

October 26, 2020

Innovation, Science and Economic Development Canada
c/o Director, Spectrum Regulatory Best Practices
235 Queen Street (6th Floor, East Tower)
Ottawa ON K1A OH5
Canada

Re: Consultation on the Technical and Policy Framework for the 3650-4200 MHz Band and Changes to the Frequency Allocation of the 3500-3650 MHz Band August 2020 Gazette Notice No. SLPB-002-20

Dear Director, Spectrum Regulatory Best Practices:

Federated Wireless, Inc. (“Federated Wireless”) provides these comments in response to the Innovation, Science and Economic Development (“ISED”) “Consultation on the Technical and Policy Framework for the 3650-4200 MHz Band and Changes to the Frequency Allocation of the 3500-3650 MHz Band” (“the Consultation”). Federated Wireless commends ISED for its efforts to make this critical mid-band spectrum available for flexible wireless broadband services (“WBS”). We appreciate the opportunity to share our experience in implementing automated dynamic spectrum sharing solutions in the United States in the 3 GHz band and offer our perspectives on how this same technology can be readily deployed to meet ISED’s goals for the 3650-4200 MHz Band (“3.8 GHz Band”), including maximizing efficient use of spectrum, encouraging innovation, and supporting the rapid and widespread deployment of next generation wireless networks.

I. Background on Federated Wireless and Automated Dynamic Spectrum Sharing

Federated Wireless is a U.S.-based wireless technology company that has been certified by the U.S. Government to manage dynamic sharing of the 3550-3700 MHz band, known as the Citizens Broadband Radio Service (“CBRS”), between incumbent military and commercial uses, as well as between different tiers of commercial uses on both a licensed and unlicensed basis. Commercial services launched in September of 2019 and today there are more than 60,000 CBRS devices operating across the United States providing wireless broadband services via fixed wireless providers (“WISPs”), enterprise IT, hospitality, retail, real estate, industrial IoT, and transportation, education, among numerous other sectors.

While the FCC’s rules for CBRS are specific to the United States and its incumbent users, the Federated Wireless cloud-based, automated Spectrum Access System (SAS) is readily adaptable to new frequency bands and wireless technologies. Once protection criteria for incumbent users (or higher tier users) are established and a database is updated with the most

current information about these users, it is straightforward to adapt the dynamic shared access system developed for CBRS to address challenges in other frequency bands.

For example, Federated Wireless is a prospective Automated Frequency Control (“AFC”) system administrator for the 6 GHz band in the United States. The Federal Communications Commission (“FCC”) adopted new rules earlier this year that will permit the introduction of unlicensed devices (WiFi, 5G NR-U, etc.) to operate on a shared basis in the 5.925-7.125 GHz band. Standard power and outdoor unlicensed devices will be required to connect to an AFC system to determine what frequencies are available for unlicensed operations. The Federated Wireless AFC determines what frequencies are available after downloading information about incumbent services from the FCC’s Universal Licensing System (“ULS”), analyzing the potential impact of unlicensed devices to incumbent operations, and determining what frequencies can be used while implementing FCC-defined protection of those incumbents. This simplified type of automated dynamic sharing can also be adapted readily to other frequency bands, other types of incumbents, and other new services.

Another example is the United Kingdom’s 5G New Thinking (“5GNT”) Shared Spectrum Rural Network (“SSRN”) project. Federated Wireless is part of the team developing a prototype system to streamline and then automate the Local Access Licensing spectrum sharing process adopted by the U.K.’s Office of Communications (“Ofcom”). The U.K. Department for Digital, Culture, Media & Sport (“DCMS”) is funding this project to focus on enabling rural communities to deploy 5G networks on a shared basis in unused spectrum licensed to the national mobile network operators.

We believe that shared spectrum solutions such as these can help ISED to tackle a variety of challenges as it introduces WBS into the 3.8 GHz Band and manages co-existence with incumbent services, including Fixed Satellite Service (“FSS”), fixed Point-to-Point (“PTP”) and the 3.65-3.70 GHz WISPs. Some ways in which a shared spectrum solution, such as a SAS, could facilitate the introduction of WBS include:

- Speed to market and agility of deployment for new WBS systems;
- Support for innovative business plans and the creation of a robust and sizeable ecosystem of suppliers and vendors;
- Increased spectrum efficiency through opportunistic spectrum access;
- Seamless protection of incumbent users without need for manual coordination and/or large separation distances;
- Flexibility to adjust protection criteria (whether more conservative or more liberal) as needed;
- Ability to adjust for future growth of both incumbent and new WBS services;
- Reduced administrative burdens for ISED and spectrum users;

- Streamlined cross-border coordination.

