Canwisp's Submission to

ISED's Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band

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Table of Contents

List of Figures

1. Summary of Canwisp Position in Response to the 3500MHz Consultation & 3800MHz pre-Consultation

Canwisp supports a flexible licensing approach that enables service providers flexible use of spectrum for 4G and 5G applications in the 3500 MHz and 3800 MHz bands according to their needs.

As demonstrated in this submission, Canwisp strongly believes that for rural Canada there will be negative economic consequences of the proposed spectrum reallocation. Canwisp notes that the current framework of exclusive spectrum licensing and use of auctions to maximize revenues for Treasury restricts availability of spectrum for rural service providers, transfers potential investment capital from private enterprise to government, reduces consumer surplus and hinders economic growth in rural areas[1].

Canwisp advocates for the implementation of a 'Spectrum as a Service' model comprised of a multi-tier licensing, a spectrum access system ('SAS')[2], appropriate secondary licensing process(es) and mechanisms for capturing and sharing of the spectrum revenues. Canwisp recommends that the spectrum as a service model be first applied in the 3500 MGHz and subsequently in the 3800 MHz and other bands in light of its advantages in spectral efficiency - necessary to accommodate the geometric increases in data usage for 5G applications as well its spectrum sharing capability among multiple tiers of users – necessary in the rural areas to enable adequate, cost-efficient spectrum for smaller service providers.

Canwisp firmly believes that there is no incompatibility in the simultaneous roll out of new and innovative 4G and 5G services in the 3500 MHz and 3800 MHz bands. The needs of the MNOs for 5G spectrum in metropolitan areas can be met without restricting availability of cost efficient spectrum for rural service providers. The 3800 MHz band would be a good candidate to roll out the SAS and associated dynamic spectrum allocation management model given the multiplicity users, global gear ecosystems and differing needs for spectrum by service providers in rural and urban economies.

As the majority of Canwisp members are already using 4G LTE equipment, the technology pathway for Wireless Internet Service Providers (WISPs) to 5G in the next few years will be cost efficient. WISPs have demonstrated that they are both spectrally efficient and cost effective service providers. Thus, provision of adequate, cost-efficient spectrum to WISPS under an SAS framework would enable WISPs in turn to provide rural citizens with innovative and affordable triple and quad play services and enable them to fully participate in the 5G economy.

As indicated in Canwisps answers to the Consultation questions, WISPs are fully able and willing to assist ISED in shaping a new regulatory spectrum licensing and management framework that meets the needs of all stakeholders and provides an overall industry solution.

Canwisp acknowledges Nordicity's role in assisting with research and preparing this submission.

[1] Toshifumi Kurodaa, and Maria del Pilar Baquero Forerob, 2017 "*The effects of spectrum allocation mechanisms on market outcomes: Auctions vs beauty contests"* Telecommunications Policy 41 (2017) p. 341–354.
[2] Software that enables dynamic frequency sharing and management

2. The Role of WISPs in Overcoming Connectivity Deficit in Rural Markets

In Canada and other leading economies, economic growth has been unevenly focused in metropolitan areas and consequently, employment, incomes and populations have lagged and even decreased in rural areas.[3] Resource industries are no longer labour intensive and rural economies must attract new, innovative firms in the service industries in order to compete. A key component to competitiveness for firms in rural Canada is affordable and accessible broadband. However, there is a 'connectivity deficit' in Canada whereby citizens in rural and remote communities[4] do not enjoy the same access to broadband services as do those in urban areas, as typically, incumbent operators have not found it viable to offer broadband services in those areas as reported by the House of Commons Broadband Connectivity in Rural Canada report released in April 2018[5].

Globally, governments have recognized the need to address this connectivity deficit through a combination of incentive funding measures, release of spectrum and setting of national broadband accessibility goals. In Canada, all three government levels have adopted measures to improve connectivity to citizens in rural areas. Both ISED and the CRTC have underlined the importance of rural connectivity through funding programs such as Connect to Innovate and Rural Broadband Fund. However, although funding subsidy mechanisms have helped to make basic internet services available to a portion of rural Canadians, they have proven to be less efficient in the creation of a competitive market place for communications services in rural areas than has providing a regulatory framework that enables the development of smaller service providers.

In the US and other jurisdictions, spectrum regulators are considering specific licensing models and mechanisms such as 'spectrum access system' that would enable the development of new services to rural consumers and a diversity of rural service providers. In particular, best practice regulation includes consideration of rural service providers in defining licensing areas, licence periods, roll out and other licence conditions,spectrum return policies enabling service continuity and notification periods in the case of licensing to primary licensing under the SAS model to Priority Access Licensing (PALs).

In Canada, the Government, ISED and the CRTC have all indicated the importance of affordable innovative telecommunications services for rural consumers:

The Government of Canada has indicated that its Innovation Agenda will target a number of areas for action. One of these, *"Competing in a digital world," focuses on "maximizing the benefits of current and emerging digital technologies. … Canada must also do more to give rural communities and low-income Canadians affordable access to high-speed Internet so that they can participate fully in a digital and global economy for a better quality of life."*[6]

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[3] Cities and Growth: Earnings Levels Across Urban and Rural Areas: The Role of Human Capital See: https://www150.statcan.gc.ca/n1/pub/11-622-m/2010020/part-partie1-eng.htm

[4] Source: Connect to innovate Program https://www.canada.ca/en/innovation-science-economic-development/programs/computer-internet-access/connect-to-innovate.html In this paper, we use both 'rural and remote and 'rural' interchangeably.

[5] http://www.ourcommons.ca/DocumentViewer/en/42-1/INDU/report-11

[6] https://crtc.gc.ca/eng/publications/reports/rp161221/rp161221.htm?_ga=2.186978926.779592040.1530888194-239201053.1513021143

As expressed by the Minister of Innovation, Science and Economic Development, the Honourable Navdeep Bains in a news release form August 4th, 2017, "*When it comes to telecommunications, Canadian consumers deserve the very best. At a time when middle-class Canadians are concerned about both the availability and the rising cost of these services, our government will encourage more private sector competition and investment in services that have become essential in a digital economy. Making this spectrum available for commercial mobile services has the potential to benefit millions of Canadians in both urban and rural areas. Canadians deserve improved coverage, service quality and affordability, as well as the economic benefits and opportunities for all regions of the country provided by increased access to wireless spectrum for mobile services."*[7]

In the Government of Canada's Innovation Agenda, ISED indicated that Canada must do more to give rural communities and low-income Canadians affordable high-speed Internet access services so that they can participate fully in the digital and global economy for a better quality of life.[8]

The CRTC underlined the importance of innovative, affordable telecommunication services to rural and remote consumers as key objectives in its *Telecom Regulatory Policy CRTC 2016-496*:

