fi CERTIFIED™, Wi-Fi Protected Setup™, Wi-Fi Multimedia™, WPA2™, Wi-Fi CERTIFIED Miracast™, Wi-Fi ZONE™, the Wi-Fi ZONE logo, Wi-Fi Aware™, Wi-Fi CERTIFIED HaLow™, Wi-Fi HaLow™, Wi-Fi CERTIFIED WiGig™, Wi-Fi CERTIFIED Vantage™, Wi-Fi Vantage™, Wi-Fi CERTIFIED TimeSync™, Wi-Fi TimeSync™, Wi-Fi CERTIFIED Location™, Wi-Fi CERTIFIED Home Design™, and the Wi-Fi Alliance logo are trademarks of Wi-Fi Alliance

[4] Steve Methley and William Webb, Wi-Fi Spectrum Needs Study, 26, Final Report, QUOTIENT ASSOCIATES LTD. (Feb. 2017)

In the TV bands, a calculation database relying on the FCC rules, a geolocation database, and the geographic coordinates of the licence-exempt fixed radio ensures that TVWS devices can operate in the so-called white spaces without causing harmful interference to licensed operations. Here the TVWS database provides dynamic spectrum access.

Finally, there are IEEE 802.11 task groups developing successor technical standards to 802.11ac in the 5 GHz band (802.11ax) and to 802.11ad in the 60 GHz band (802.11ay). Each of these standards will pave the way for more efficient use of licence-exempt spectrum in the respective frequency bands.

Q7 – What existing licence-exempt frequency bands will see the most evolution in the next five years? Are there any IoT applications that will have a large impact on the existing licence-exempt bands? If so, what bands will see the most impact from these applications?

60 GHz Band

Canada has rules in place for licence-exempt operations in the 57-64 GHz frequency band.[5] WiGig®[6]-enabled devices operating within this frequency band are commercially available today. ISED is conducting a consultation on whether to extend licence-exempt use up to 71 GHz. The DSA filed comments in the proceeding.[7] Extending the upper boundary of the band to 71 GHz will double the number of 2.16 GHz-wide licensed-exempt channels available for Canadian consumers and businesses from three to six, allowing for new uses and greater usages of the frequency band. IEEE 802.11 is in the process of developing the next generation standard, 802.11ay, that will allow for the bonding of up to four 2.16 GHz-wide channels. For Canadians to benefit from license-exempt devices with this extremely large bandwidth, ISED needs to complete its consultation on the 64-71 GHz band expeditiously and authorize licence-exempt use across the entire 57-71 GHz frequency band.

5 GHz Band

The DSA expects that, due to ISED amending its technical rules for licence-exempt operations in the 5150-5250 GHz band last year,[8] there will be greater utilization of this frequency band by both consumer and enterprise users. Additionally, the DSA understands there to be industry-led efforts to make greater use of the 5250-5350 MHz and 5470-5725 MHz frequency bands that require Dynamic Frequency Selection (DFS) to protect government users from harmful interference. ISED may consider examining if changes are required to its technical rules or procedures regarding license-exempt devices that may allow for greater utilization of these frequency bands for Canadian consumers. To these ends, it is very important that Canada supports no change to agenda item 9.1.5 at the 2019 World Radiocommunication Conference (WRC-19). If RLAN devices must detect two additional types of radars that are designed to be undetectable, it will not be possible to protect government users in the DFS band. Consequently, it would be up to each Administration whether RLANs could continue to operate in the DFS bands. Given the urgency to identify additional resources for (licensed and) licence-exempt spectrum to meet the projected growth of wireless data and services, treaty-based recommendations that would effectively remove 355 MHz of licence-exempt spectrum from Wi-Fi use seems unwise and would clearly hurt Canadian interests.

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[5] *See 'RSS-210 — Licence-Exempt Radio Apparatus: Category I Equipment', Annex J,* [Issue 9, August 2016]

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

[7] *See* Comments of the Dynamic Spectrum Alliance in 'Consultation on Releasing Millimetre Wave Spectrum to Support 5G' (SLPB-001-17) Canada Gazette, Part 1, June 2017, http://dynamicspectrumalliance.org/wp-content/uploads/2017/09/DSA-Comments-to-ISED-Canada-Millmeter-Wave-Band_09152017.pdf (filed September 15, 2017)

[8] *See* Innovation, Science and Economic Development Canada, 'Decision on the Technical and Policy Framework for Radio Local Area Network Devices Operating in the 5150-5250 MHz Frequency Band', (SMSE-013-17), May 2017

TV White Spaces (TVWS)

The three licence-exempt use cases envisioned for the TVWS are broadband access, enhanced Wi-Fi, and the Internet of Things (IoT). Now that Keybridge has been certified as a whitespace database provider in Canada, the DSA expects there to be commercial rollout of communications incorporating TVWS links in Canada over the next five years. The DSA also considers the TVWS as being important for certain IoT applications that require large geographic coverage area but are not latency sensitive. These applications include but are not limited to agriculture, a range of extractive industries, and environmental monitoring.