Given that dynamic shared access technology is already available from multiple vendors and has been thoroughly tested through a rigorous process involving multiple government agencies, incumbent users, industry associations and technology providers, we urge ISED to move as quickly as possible to adapt commercially available sharing solutions to the 3.8 GHz Band.

II. Responses to ISED's Consultation Questions

Questions 1-3:

Q1 ISED is seeking comments on the timelines for the development of an equipment ecosystem using 5G technologies in the 3800 MHz band.

Q2 ISED is seeking comments on the potential linkages between the equipment ecosystems using 5G technologies in the 3500 MHz and 3800 MHz bands.

Q3 ISED is seeking comments on how the difference in technical rules between the U.S. and EU could impact Canada's ability to leverage the economies of scale from the global 3800 MHz ecosystem.

The 3.8 GHz Band is currently covered by several 3GPP band classes – both for 4G (“LTE”) and 5G New Radio (“NR”) systems.

- B42 (3400-3600 MHz)
- B43 (3600-3800 MHz)
- B48 (3550-3770 MHz)
- n77 (3300-4200 MHz).
- n78 (3300-3800 MHz)
- n48 (3550-3700 GHz)

As of September of 2020, eighteen European countries had commenced deployment of 5G services using the 3400-3600 MHz and 3600-3800 MHz bands.¹ A harmonized approach for licensing the 3.8-4.2 GHz band has not yet been developed, but several European countries are considering a shared licensing approach given the presence of FSS incumbents in much of the

¹ <https://5gobservatory.eu/market-developments/5g-services/#:~:text=1.,Spain%2C%20Sweden%20and%20the%20UK>.

band. Ofcom, for example, has identified this band for its Local Access Licensing rules, which allow new entrants to request use of spectrum on a local basis on a shared basis with incumbent users.

In Asia, 5G deployments have commenced in Korea, Japan and China in parts of the 3 GHz band. Several other countries in the region have completed or announced plans to auction the 3.4-3.8 GHz band.

In September of 2019, the U.S. FCC authorized commercial broadband services in Band 48, the U.S. CBRS band for the General Authorized Access (“GAA”) tier. The FCC recently concluded Auction 105 for 70 MHz of CBRS Priority Access License (“PAL”) spectrum. CBRS deployments to date use LTE technology with over 40 vendors supplying equipment. The transition from LTE to 5G in this band is expected to take place starting in 2021. The FCC is also preparing to start the auction of the 3700-3980 MHz band (“U.S. C-Band”) in December of 2020. Licenses are expected to be issued in Q1 2021 and 5G deployments are anticipated starting in late 2021.

Given the widespread licensing of the 3.4-3.8 GHz band globally, a 5G equipment ecosystem is beginning to develop for that part of the 3 GHz band. The ecosystem for equipment in the 3.8-4.2 GHz band, on the other hand, will take longer to develop and mature.

As ISED weighs options for licensing the 3.8 GHz band and establishing technical rules, it is important to note that it can leverage the ecosystem development in any of the three Regions. However, given its common border and similar use of the 3650-3700 MHz band, we recommend that ISED adopt rules that would align its use of the 3.8 GHz band with the United States to the greatest extent possible. This will significantly ease cross-border coordination and enable Canadian WBS licensees to take advantage of the sizeable equipment ecosystem that already exists for Band 48 and that will ultimately develop for the U.S. C-Band.

Q5 ISED is seeking comments on developing a flexible use licensing model for fixed and mobile services in the 3650-4000 MHz band.

Federated Wireless applauds ISED for its recognition of the importance of maximizing spectrum usage and access. We agree that adopting a flexible licensing model will facilitate a wider range of use cases, foster innovation, and result in more efficient spectrum utilization. We also encourage ISED to adopt its proposal to offer spectrum access on both a licensed and lightly-licensed basis within the same band – preferably subject to the same technical rules with a band-wide interoperability requirement and a “use-it or share-it” condition on the licensed portion. This tiered licensing approach will assure the largest possible ecosystem for equipment and devices, resulting in more choice and lower cost for both network operators and end users.