- *Canadians in urban, rural, and remote areas can access affordable, high-quality telecommunications services;*
- *Telecommunications companies continue to invest in and various levels of government continue to fund robust, scalable infrastructure capable of providing high-quality telecommunications services to Canadians across the country;*
- *Canadians can access innovative service offerings that enhance social and economic development; and*
- *Canadians can make informed decisions about their telecommunications services.*[9]

WISPs are a critical component in the delivery of broadband services in rural communities and have demonstrated their ability to provide broadband service to subscribers in areas where the national players, the large spectrum owners, do not currently provide service, with innovative and cost-efficient service offerings. WISPs have accomplished this despite the fact that many are owner-operators with less than 50 employees. However, the current lack of access to adequate spectrum will compromise WISPs' ability to deliver the next generation of broadband services to their subscribers. This is an existential threat to Wireless Internet Service Providers' (WISPs) viability and could affect 6.5% of Canadian households. As pointed out in in the CRTC Communications Monitoring Report 2017[10], 31% of

[7] https://www.canada.ca/en/innovation-science-economic-development/news/2017/08/canadians_deserveaffordablehigh-qualitywirelessservicewithdepend.html

[8] https://crtc.gc.ca/eng/archive/2016/2016-496.htm

[9] https://crtc.gc.ca/eng/archive/2016/2016-496.htm

[10] Source: CMR data published by the CRTC in November 2017. See: http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2017/cmr.htm

Canadian rural households rely on fixed wireless access service as the only way to access high speed internet other than satellite. Since the report considers 21% of Canadian households to be rural, 6.5% of Canadian households overall rely on WISPs or satellite for their internet.

Currently, most WISPs are using the lightly-licensed (all come, all served) 3.65 GHz band that is part of LTE band 43. The combination of easy access to a lightly-licenced frequency band combined with the ubiquitous LTE ecosystem and multiple proprietary FWA (Fixed Wireless Access) solutions has been instrumental in allowing WISPs to achieve their business plans. In other bands, WISP access to licenced spectrum is primarily through subordinate licensing from operators which often are focused on their spectrum needs in urban markets and/or simply do not want to negotiate with small, rural service providers and ISED over subordinate licensing. The amount of spectrum available to WISPs in the ''lightly licensed '' 3.65GHz band is already limiting WISPs ability to offer competitive service packages - much less the next generation of broadband services. WISPs access to licensed-exempt spectrum in the 900 MHz, 2.4 GHz and 5 GHz bands is also compromised by the intensification of other uses and thus, the provision of commercial-grade services by WISPs to their subscribers is becoming increasingly difficult.

The Department argues in paragraph 43 of the Consultation that with improved deployment efficiencies and new technologies, licensees should be able to maintain current service offerings with a reduced amount of spectrum. This is a misconception: new technologies help of course, but the problem lies in the fact that the amount of spectrum available to WISPs today is already limiting their ability to meet their business plans and that new services, applications and use cases constantly require an increase in bandwidth, throughput or number of simultaneous connections along with reduced latencies.

Going forward, in order to be competitive with 4G and 5G services, WISPs will require economically-viable access to additional spectrum – especially in LTE bands 42 and 43 (covering the spectrum from 3400 to 3800 MHz). This would provide the best solution given the technological ecosystem and service offerings of WISPs.

In absence of a dynamic and competitive WISP sector, the provision of telecommunications services in rural communities and the introduction of new and innovative services tailored to individual communities will be delayed, the price of broadband services will be significantly higher than in urban areas, and overall access to broadband services lower.

ISED needs to recognize the vital role WISPs play in delivering broadband services in rural areas and provide a licensing and wider regulatory framework in the 3500 and 3800 MHz bands that encourages investment, technology evolution and equitable access to spectrum. Overall, WISPs are requesting that ISED, in considering the 'spectrum acees system' or other models for those bands, also considers the viability requirements of WISPs when defining licensing areas, licence periods, roll out schedules & requirements, protection and notification periods, spectrum return policy and other licence conditions in the creation of new regulatory frameworks.

3. Canwisp Submission: Responses to Questions

International situation and ecosystem development in the 3500 MHz and 3800 MHz bands

Q1 — ISED is seeking comments on its assessment of the timelines identified for the development of an equipment ecosystem for 5G technologies in the 3500 MHz and 3800 MHz bands, and whether the timelines will be the same in both bands.

1. In its release 15 documentation, 3GPP defined two spectrum bands for 5G NR radios[11] overlapping the spectrum under consideration in this Consultation: band n77, ranging from 3300 to 4200 MHz and band n78, which is a subset of n77, ranging from 3300 to 3800 MHz.

2. Fixed Wireless Access (FWA) equipment using 3GPP standard based technology already exists in most of what will constitute 5G NR band n78, as it overlaps with LTE bands 42 (3400-3600 MHz) and 43 (3600-3800 MHz) for which equipment has been available from manufacturers for some time as reflected by the Department in paragraph 23 of the Consultation. Canwisp notes however that the TDD LTE RAN equipment developed for bands 42 and 43 is not necessarily fixed as implied by the Department: it could support mobility if connected to Core Network equipment supporting the feature.

3. As it has been the case with the transition of the ecosystem from 3G to 4G LTE (namely through 3GPP releases 8 and 9), Canwisp submits that today's manufacturers of 4G LTE equipment will undoubtedly produce radio hardware capable of broadcasting both 4G LTE and 5G protocols, thanks to the evolution of software defined radio technology, and that the same hardware will support release 15 and 16 specifications.

4. This leads Canwisp to believe that 5G NR radio equipment will be available in the 3300 to 3800 MHz range before it is available in the 3800 to 4200 MHz range.

5. This early availability of equipment in the lower portion of the 5G NR n77 band (or in the n78 band) is not expected to last long. As pointed out by Huawei Technologies in their 5G spectrum Public Policy Position[12], released in November 2017, *"The C-band (3300-4200 and 4400-5000 MHz) is*

[11] https://portal.3gpp.org/ngppapp/CreateTdoc.aspx?mode=view&contributionUid=RP-172475
[12] http://www-file.huawei.com/-/media/CORPORATE/PDF/public-policy/public_policy_position_5g_spectrum.pdf?la=en

emerging as the primary frequency band for the introduction of 5G by 2020, providing an optimal balance between coverage and capacity for cost efficient implementation.''

6. Canwisp notes that the Department's definition of what constitutes the 3500 MHz and the 3800 MHz band is not entirely aligned with the 3GPP definition of n77 and n78 as it is often the case when the regulator needs to balance incumbent use of spectrum with policy development and future use. Consequently, considering how the Department defined the 3500 MHz (3400-3650 MHz) and the 3800 MHz (3650-4200 MHz) bands, the early availability of 5G equipment in the n78 band (overlapping LTE bands 42 and 43) will translate into significant spectrum availability for 5G equipment in both ISED bands: up to 250 MHz of spectrum in the 3500 MHz band and 150 MHz in the 3800 MHz band respectively.