IoT

The DSA believes that the more licence-exempt spectrum available for IoT the better, and that ISED should not designate any specific frequency bands for IoT. There is a continuum of IoT applications based on requirement such as range, latency, bandwidth required. Given that radio waves in different frequency bands exhibit different properties such as path loss, rain fade, molecular absorption lines, etc., and given that the narrow band channel sizes available vary by band, the greater the amount of licence-exempt spectrum available the more flexibility there will be in fashioning the most appropriate IoT solution for a given application.

Q8 – Will the trend for offering carrier-grade or managed Wi-Fi services continue to increase over the next five years? If so, will this impact congestion in Wi-Fi bands and which bands would be most affected?

The DSA expects the trend for mobile network operators to offer carrier-grade or managed Wi-Fi services to continue and to increase. The 2.4 GHz Wi-Fi band can concurrently support three independent 20 MHz channels or one 40 MHz and one 20 MHz channel. There is general acknowledgement that in moderate- and high-densely populated areas the 2.4 GHz is already heavily congested. The 5 GHz band will be most affected by this increased congestion, particularly the frequency bands where DFS is not required. While enterprise networks have embraced use of the DFS bands, consumer use has lagged due to increased relative cost, complexity, and inability for there to be 'soft APs', for example. Compounding the situation in the non-DFS bands is the question of whether unlicensed LTE technologies can coexist fairly with Wi-Fi. Within the urban cores of large Canadian cities, if unlicensed LTE technologies cannot share access to the medium fairly with Wi-Fi, then there will be less availability for 5 GHz Wi-Fi spectrum, and increased congestion.

Q19 – Provide, with rationale, your view of the above assessments on the bands being considered internationally for commercial mobile, fixed, satellite, or licence-exempt.

3400-4200 MHz Band

- ISED should adopt a three-tiers-of-access spectrum management framework for the 3550-3700 MHz frequency band that is harmonized with the United States Federal Communication Commission's Part 96 rules.

- ISED should consider rules changes that will make it easier for the fixed service to share spectrum with the fixed satellite service downlinks in the 3700-4200 MHz frequency band through a simple database coordination process. The fixed service links can be used by Wireless Internet Service Providers to provide broadband access, including exurban and rural areas.

5 GHz Band

- Consistent with ISED's 2017 decision to authorize licensed higher-power indoor and outdoor RLAN operations, and licensed-exempt RLANs for devices operating at no greater than 200 mW in the 5150-5250 MHz frequency band, Canada may consider supporting outdoor and higher power RLAN operation in the frequency range 5150-5350 MHz under WRC-19 AI 1.16. Whether these devices need to be licensed or remain licence-exempt is a national matter for Administrations to consider.

- It is critical that the ITU does not take any action that places undue constraints on RLAN devices operating in the DFS frequency bands. The DFS Recommendation adopted by the ITU in 2003 essentially says that RLANs need to detect (and protect from harmful interference) all the radar types listed in the accompanying report. Incorporating by reference into the 2003 report two new radars that did not exist at the time and for which there is no way today to meet these requirements is sneaky and just plain wrong.

37 and 38 GHz Bands

- ISED should move forward to finalize its mmW '5G' consultation expediently, including the rules for sharing in the 37.0-37.6 GHz band regardless of whether the FCC does, and consider additional mmW bands for shared access. As stated in our filed comments, the DSA is most interested in the potential for dynamic shared spectrum use by prospective federal and non-federal users in the sub-band 37.0-37.6 GHz.[9] It is the perfect opportunity for ISED to establish rules that leverage software defined radio and cognitive radio technologies and techniques to demonstrate dynamic spectrum access, dynamic spectrum authorization, and even dynamic spectrum allocation.

- The DSA supports ISED's proposal to adopt a 37-40 GHz band plan harmonized with that developed by the FCC for the 37 GHz and 38 GHz bands. For the 37-37.6 GHz lower band segment, the DSA recommends ISED establish a framework that authorizes licensed, license-by-rule, and license-exempt operations. We also recommend ISED authorize opportunistic access on a use-or share basis to unused capacity across the 37.6-40 GHz band segment. The sharing between licensed and licensed-by-rule users could be facilitated through a software-based SAS, like the one being certified for the three-tier-of-access spectrum sharing in the 3550-3700 MHz frequency band in the United States.

- Rather than setting a minimum channel size and spectrum aggregation limits for the 37 GHz and 38 GHz bands, a SAS coordination mechanism would allow for variable channel sizes based on the actual bandwidth each user requires in an area to maximize spectrum utilization. The DSA further suggests that ISED consider the feasibility of authorizing indoor-only use of the 37-37.6 GHz band on an licence-exempt basis. We believe that additional protections can be applied to minimize the risk that "signal leakage" from indoor-only use of the 37-37.6 GHz band could disrupt neighboring deployments. For example, requiring that these devices be AC-powered maybe one means to ensure that they only operate indoors.