With a combined/tiered licensing approach, equipment manufacturers will build devices to satisfy both the needs of licensed and unlicensed users, particularly if there is a band-wide interoperability mandate. Without this combination, a market where equipment is purpose-built

for specific customers and their exclusively licensed bands will continue. Limiting the potential size of the equipment and device ecosystem will similarly limit the potential for new and innovative uses of these bands, and it increases the likelihood that these bands will be licensed only by those with sufficient size and capital to drive ecosystem development (e.g., the incumbent mobile network operators).

A “use-it or share-it” approach provides higher tier licensees with enough certainty that the spectrum they have purchased via auction is available to them when and where they need it without having to make business decisions years in advance. At the same time, it provides opportunistic access for lower tier users who may only need the spectrum on a temporary basis to support a particular event or who are looking to tailor their network to a specific set of needs or geography, such as Industrial Internet of Things (IIoT) or security.

In addition to adopting a “use-it or share-it” license requirement, Federated Wireless recommends that license conditions for new bands include the right for the license holder to lease the spectrum to others – whether on a geographic basis (partitioning) or by sub-dividing the spectrum (disaggregating). Once eligibility criteria for lessees as well as protection criteria amongst users are established, a dynamic shared access system can facilitate leasing arrangements by automating the process and ensuring protection criteria are met. Such a secondary market will drive innovation, allow new technology to be deployed by leased spectrum users, and support niche sectors, such as enterprise networks and industrial uses. Furthermore, in order to incentivize more efficient spectrum use, we recommend allowing license holders to include any coverage and deployments undertaken by leased spectrum users to count towards the license holder’s performance obligations. This condition would not be an obligation to lease spectrum, merely an option available to license holders.

Under a “use-it or share-it” and streamlined secondary market approach, we anticipate that license holders will opt to lease any unused spectrum to other users. By offering leases to opportunistic users, the license holders will be able to monetize unused portions of their licensed spectrum and attribute the deployments of their lessees towards their own performance obligations. In turn, the opportunistic users are likely to enter into leases with license holders in order to have greater certainty regarding spectrum access rights. An automated spectrum sharing system can facilitate these secondary market transactions through the automation of spectrum leasing and the reduction of transaction costs and administrative burdens.

As ISED seeks to encourage the introduction of new use cases through a flexible licensing regime, we believe a combination of licensed, shared-licensed and unlicensed in the same band will best achieve the goals of encouraging innovation and enabling enterprises and operators the ability to develop new business models, applications, services, products and capabilities.

Questions 6, 8 and 11:

Q6 Given the proposal in section 7.2 on developing a flexible use licensing model for fixed and mobile services in the 3650-4000 MHz band, ISED is seeking comments on the proposal

that no new FSS earth stations be authorized in the 3700-4000 MHz band in the future and that the authorization of new FSS earth station licences be limited to the 4000-4200 MHz band.

Q8 ISED is seeking comments on the proposal to maintain a primary allocation to FSS in the entire 3700-4200 MHz band and the proposal that existing FSS earth stations in satellite-dependent areas remain licensed in the entire 3700-4200 MHz band.

Q11 ISED is seeking comments on its proposal to remove the FSS allocation in the 3500-3650 MHz band and to suppress Canadian footnote C20 in the CTFA as detailed in annex B. In addition, ISED is seeking comments on the proposed grandfathering of the existing earth station operations listed in annex C, such that fixed or mobile stations in the 3500-3650 MHz band will be required to coordinate with these earth stations as specified in SRSP-520.

As ISED seeks to introduce new WBS operations, while also supporting existing and new FSS systems in the 3.8 GHz Band, Federated Wireless recommends the use of an automated dynamic sharing solution to:

- Manage co-existence between FSS and WBS operations on both a co-channel and adjacent channel basis;
- Ensure protection of incumbent FSS systems;
- Maximize spectrum access for new users by avoiding inefficient exclusion zones; and
- Minimize administrative coordination burdens on ISED and licensees.