7. The context evolution of the 3500 MHz and 3800 MHz bands in various jurisdictions, discussed by the Department in section 5 of the Consultation document, will certainly support the evolution of the 5G ecosystem. Canwisp wishes to point out that other countries with large rural areas similar to Canada, have adopted frameworks to protect current spectrum users in their rural and remote areas. The U.S created an innovative three-tiered framework to coordinate the use of the CBRS band, protecting incumbent users and ensuring spectrum is accessible through what the FCC named General Authorized Access (GAA). Australia is implementing a seven-year transition period for incumbent users of the 3575-3700 MHz band in its regional areas. Canwisp submits that Canada as well needs to protect existing users of the 3500 and 3800 MHz bands and limit unnecessary displacements, especially in its rural and remotes areas.

8. Canwisp understands the global push for C-band spectrum to be made available for 5G and submits that introduction of 5G services in densely populated areas is not incompatible with providing Fixed Wireless internet Access and other broadband services in rural and remote areas.

9. As pointed out by the Department in paragraph 8 of the Consultation *''given Canada's geography and widely dispersed population, it can be difficult to make a business case for the deployment of new innovative services in some rural and remote areas of the country''*. Canwisp submits that these difficulties will remain despite the introduction of 5G technology and urges the Department to adopt the 'spectrum access system' model for spectrum licensing and management for the 3500 and 3800 MHz bands as well as other 5G spectrum bands in order to ensure that rural and remote consumers are not sacrificed for the benefit of urban consumers.

10. Canwisp further submits WISPs have shown and continue to show innovation and a willingness to invest in infrastructure to deliver internet access and other telecommunication and information technology services where larger organizations have failed to establish successful operations due to lower population density.

11. There is already a global commercial ecosystem for 4G LTE in the 3GHz bands that has been widely adopted by Canadian WISPs: 51% of WISPs responding the Canwisp 2017 survey were already using LTE to serve their subscribers.[13] CBRS priority Access licencing in the US over the 3500 band is expected to further develop this ecosystem and speed the development of innovative, low cost 4G and 5G for WISPs.

12. 5G is already on the radar for WISPs as they continue to monitor the evolution of use cases that might be applicable for rural and remote areas. Moreover, WISPs are already on the 3GPP evolution path and there is a clear trend that they are continuing to deploy 3GPP standard based technology where economically feasible. 14% of respondents to the Canwisp 2017 survey which were not yet on LTE expressed their desire to migrate to the technology while 11% were already talking about investments in 5G technology over the 2018-2022 time period. It is anticipated that equipment manufacturers will be able to economically and quickly release radio hardware capable of supporting 4G and 5G standards simultaneously, – through software adaptions and as indicated above. CBRS priority Access licencing in the US over the 3500 band is expected to further develop the 4G and 5G equipment ecosystem.

The 3500 MHz band

Further changes to the allocations in the 3500 MHz band

Q2 — ISED is seeking comments on the proposals for:

- **adding a primary mobile allocation to the 3450–3475 MHz band**
- **removing the radiolocation allocation in the 3450–3500 MHz band**
- **making the corresponding changes to the Canadian Table of Frequency Allocations**

13. Canwisp supports the addition of a primary mobile allocation and removal of radiolocation allocation to the 3450-3475MHz band along with the corresponding changes to the Canadian Table of Frequency Allocation. .

14. Canwisp is of the opinion that increasing the amount of spectrum available to the deployment of 5G systems should also positively impact the delivery of FWA services in rural and remote areas if a policy and licencing framework consistent with the Telecommunications Act's objective of

[13] Source: Canwisp's survey executed in December 2017 in preparation of its response to the Spectrum Outlook Consultation) WISP Respondents who shared their technology mix.

''*promoting the availability of reliable and affordable services to all regions of Canada*'' and ISED's own policy objective of ''*facilitating the deployment and timely availability of services across the country, including rural areas*'' is adopted by the Department for the band.

Flexible use in the 3500 MHz band

Q3 — ISED is seeking comments on the proposal to allow flexible use in the 3450–3475 MHz band.

15. Canwisp agrees with the Department that adding 25 MHz of spectrum to allow flexible use over the entire 3450-3650 MHz will not negatively impact existing use of the band.

16. Canwisp submits that the more spectrum the Department assigns to flexible use, the easier it should be to implement a licencing framework that will allow early deployment of 5G systems in urban areas, the continuation of service for spectrum users in rural and remote areas and the coordination or share of the spectrum asset in fringe areas between the two.

17. Canwisp supports the implementation of flexible use overall as it allows the licensee to choose how to best use the spectrum (access – fixed or mobile - or backhaul), as long as the Department implements a licensing framework that allows small regional players to access spectrum for fixed wireless services in rural and remote areas.

Coexistence of radiolocation and other services in the 3400–3450 MHz band

Q4 — ISED is seeking comments regarding interest in sharing spectrum between radiolocation and other services in the 3400–3450 MHz band, and options for doing so.

18. Canwisp commends the Department for recognizing that "*there are new technologies and techniques (e.g. cognitive radio, dynamic spectrum access) being developed that will change the way spectrum is accessed through intelligent decision-making solutions and geographic/operational awareness of the radio environment*" (re. paragraph 38 of the Consultation).

19. Canwisp agrees with the Department that these technologies and techniques will provide new opportunities for optimizing the use of spectrum and promise to make it increasingly feasible to share spectrum in real time between multiple different services.

20. However, Canwisp submits that in order for such benefits to materialize, monitoring progress is not sufficient. Regulatory frameworks where spectrum sharing is enabled and expected needs to be established by the Department. In other words, sharing needs to be enabled through the adoption of the "spectrum access system' licensing and regulatory model in order to accelerate the development of new techniques and ensure parties will not have the opportunity to use legal proceedings to delay the implementation of these new sharing techniques.

21. Therefore, beyond sharing techniques that may develop or their tecnical complexity and effectiveness, Canwisp argues that future ISED policy and licensing frameworks, including those for the 3500 and 3800 MHz bands, need to start paving the way for these new spectrum-sharing techniques today, so that Regulatory frameworks tomorrow do not impair the use of spectrum or end in onerous legal battles because incumbent are fighting for exclusive licensing that was part of the framework at the time spectrum was acquired, even though future technology would allow them to share it with minimal or no negative impact.

22. In the case of sharing between radiolocation services and flexible use services in the 3400-3450 MHz band, in light of the Department's objective of protecting radiolocation services in the band, several techniques could be implemented including the establishment of a geographical exclusion policy, limits in aggregate emissions of flexible use systems in the 3400-3450 MHz band, limiting flexible use systems to in-building use in proximity of radars, preventing flexible use systems from using specific narrow band spectrum in proximity of a radiolocation system using it, etc.