[9] *See* Comments of the Dynamic Spectrum Alliance in 'Consultation on Releasing Millimetre Wave Spectrum to Support 5G' (SLPB-001-17) Canada Gazette, Part 1, June 2017 http://dynamicspectrumalliance.org/wp-content/uploads/2017/09/DSA-Comments-to-ISED-Canada-Millmeter-Wave-Band_09152017.pdf (filed Sept. 15, 2017)

66-71 GHz Band

- ISED should expeditiously complete its consultation to authorize the 64-71 GHz band for licence-exempt use. Consequently, the DSA urges that the spectrum band 66-71 GHz not be identified for IMT-2020 under WRC-19 Agenda Item AI 1.13.

Q20 – ISED is seeking comments on the potential frequency bands for release in table 7:

71-76 GHz Band

The DSA strongly encourages ISED to open the 71-76 GHz frequency band for licence-exempt operations, provided that such use can coexist with incumbent operations on a non-interfering basis. Assuming ISED finalizes its rules to authorize licence-exempt spectrum between 64-71 GHz, it would create a licence-exempt spectrum block between 57-76 GHz in Canada that can support eight independent, 2.16-MHz wide, IEEE 802.11ad compliant channels. The two IEEE 802.11ad compliant channels that would operate between 71-76 GHz can use the same technology developed in the 57-71 GHz band. With respect to timing, once 71-76 GHz is not identified for IMT-2020, ISED should initiate a consultation for releasing the 71-76 GHz frequency band for licence-exempt use. By then, the rollout of WiGig devices will be accelerating and the IEEE will have adopted 802.11ay, the successor to the current standard that will allow for the bonding of multiple channels.

Q21 – Are there any other bands that should be considered for release in the next five years for commercial mobile, fixed, satellite, or licence-exempt that are not discussed above? Provide rationale for your response.

6 GHz band

The DSA strongly encourages ISED to consider releasing spectrum in the frequency range 5925-7125 MHz ('6 GHz Band') for licence-exempt use on a shared basis.

With IEEE 802.11ac now shipping in widely distributed consumer devices, and IEEE 802.11ax moving rapidly towards deployment, Canadians have begun to demand wider gigabit-capable bandwidths. These standards require wider bandwidths[10] in order to allow consumers' Wi-Fi to keep up with the unprecedented gigabit connection speeds that DOCSIS 3.1 and fiber are bringing into their homes.

Without access to the 6 GHz band, addressing this spectrum and connectivity need is impossible. Wi-Fi users already experience interference and slow speeds during the busy peak hours across the country. In fact, a 2017 study by Qualcomm found that, without access to additional spectrum, wireless networks of tomorrow will lack the spectrum resources needed to preserve even today's level of service, much less be able to support the future advances we know will emerge.[11]

Similarly, the Wi-Fi Alliance commissioned a study by Quotient Associates that found that the United States will require at least an additional 540 MHz of spectrum to accommodate the demand expected in 2025; if new technologies require additional spectrum and the DFS bands continue not to operate at full capacity, the

[10] The new Wi-Fi standards of 802.11ac and 802.11ax will deliver Gigabit level speeds using more multi-user MIMO, high density modulation, and wider RF bandwidth (up to 160 MHz).
[11] Rolf de Vegt et al., *A Quantification of 5 GHz Unlicensed Band Spectrum Needs*, QUALCOMM TECHNOLOGIES, Inc. (2017)

shortfall could reach 1,588 megahertz.[12] While the Wi-Fi spectrum shortfall for Canada will be different, the overriding trend is the same.

The 6 GHz band is ideal for licence-exempt use of a shared spectrum resource. The 6 GHz band is home to a diverse group of incumbents with differing protection needs. These include, but are not limited to, fixed point-to-point links, fixed satellite earth station uplinks, and mobile broadcast auxiliary services. Licence-exempt devices would have to protect these licensed services from receiving harmful interference and could not claim protection from interference. Moreover, while licensed services must coordinate with each other when introducing new links, licence-exempt services may not assert coordination rights with a licensed service and must accept new interference when an incumbent expands or changes its network. These features would ensure that licence-exempt operations do not abridge the rights of existing licencees and that incumbents may continue to grow their networks organically. Licence-exempt technologies have a strong track record of using the technical rules[13] to create economic value by sharing spectrum with a wide variety of incumbents. As an initial matter, mitigation techniques developed for allowing RLANs to share spectrum with incumbents in the 5150-5250 MHz and 5725-5825 MHz frequency bands are applicable to the 6 GHz band. Through the Consultation process, ISED can add special sharing requirements within its licence-exempt framework to address specific interference environments.

The Wi-Fi ecosystem can readily commercialize the 6 GHz band. Semiconductor and device manufacturers can rapidly add the 6 GHz band to an existing 5GHz Wi-Fi ecosystem, speeding availability of new technologies, allowing greater efficiency, and reducing costs. This is the case because the 6 GHz band shares propagation characteristics with the existing unlicensed bands, which will enable manufacturers to adapt existing products for use in the 6 GHz frequency band.

Respectfully Submitted,

Kalpak Gude
President
Dynamic Spectrum Alliance

[12] Steve Methley and William Webb, *Wi-Fi Spectrum Needs Study*, 26, Final Report, QUOTIENT ASSOCIATES LTD. (Feb. 2017)
[13] Canadian technical rules