The U.S. experience in the CBRS band is a good example of how an automated dynamic sharing system can enable co-existence between FSS and WBS services in the same band on a shared basis. The 3.5 GHz band in the United States is occupied by FSS earth stations in several locations across the country. The FCC's rules require new mobile and fixed broadband CBRS users to protect co-channel and adjacent channel FSS operations from harmful interference. In setting up the rules, the FCC sought to balance the protection of incumbent FSS sites and new CBRS spectrum utilization. Instead of relying on a one-size-fits-all approach based on worst-case interference assumptions and overly simplistic and inefficient exclusion zones, the FCC established aggregate interference protection criteria, enforced by the SASs.

In order to make a shared approach work, it is necessary for both FSS and WBS users to register critical information that can be used by the automated dynamic sharing system. For FSS sites, this registration information includes the earth station's location, antenna gain, horizontal and vertical antenna gain pattern, antenna azimuth relative to true north, and antenna elevation angle. For WBS operators, necessary registration information includes transmitter location, antenna pattern and height, and power level. With this information, the dynamic shared access system is able to take into consideration variables, such as building penetration loss, clutter, and antenna patterns, to more accurately pinpoint what interference protection is actually needed in a given area and thereby improve the efficiency of spectrum use.

Unlike manual, static licensing and coordination approaches, an automated shared access system is able to determine available frequencies for multiple prospective users within the same geographic area within a matter of minutes, while simultaneously protecting incumbent operations. Such an automated system can be refreshed on a regular basis, making new frequency assignments available hours after a particular user is no longer occupying the spectrum or when a new user comes online, which leads to far more efficient use of available spectrum.

Dynamic spectrum sharing technology's strength lies in its ability to adapt quickly to any set of rules in any band. Creating and assigning protection can be fully customized, as can the rules pertaining to prioritization, size, location, duration of spectrum grants, and more. The parameters can be changed if subsequent circumstances warrant, and typically such changes require little more than changes to software code, with no impact to infrastructure or devices already deployed. Conceptually, so long as the spectrum access sharing system knows the rules for the band, it can assign spectrum and provide protection when and where needed. The sharing system can dynamically adjust spectrum allocations, power limits, and other operational parameters to ensure protection to incumbents, such as FSS sites, and afford spectrum access for new entrants, such as WBS systems – all while providing regulatory and technological flexibility that allows use cases to develop over time.

Federal Wireless recommends that ISED adopt rules that are based on the use of an automated dynamic shared system to enable more efficient use of the 3.8 GHz Band by both FSS and WBS users and minimize administrative burdens associated with manual coordination requirements.

Q13 ISED is seeking comments on:

- a) establishing unpaired blocks of 10 MHz for the 3650-3700 MHz band
- b) establishing unpaired blocks of 10 MHz for the 3700-3980 MHz band

Federal Wireless supports ISED's proposal to license the 3.8 GHz Band in unpaired 10 MHz blocks, which will balance the needs of larger licensees looking to aggregate blocks for wider channels as well as those of smaller operators that need more affordable options.

Q14 Subsequent to changes to the spectrum utilization described in section 7 and recognizing the need to change the current WBS licensing model, ISED is seeking comments on its proposal to displace the existing WBS licensees and designate 80 MHz of spectrum available for the development of a new shared licensing process in the 3900-3980 MHz band as described in Option 2. Specifically, ISED is seeking comments on:

- a) the amount of spectrum proposed (80 MHz) under a shared spectrum licensing process
- b) whether there should be a provision that allows certain users (e.g. existing WBS licensees) priority licensing (e.g. an initial application window before accepting applications from others)

Federated Wireless supports ISED's proposal to increase the amount of spectrum available for current WBS licensees in the 3650-3700 MHz on a lightly-licensed basis. However, Federated Wireless has concerns that relocating such users to 3900-3980 MHz will result in delays in access to equipment and will disadvantage these operators by limiting their access today to an existing ecosystem for equipment in their current band. Instead of relocating these users to the upper end of the 3.8 GHz Band, we recommend that ISED maintain the current allocation and align with the United States to the greatest extent possible. This will significantly ease cross-border coordination and enable Canadian WBS licensees to take advantage of the sizeable equipment ecosystem that already exists for Band 48.