23. In 2007, the ITU-R published report M.2111 on *Sharing studies between IMT-Advanced and the radiolocation service in the 3 400-3 700 MHz bands*[14]. Studying the compatibility of terrestrial broadband systems with radars. Although dated, the report studies several mitigation techniques that could be implemented to minimize the impact of spectrum sharing. Canwisp notes that IMT-Advanced terrestrial equipment of the time, despite said to work over 25MHz and 100MHz bandwidths, was not making use of beam forming antennas and several other technological characteristics of 5G systems that could further enhance the ability to share spectrum.

[14] https://www.itu.int/pub/R-REP-M.2111-2007

Provisions to allow existing licensees to continue services in the 3500 MHz band

Q5 — ISED is seeking comments on the expected impacts of the following options with regards to the continuation of existing services, competition in the Canadian marketplace and availability of new 5G services for Canadians.

Option 1

For each licence area, existing licensees would be issued flexible use licences for one third of their current spectrum holdings rounded to the nearest 10 MHz, with a minimum of 20 MHz.

Option 2

For each licence area, existing licensees would be issued flexible use licences for a fixed amount of spectrum. Any licensee that holds 50 MHz of spectrum or more would be licensed for 50 MHz, and all other licensees would be licensed for 20 MHz

24. From the 2 options described by the department in Question – Q5, Canwisp believes Option 2 provides better supports to continuation of existing services while allowing the Department to recuperate a sufficient amount of spectrum to promote competition in the Canadian marketplace and availability of new 5G services.

25. However, Canwisp notes that an important consideration was overlooked by the Department in regard to the definition of what constitutes an incumbent spectrum user. Small regional entities who have access to spectrum in the 3450-3650 MHz range often do so through subordination agreements with larger organization. Incumbents who grant smaller operators access to spectrum through that process do not necessarily subordinate their entire 3500 MHz spectrum holdings in a given geographical area, they sometimes keep a portion for their own operations or future use.

26. Canwisp submits that in order to achieve its policy objective of ''*facilitating the deployment and timely availability of services across the country, including rural areas*'' described in section 3 of the Consultation document, which necessarily has to include service continuity in those same rural areas, the Department needs to ensure that, in its spectrum return policy, the entities considered as incumbent spectrum users are those who are actually using the spectrum asset.

27. For example, assuming an operator holding a licence for 125 MHz of 3500 MHz in a given geographical area who subordinated 50 MHz of spectrum to a smaller service provider, and assuming that the larger operator has not yet put the remainder of its 75 MHz to use, the primary licence holder might be tempted to terminate the subordination agreement with the smaller operator if it must return everything but the 50 MHz of subordinated spectrum to ISED.

28. In such circumstances, although ISED intended to ensure service continuity by establishing a spectrum return policy that would enable current licence holders to retain spectrum to continue to offer service, the policy would fail to achieve its objective.

29. Canwisp maintains that in order for the Department to achieve service continuity through an effective spectrum return policy, it needs not only to consider who's the primary licensee of the spectrum asset, but also who is using it to serve subscribers.

Q6 — ISED is seeking comments on alternative options for licensees to return spectrum to the Department to make available for a future licensing process. Respondents are asked to provide a rationale for any alternative proposals, including how they would meet ISED's policy objectives as stated in section 3.

30. Canwisp proposes **Option 3** with the following formulation:

For each licence area, existing licensees would be issued flexible use licences for a fixed amount of spectrum. Any licensee that holds 40 MHz of spectrum or more would be licensed for 40 MHz, and all other licensees would be licensed for 20 MHz.

In the case of subordinated spectrum, subordinate licence holders at the time of the publication of this Consultation would be treated as existing licensees and would in effect increase the amount of spectrum a primary licensee can retain beyond the 40 MHz limit prescribed above.

31. For further clarity, Canwisp submits 3 examples of the potential application of its proposed Option 3.

    1. Operator A is licensed with 125 MHz of spectrum from which 50 MHz are subordinated to Operator B. After the spectrum is returned to ISED, Operators A and B both maintain the ability to use 40MHz of spectrum.
    2. Operator A is licensed with 75 MHz of spectrum from which 50 MHz are subordinated to Operator B. After the spectrum is returned to ISED, Operator B is allowed to continue to use 40 MHz of spectrum while Operator A maintains rights over an additional 20 MHz.
    3. Operator A is licensed with 50 MHz of spectrum which is entirely subordinated to Operator B. After the spectrum is returned to ISED, Operators B would maintain the ability to use 40MHz of spectrum. Operator A is not granted additional spectrum.

32. Canwisp sees several benefits to Option 3. It rewards primary licensees who have promoted efficient use of the spectrum asset by allowing subordination of spectrum they were not using, it addresses the concern raised by Canwisp in its response to Question Q5 of this consultation where it stated that a spectrum return policy that did not consider who is actually using the resource would fail to meet the Department's policy objective, it further increases the amount of spectrum returned to ISED for 5G services in areas where no subordination has taken place and it is consistent with the channel bandwidths typically available on equipment (standardized or proprietary) produced for the band.

33. Canwisp also sees a threat to service continuity for FWA in rural areas given the fact that the band will be available for mobile use after returned spectrum is auctioned. This has the potential to drastically increase the value of spectrum which in turn, could drive some primary licensees which were allowed to retain additional spectrum because of subordination agreements (in our Option 3 proposed above) to subsequently terminate those agreements and deploy mobile services (in areas where the population density allows it). Thus, Canwisp urges ISED in its licensing of 5G spectrum, to adopt fair displacement policy to protect existing FWA service providers – including those who are using spectrum through subordinate agreements.

34. In order to minimize both the operational impact on primary and subordinate licensees returning spectrum to ISED along with the capital investment required for hardware upgrades, licensees should have the ability to select the blocks they keep and the blocks they return when fulfilling the Department's spectrum return policy, subject to conditions ensuring the number of adjacencies with other entities are minimized.

Changes to the 3500 MHz band plan and interference mitigation

Q7 — ISED is seeking comments on a revised band plan using unpaired blocks of 10 MHz in the frequency range of 3450–3650 MHz.

35. Canwisp agrees with the revision of the band plan proposed by the Department in section 6.7 of the Consultation document. TDD is a more efficient use of spectrum than FDD and most systems operating in the 3500 MHz band today use TDD technology. The proposed band plan allows aggregate packages in multiple of 10 MHz compatible with the technology currently available as well as 5G. Canwisp maintains that the band plan is appropriate.

Q8 — ISED is seeking comments on whether any additional measures should be taken to limit potential interference issues with the proposed TDD band plan.