While it would be preferable to expand lightly-licensed WBS operations from 50 to 80 MHz, which could be possible by extending the current allocation from 3650-3730 MHz, another approach to increase the amount of spectrum available for opportunistic WBS access would be to implement a "use-it or share-it" requirement for the remainder of the 3.8 GHz Band. Federated Wireless recommends that the entire 3.8 GHz Band be subject to the same technical rules for WBS operations, that a band-wide interoperability requirement be adopted, and that a "use-it or share-it" condition be placed on the licensed portion. Such a tiered licensing approach will assure the largest possible ecosystem for equipment and devices, resulting in more choice and lower costs for both licensed and lightly-licensed operators and ultimately for Canadian consumers. It will also provide lightly-licensed WBS users with access to additional spectrum beyond the current 50 MHz.

Q19 ISED is seeking preliminary comments on the future spectrum licensing process for 3900-3980 MHz, including the following:

- a) what type of applications are envisioned for this spectrum
- b) what type of shared licensing process ISED should consider (e.g. database approach, licensee to licensee coordination)
- c) what additional measures ISED should consider employing to manage access to the band in high demand areas, such as major metropolitan centres
- d) what technical restrictions should be considered (e.g. technical rules similar to adjacent 3500 MHz flexible use band with reduced power levels, a guard band between new flexible use systems below 3900 MHz, shared use above 3900 MHz, etc.)
- e) what type of eligibility criteria, if any, should be established

As mentioned above, Federated Wireless applauds ISED’s initial proposal to maintain a lightly-licensed approach for WBS operators - whether in 3900-3980 MHz band or in 3650-3700 MHz. We believe that the CBRS rules for GAA operations could be a good model. A year into commercial CBRS operations using GAA spectrum, we are seeing an unprecedented number of new uses cases emerging as the result of new spectrum access options becoming available. These new use cases include:

<i>IN-BUILDING</i>	<i>PUBLIC SPACES</i>	<i>INDUSTRIAL IoT</i>
<ul style="list-style-type: none"> • Education • Military • Hospitality • Healthcare • Multi-family Residential • Office Space 	<ul style="list-style-type: none"> • Entertainment • Government • Retail • Smart City 	<ul style="list-style-type: none"> • Manufacturing • Mining • Oil and Gas • Power and Utilities • Transportation

As ISED seeks to encourage the introduction of new use cases through non-traditional licensing schemes, we believe a combination of licensed, shared-licensed, and lightly-licensed access in the same band will best achieve the goals of encouraging innovation and enabling enterprises and operators the ability to develop new business models, applications, services, products and capabilities.

Furthermore, use of a SAS or a similar automated database solution, will maximize the use of this spectrum, minimize interference among users, and reduce administrative burdens on ISED and licensees.

Q43 ISED is seeking comments on the proposal to rely on technical limits and coordination procedures rather than mandate specific technology solutions (e.g. TDD synchronization between systems) to address interference issues between TDD flexible use systems in the 3650-3980 MHz band.

In addition to its ability to facilitate the introduction of new services into bands occupied by other services, dynamic spectrum sharing technology is also capable of addressing the challenges associated with a lack of TDD synchronization in unpaired frequency allocations. As ISED notes, a lack of synchronization of TDD systems could lead to harmful interference and/or inefficient use of spectrum, particularly if guard bands or large separation distances are imposed. While ISED might consider mandating a particular synchronization frame to ensure compatibility among different systems, Federated Wireless believes another approach should be considered, namely, to rely on industry agreement and the use of dynamic spectrum sharing technology to coordinate spectrum usage.

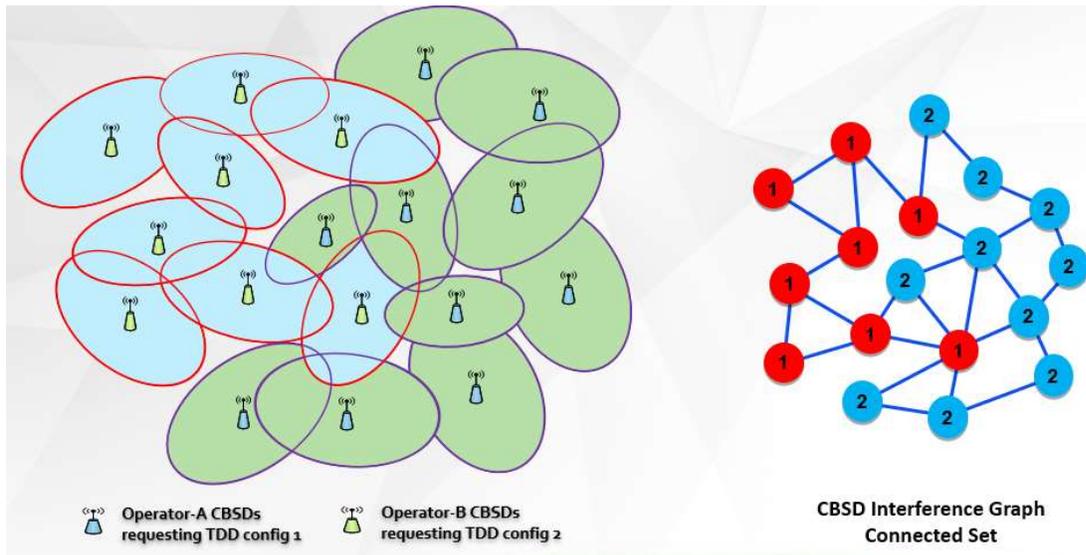
In order to facilitate the introduction of TDD systems in the CBRS band, the CBRS Alliance developed networking and coexistence specifications regarding a number of critical issues, including cell phase synchronization, TDD configurations, GAA channelization, and SAS-CBSD protocol extensions.² By agreeing in advance to a set of preferred TDD configurations and a process for determining which configuration should be implemented, the CBRS industry greatly reduced the expense and complexity associated with peer-to-peer manual coordination and avoided the inefficiencies associated with mandatory guard bands and separation distances.

In order to facilitate the sharing of the CBRS band by multiple tiers of users, all base stations that are deployed in the band must register with a SAS and provide key details about their operating parameters, including location, transmit power, as well as antenna gain, height, and orientation. With knowledge of these operating characteristics, the SAS is able to predict the RF coverage of every base station. In the event that there is overlap of RF coverage predicted between base stations under the control of different operators that have chosen to implement different TDD frame configurations, SAS algorithms use of graph theory and graph coloring to determine how best to enable co-existence.

Using graph theory to represent the interrelationship of base stations that have RF coverage overlap, which are termed Connected Sets (see Figure 2 below), the SAS applies grouping definitions so that a collection of base stations that form a single network entity can be distinguished and analyzed as such. An operator may request its preferred TDD configuration per CBRS Alliance specifications for base stations within a Connected Set that are under its control. If the TDD configurations chosen by operators differ, however, interference may occur, making it necessary to resolve the conflict.

² https://www.cbrcalliance.org/wp-content/uploads/2020/02/CBRS-SA-TS-2001-V3.0.0_Aproved-for-publication.pdf

Figure 2 – Formation of Connected Sets



In that case, the SAS then selects a single TDD configuration for the base stations within the Connected Set (i.e., the graph that defines the coverage overlap of the operator networks), which is the requested TDD configuration associated with the majority of base stations in the Connected Set. If there is a tie in the number of base stations controlled by each operator within the Connected Set, a pseudorandom selection is made. In order to minimize the number of possible TDD configurations to select from, the CBRS Alliance has specified two preferred configurations, shown in Figure 3 below, that represent the majority of anticipated traffic scenarios.

Figure 3 – E-UTRA TDD UL/DL Configurations from CBRS Alliance

Uplink-Downlink Configuration	UL:DL ratio	Subframe Number									
		0	1	2	3	4	5	6	7	8	9
1	4:4	D	S	U	U	D	D	S	U	U	D
2	2:6	D	S	U	D	D	D	S	U	D	D

Through this industry-led approach, implemented using dynamic shared spectrum technology, the hazards associated with a lack of synchronization of TDD systems are avoided. Federated Wireless recommends that ISED consider a similar approach for the 3.8 GHz Band in Canada, leveraging the significant technology development and industry-driven progress that has already been achieved.

III. Conclusion

Federated Wireless appreciates the opportunity to share our experience in implementing commercial services on a shared basis in the 3.5 GHz band in the United States and our recommendations for the 3.8 GHz Band in Canada. We believe this band holds significant promise and we applaud ISED for its efforts to unlock opportunities for improved spectrum utilisation. We believe that automated dynamic shared spectrum solutions can help ISED to tackle many of the challenges it has identified with the introduction of WBS into the 3.8 GHz Band, including managing co-existence between new and incumbent services as well as among new users themselves. We look forward to working with ISED and the Canadian wireless industry to leverage dynamic shared spectrum technology to increase spectrum access through more flexible licensing arrangements.

Respectfully submitted,
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