36. Canwisp believes that adjacent operators (in band or in geographic area) have a mutual interest in establishing collaboration and believes the definition or choice of interference mitigation measures should be left to licences. Canwisp is however in support of a condition of licence mandating collaboration with other licence holders to resolve potential interference issues and believes the Department should establish a policy framework that enables spectrum sharing for the band.

Timing for the introduction of mobile services in the 3500 MHz band

Q9 — ISED is seeking comments on the proposal to align the timing of the issuance of flexible use licences to incumbents with the issuance of licences to those who acquire 3500 MHz flexible use licences in a future licensing process.

37. Canwisp supports the Department's proposal that the issuance of all flexible use licences, to both incumbents and new licensees of the 3500 MHz band, be issued at the same time, after new licensees had a chance to acquire 3500 MHz flexible use spectrum in a future licencing process.

38. Canwisp is of the view that aligning the timing of the issuance of flexible use licences will create the conditions to maximize competition to the benefit of Canadians.

Future licensing process in the 3500 MHz band

Q10 — ISED is seeking preliminary comments on the importance of price discovery in a licensing process for flexible use licences in the 3500 MHz band.

39. Canwisp submits that, complex auction formats and large geographic areas for competitive licencing only serve larger service providers (national incumbent and large regional players alike). Smaller carriers and service providers – including WISPs – are not structured with the corporate and financial capacity to participate in auctions in which incumbents can bid or for that matter in complex format auctions such as CCA. Even large regional entities require help from the Department in order to ensure they have access to spectrum and that the asset will not be swiped and hoarded by national incumbent operators (re: spectrum aggregation limit in the recent 600 MHz licensing framework).

40. Large incumbent service providers (national and regional) are already sitting on significant quantities of rural spectrum that is underutilized or simply not used, while small WISPs who are providing service in rural and remote areas are spectrum poor and struggling with the inconvenience of all come all served or licenced-exempt spectrum.

41. As demonstrated in Canwisp's response to the Department's 2018-2022 Spectrum Outlook Consultation, technology ecosystems for mobile and fixed wireless access have merged[15] and WISPs are on the 3GPP evolution path, same as incumbent mobile operators asking for 5G spectrum. However, WISPs need access to additional spectrum in order to both achieve the service objectives of 50 Mbps/10 Mbps established by the CRTC for all Canadians in December 2016, as well as the roll out of new 5G services.

42. As pointed out in in the CRTC Communications Monitoring Report 2017[16], 31% of Canadian rural households rely on fixed wireless access service as the only way to access high speed internet other than satellite. Since the report considers 21% of Canadian households to be rural, 6.5% of Canadian households rely on WISPs or satellite for their internet.

[15] 51% of respondents to the Canwisp survey are on the 3GPP evolution path, a further 14% intend to migrate and 11% are already discussing 5G

[16] Source: CMR data published by the CRTC in November 2017. See: http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2017/cmr.htm

43. Based on these elements, Canwisp submits that a Policy and Licencing frame work needs to be adopted to enable small services providers to access flexible use spectrum in the 3450-3650 MHz band in rural areas.

44. Canwisp further submits that the Department should consider the socio-economic benefits of internet access in rural areas as a counterweight to increased auction proceedings that will result in more spectrum on the shelves and less service for rural Canadians. Canwisp also believes that, in order to meet the Department' policy objectives listed in section 3 of the Consultation document, the establishment of a licensing framework enabling the acquisition of spectrum by small regional entities carries more weight than price discovery for rural areas.

45. Several options could be combined to achieve this objective: Tier 6 or census track licence area for competitive licencing, spectrum aggregation limits for large operators in rural areas, preventing operators with large quantities of unused rural spectrum from bidding, long transition periods in rural areas for existing users, etc.

Transition plan for incumbents of the 3500 MHz band

Q11 — ISED is seeking comments on the proposed protection and notification provisions for incumbent licensees as outlined below.

Protection period:

For Tier 4 service areas that include a population centre of 30,000 people or more:

- a minimum protection period of 6 months for sites within large urban population centres and the 10 km buffer zone surrounding those centres
- a minimum protection period of 2 years for all other sites

For all Tier 4 service areas that include a population centre of less than 30,000 people, a minimum protection period of 3 years

Notification period:

- a minimum notification period of 6 months in large urban population centres and in the 10 km buffer zone surrounding those centres
- a minimum notification period of 1 year in all other areas

46. Canwisp commends the Department for its Transition plan principle established at paragraph 63 of the Consultation **''where and when necessary**'' and note that such a principle should allow existing users to use the spectrum indefinitely if new licensees are not deploying in the area where the existing user is operating.

47. Canwisp also appreciates the Department's involvement in the notification process. This should allow to measure the credibility of new licensees who might be tempted to displace ''as soon as possible'' rather that ''where and when necessary''. Canwisp would be interested in commenting on the technical criteria the Department intends to apply to ensure that displacement requests received from new flexible use licensees as per the process described at paragraph 67 of the consultation will not result in unnecessary displacement of incumbents, especially in rural and remote areas.

48. Additionally, Canwisp notes that the whole wireless industry is notorious for encountering delays from original plans when new services are deployed. Canwisp believes Department should consider penalties for new licensees who have displaced an incumbent spectrum user (primary and subordinate) but failed to deploy their new service within required timelines of the condition of licence.

49. In its transition plan objective stated in paragraph 62 of the consultation, the Department states that its transition plan for the 3500 MHz band seeks to address two objectives: i) providing timely access to flexible use spectrum in order to facilitate the introduction of 5G technologies for Canadians, and ii) **accommodating the continued provision of existing fixed wireless broadband services to Canadians who rely on them**. Canwisp believes a protection period of 6 months near large urban centers is not sufficient to implement an alternate solution (at least 12 months are required) and that the proposed 10 Km buffer zone contradicts the Department's transition plan principle of ''where and when necessary'', given the propagation characteristics of the 3500 MHz band.

50. Canwisp submits small cells who will often be used in the 5G Network architecture for mobile application have a range of a few hundred meters at most and that even in the situation where macro sites would transmit 5G mobile signal at 3500 MHz, a range superior to 2-3 Km is unlikely.

51. Canwisp further submits that beam forming antennas and resilience to interference of 5G systems should allow the Department to reduce the buffer zone to 3 or 4 Km instead of the proposed 10 Km. There are many households within 10 km of many of large urban population centres that do not have access to reliable high-speed broadband services through fiber, cable, or ADSL infrastructure. These households depend on fixed wireless services, and a buffer zone that is unnecessarily large combined with a protection period that is not long enough to allow incumbent sufficient time to deploy alternate technology to serve their subscribers will result in a rupture of service continuity and a failure of the transition policy objective stated above.

52. Canwisp notes that rather than a buffer zone, the Department could require new licensees to provide technical justification for the displacement they seek. Canwisp wishes to point out to the Department that a few years from now, Fixed Wireless services in rural areas will have started their transition to 5G. Therefore, over the long run, 5G and FWA services in rural and remote areas may very well be one and the same.

Q12 — ISED is seeking comments on alternative transition plans, or variations to the times proposed. Respondents are asked to provide a rationale for any alternative proposals.

53. Canwisp submits that the Department needs to increase the minimal protection period in any given circumstances to 1 year to allow existing users to transition to a new technology.

54. Canwisp further submits that the 10 Km buffer zone around large population centers proposed by the Department contradicts its own ''where and when necessary'' principle, is inconsistent with the propagation characteristics of the 3500MHz band, the anticipated resilience to interference of 5G systems and the evolving trend towards spectrum sharing.

55. For those reasons, CAWISP urges the department to reduce the 10 Km buffer zone to 3 or 4 Km or eliminate it completely and require of new licensees that they provide technical justification to the displacements they seek.

Technical and cross-border considerations for the 3500 MHz band

Q13 — ISED is seeking comments on whether the fixed and mobile equipment for LTE and 5G technologies will be able to operate with intermittent interference from radars, including cross-border interference, within the 3450–3650 MHz band and in adjacent bands

56. Canwisp agrees with ISED that LTE and 5G technologies (as well as recent proprietary fixed wireless broadband equipment for that matter) are more resilient to interference than legacy technologies.

57. Canwisp commends the Department for its initiative in experimenting with light cases of interference rather than adopting a conservative incumbent approach where exclusive use is the only way to operate. Canwisp favors efficient use of spectrum and is pleased that the Department is taking steps in this direction.

58. In its answer to question Q4 above, Canwisp pointed to the 2007 ITU-R M.2111 report on *Sharing studies between IMT-Advanced and the radiolocation service in the 3 400-3 700 MHz bands*[17]. Despite being 11 years old, the report was already describing mitigation techniques to allow the coexistence of radiolocation and terrestrial mobile systems. Canwisp believes that 11 years of further technology evolution (and perhaps 13 years if considering post auction 3500 MHz ecosystem), combined with innovative network engineering techniques aimed at minimizing interference between systems should allow coexistence of systems within Canada and along the US border.

The 3800 MHz band (3650-4200 MHz)

Future changes to the 3650–3700 MHz band

Q14 — ISED is seeking preliminary comments on how to optimize the use of the 3650–3700 MHz band, including the potential use of a database access model.

59. Canwisp believes that the database access model and the SAS licensing model provides a unique opportunity for ISED to further its policy goals of accessible and affordable broadband for both rural and urban Canadians and correspondingly, enable rural service providers to play an essential role in that objective. Thus, Canwisp applauds ISED's intent to fully consider SAS in a future consultation: *''ISED intends to review the band through a future consultation. This future consultation will address potential changes to the spectrum utilization policy, band plan, and the technical and policy considerations in order to optimize the use of this spectrum.* ***Spectrum Access Systems (SASs) or a similar database approach may be considered in Canada to optimize the use of limited spectrum in the WBS band****. Such a database would have the capacity to analyze interference situations and instruct base stations to reduce power or move to a different channel in order to minimize interference. In light of current developments of SASs in the United States, and in order to better develop a future consultation for WBS, ISED is seeking preliminary comments on whether a database model or other methods could be used to optimize the 3650–3700 MHz band.''*[18]

60. Canwisp believes that FWA and 5G usage are compatible in this band; however, active measures must be taken in applying the SAS model to ensure that FWA services continue to be available to rural citizens and are not inadvertently crowded out by incumbents capturing the spectrum in order to provide 5G services in urban areas.

[17] https://www.itu.int/pub/R-REP-M.2111-2007
[18] paragraph 90 of the consultation

61. Canwisp is concerned about the future of the WBS band (3650-3700 MHz), as it this the work horse of WISP FWA deployments. As the Department pointed out in paragraph 84 of the Consultation document, there are 281 licensees of WBS spectrum in Canada, most of which use the spectrum to provide broadband internet services in rural and remote communities. As it seeks to migrate the band to flexible use, the Department will have to use special care in order not to undermine its own policy objectives and past efforts in fostering and financing broadband connectivity in rural Canada.

62. Some of our members have asked if we shouldn't ask the Department to restrict mobile use in the WBS band, reserve it to transition displaced 3500 MHz users, mandate Dynamic Spectrum Allocation for all systems in the band within a few years, mandate decentralised Interference control features (such as LBT standardized in 3GPP release 13) or even establish a 7 years displacement policy similar to what ACMA does in regional areas of Australia. These are all potential solutions, but the most important aspect is for ISED to establish a policy and licencing framework that enables small regional entities to acquire spectrum at a price that reflects the difficulties mentioned by the department at paragraph 8 of the Consultation ''*given Canada's geography and widely dispersed population, it can be difficult to make a business case for the deployment of new innovative services in some rural and remote areas of the country''.* A successful policy and licencing framework will enable WISPs for the future and remove investment uncertainty over deployment of FWA systems in rural areas.

Opportunities for new uses of the 3700–4200 MHz band

Q15 — ISED is seeking comments on the importance of the 3700–4200 MHz band to future FSS operations.

63. In paragraph 91 of the Consultation, ISED is seeking comments on ''how to position Canada in regard to long-term changes to the 3700–4200 MHz band''. Canwisp believes that with 500 MHz of available spectrum in this band and the fact that different uses of the band will take place in different geographic areas, 5G, FWA and licenced and unlicenced FSS users should be able to share the asset.

64. Canwisp sees a complementarity between emerging 5G systems in urban areas and FWA systems in remote and rural areas. The deployment drivers and the targeted geography are different, but the technology converges, which should make it easy to share or coordinate the spectrum asset between neighboring operators.

65. Canwisp agrees with the Department's statement in paragraph 93 of the Consultation to the effect that in order to maximize the use of the band, ISED would be required to implement a process to determine the location of unlicensed TVRO, Cable head end and other unlicensed FSS users along with their technical parameters. Canwisp believes that more about this needs to be understood (on the number, the location and the technical characteristics of such users) before it can be determined whether frequency management parameters, exclusions zones or other protection mechanisms are required.

66. The numerous downlinks for small community TV operations make it difficult for ISED to know exactly how many users there are in this band. Although 5G mobile use in this band provides a higher risk of Interference because one cannot control where the users will be, Fixed Wireless Access can overcome this problem if the location of current users is known by avoiding use of the same channels. Canwisp believes this would a first step and a good migration path towards Dynamic Spectrum Allocation.

67. Once more is known about unlicensed users and what part of the band they use, perhaps the Department could prioritize certain portion of the band for a specific usage and let other usage take place when there is no demand for priority usage. Canwisp could envision a framework where 5G is given priority over 160 MHz of spectrum, FWA over another 160 MHz and FSS over a third block of 160 MHz, but the full 500 MHz would be available to anyone if there is no demand from the primary service. Once again, before the details of such a framework can be put in place, more information is required on unlicensed FSS users.

Q16 — ISED is seeking comments on whether unlicensed operators in the 3700–4200 MHz band should be required to submit their technical parameters to ISED to assist in frequency management.

68. As stated above, Canwisp believes that unlicensed operators in the 3700-4200 MHz band should be required to submit their technical parameters to ISED to assist in frequency management.

69. The Department needs to understand their numbers, location and technical parameters in order to be in a position to propose measures that will be consistent with its own policy objectives and maximize the use of the band. Canwisp believes that 500 MHz of spectrum should be sufficient to meet all parties needs in the band with a policy that is properly and carefully planned. Understanding the starting point is the only way to go if the Department is to implement a successful spectrum management policy.

Q17 — ISED is seeking comments on which steps Canada should take to optimize the use of the 3700–4200 MHz band in consideration of the current services being provided and the developing technologies that would permit the use of new services in this band (e.g. exclusion zones).

70. Canwisp supports the Department desire to optimize the use of the 3700-4200 MHz band and understands that the Deployment of 5G technologies is essential to Canada becoming a global center for innovation and that this will bring Canada to the forefront of digital development and adoption through the creation and strengthening of a world-leading wireless infrastructure.

71. Canwisp argues that this objective, like the rest of the Department policy objectives, need to apply to both rural and urban areas, in order to ensure citizens of rural locations are not left out of the global economy as a side effect of the deployment of this world-leading wireless infrastructure in urban zones.

72. Canwisp maintains that a properly crafted framework can achieve both objectives, as long as the Department ensures that interests of rural citizens and the realities of their service providers are taken into account.

73. As described in our responses to questions Q15 and Q16, Canwisp believes that the first step in optimizing the use of the 3700-4200 MHz band is to understand its current use, including the number, location and technical characteristics of unlicensed FSS, TVRO and Cable head end users.

74. Canwisp believes the Department also needs to quantify the benefits on the rural economy of the adoption of a licensing framework similar to FCC's 2015 CBRS SAS framework, that would enable access to inexpensive spectrum by small cost-efficient WISPs and correspondingly, roll out of high speed internet connectivity in rural and remote areas. In effect, there is a trade-off for policy-makers between the short-term auction proceeds to the Treasury versus the longer-term, increased economic activity in rural and/or underserved areas.

75. Canwisp doesn't doubt that the conclusion of such economic study will demonstrate with hard data the conclusion already supported by the Telecommunication Act and the Department's own policy objectives, to the effect that rural and remote areas must be given favourable consideration by new policies and licensing frameworks and that impact of such frameworks on the rural and remote areas must be anticipated at the policy creation stage.

76. Canwisp believes that a policy and licencing framework for the 3700-4200 MHz band (or any other future band) that will allow rural and remote areas to thrive and minimize the digital divide between urban and remote areas will necessarily be adapted to the realities of the service providers who serve those communities and include characteristics that will:

    a. Enable small service providers to acquire spectrum at a price that reflects the reality of the environment where they operate. This requires ISED to adopt small service areas for competitive licensing (census tract, Tier 6) and pro-competitive measures to prevent large incumbent operators from acquiring the spectrum or preventing them from hoarding or shelving it.
    b. Include a spectrum return policy that will be adapted to the reality of existing service providers and the requirement to maintain service continuity, including consideration for subordinate licensees who are actually using the spectrum and protection periods sufficiently long (even around urban areas) for existing providers to build alternate infrastructure to deliver service.
    c. Provide licensing mechanisms adapted to the corporate and financial capability of small service providers serving rural and remote communities.

d. Include spectrum sharing expectations and enable spectrum sharing by mandating subordination of unused spectrum or require equipment supporting the latest spectrum sharing techniques (SAS database compliance or Dynamic Spectrum Allocation)
e. Adjust Deployment requirement so citizens of rural and remote areas do not have to wait 10 or 15 years before spectrum holders provide services to their communities.

77. Canwisp believes the Department needs to increase its understanding of where the demand for 5G services will likely be and where the demand for FWA service is today[19] in order to craft its policy and licencing framework in a manner that will meet all of its policy objectives.

78. As the FCC is making progress with its CBRS initiative, the fact that easily accessible spectrum (such as the GAA spectrum from the FCC SAS database) does not come with protection creates a challenge for smaller service providers: another organization could potentially deploy service under another GAA licence and interfere with the original GAA user. Canwisp believes that there is an opportunity for the Department to slightly deviate from what is done in the US and establish a framework that would create some investment certainty for small providers by ensuring FWA service in the band has access to interference protection. That would also help WISPs minimize the coordination efforts they have been facing over the use of the WBS or licence-exempt bands. Canwisp believes this is an opportunity for ISED to finally recognize the role played by WISPs in the fulfilment of its policy objectives.

79. Canwisp notes that large quantities of spectrum which is the hands of mobile operators in still unused. While we understand that the Department is anxious to put measures in place to foster 5G deployments in Canada, perhaps it would be wise not to allocate the entire 3500 and 3800 MHz bands to mobile use until it has been clearly demonstrated that there is a real need for it. If the mobile industry is so keen on putting its hands the 3500 and 3800 MHz bands because of global interest, perhaps trades with other unused spectrum that could be made available to other entities ought to be considered by the Department.

Q18 — ISED is seeking comments on the challenges and considerations related to the coexistence of other services, such as mobile and/or fixed wireless access, in the 3700–4200 MHz band.

80. At paragraph 96 of the Consultation, ISED states: ''As discussed, the FCC has begun to develop multi-tiered sharing approaches for the 3500 MHz band and is exploring the opportunity to expand it up to the 4200 MHz band through a recent Notice of Inquiry. Ofcom is also considering developing a similar approach for portions of the 3800 MHz band. ISED will be monitoring the developments from other countries, in particular with respect to the potential for sharing spectrum between services in the 3400–4200 MHz frequency range, with a view to improving efficiencies throughout both bands.''

[19] the 927 WBS licences referred to by the Department at paragraph 84 of the Consultation is a good start, as the survey completed by Canwisp in December 2017 indicated that 95% of WISPs are using the spectrum

81. Canwisp believes, as stated earlier in this document, that there are no reasons why urban 5G and rural and remote FWA systems (some of which will undoubtedly use 5G technology) would not be able to coexist, if a policy and licencing framework that is supporting their coexistance is established by the Department.

82. The Department could also consider mandating interference mitigation techniques, such as Dynamic Spectrum Allocation, GPS sync features, etc., but it will be a challenge to keep up with technology evolution. At some point in the future, equipment could be prevented from being deployed because it misses a frequency coordination feature that has been supplanted by a more recent technique available in the said equipment. Canwisp believes the Department should rather focus on enabling, fostering or mandating spectrum sharing in the policy framework and leave the evolution of interference mitigation techniques to equipment manufacturers. As stated before in this response to the Consultation, Canwisp believes provisions mandating spectrum sharing in the framework or at least creating the expectation of sharing will do more to promote sharing of the resource than would technical requirements to be met.

Appendices

1. Conceptual Economic Model to Assessment Impacts of Alternative Licensing Scenarios for 3GHz Spectrum: Exclusive 5G MNO Scenario vs. 4G and 5G Sharing with Rural Exception Scenario

ISED has proposed reallocation of the 3500 MHz band to mobility and 5G uses. We believe that the proposed spectrum reallocation should not overlook its short-term and long-term implications for availability of affordable broadband services in the rural areas of Canada. There is a general consensus that the lack of broadband can have adverse economic consequences. According to the World Bank estimate, "*a 10% increase in broadband penetration can lead to a 1.21% jump in GDP growth in developed economies and a 1.38% jump in developing economies.*"[20]

In this context, it is worth noting that Canwisp has been instrumental in bringing broadband to rural Canada using Fixed Wireless Access and that 51% of the members who shared their technology mix in the survey Executed by Canwisp in December 2017, already use LTE technology. Whereas, major operators continued to invest in wireless LTE infrastructure for mobile services only in high profit urban and sub-urban areas of Canada. We believe, their 5G rollout will continue to remain in high demand and high profit areas. We also note that whether it is a mobile or fixed wireless network the architecture of LTE/5G technologies is same. It only depends on how it is used and configured – either for fixed wireless service or mobile service. For example, the network deployment build of 5G for mobile services will eventually involve 10 to 100 times more antenna locations than 4G or 3G.[21], whereas in rural areas WISPs will upgrade their networks to 5G equipment using the minimal site density that meets their service requirements. In this sense, it is critical to consider the economic implications of making the proposed 3500 MHz spectrum reallocation in rural Canada.

It is generally agreed that the overall policy objectives for a regulatory framework is to maximize consumer welfare. This objective, with respect to the spectrum allocation for telecom services, can be achieved by implementing policies to

[20] https://www.bcg.com/publications/2018/economic-case-bringing-broadband-rural-united-states.aspx
[21] Dhar, Sanjay Dha & Rao, Tejas & Al Amine, Majed & Mathias, Kenneth & Dyer, Thomas & Stutchbury, Jason & Chakravarthy, S.E., " How 5G Can Help Municipalities Become Vibrant Smart Cities" Accenture, 2017

- increase affordability by reducing the cost of service, and
- enabling innovative services by increasing competition

As illustrated below, we believe these two policy objectives will not be achieved for rural Canada.

a) Cost of Wireless Service will increase

The two major cost components of a wireless service include (a) cost of network, and (b) cost of spectrum. It is a proven fact that when major mobile network operators participate in a spectrum auction, the cost of spectrum increases given their buying power combined with their motive to warehouse spectrum for future demand. Therefore, when a spectrum auction packages include rural areas, the spectrum cost is likely to increase as per Figure 1 below.

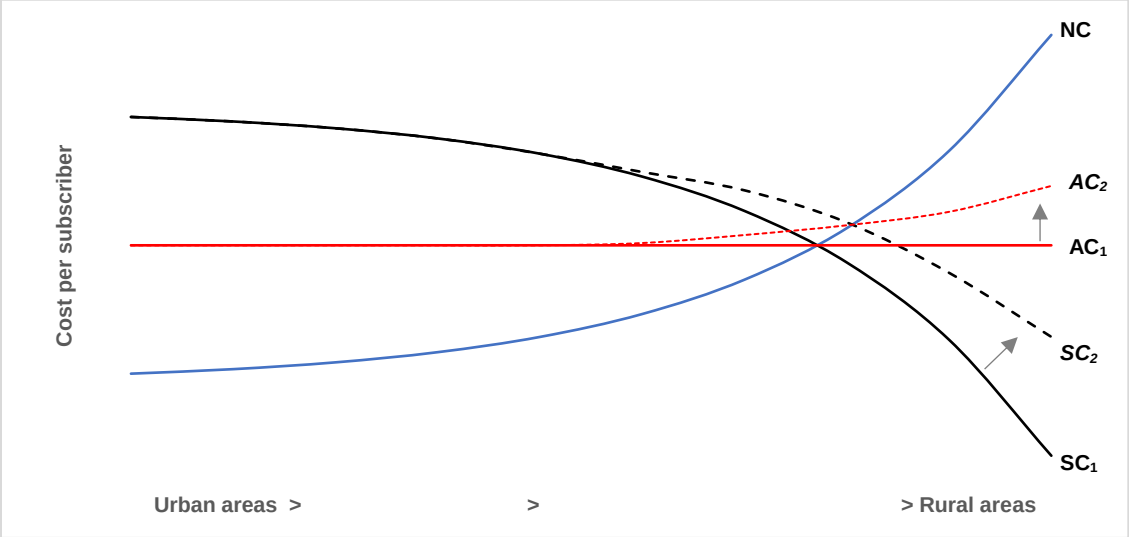

Figure 1: Impact on cost per subscriber in rural Canada

Figure 1 shows that, the cost of network per subscriber (**NC**) increases as we move from urban to rural areas. However, traditionally the spectrum cost (**SC**) exclusive to rural areas is lower as compared to urban areas. Assuming (for simplicity) the network and spectrum costs carry equal weights in the average cost per subscriber (**AC**), the lower spectrum cost offsets the higher network cost in rural areas. As a result, overall average cost per subscriber remains the same from urban to rural areas. However, if major operators are able to participate in a spectrum auction that includes packages including rural areas, the spectrum cost curve (***SC'***) will shift upward in the rural areas as shown in Figure 1, above, consequently the average cost of service will increase from $\mathbf{AC_1}$ to $\boldsymbol{AC_2}$.

To avoid this outcome, we believe a detailed economic analysis should be undertaken before 3500 MHz reallocation framework rules are finalized.

b) Competition will decrease

According to Polykalas et al (2015), *"competition is likely to exist when demand is either steady or increasing and, at the same time, retail prices are decreasing"*[22]. We believe it is critical to study this criterion with respect to the future use of 3500 MHz spectrum in rural Canada. As illustrated in Figure 2 below, we believe the prices of broadband services will increase in rural Canada if major mobile service providers are allowed to capture spectrum for rural areas.

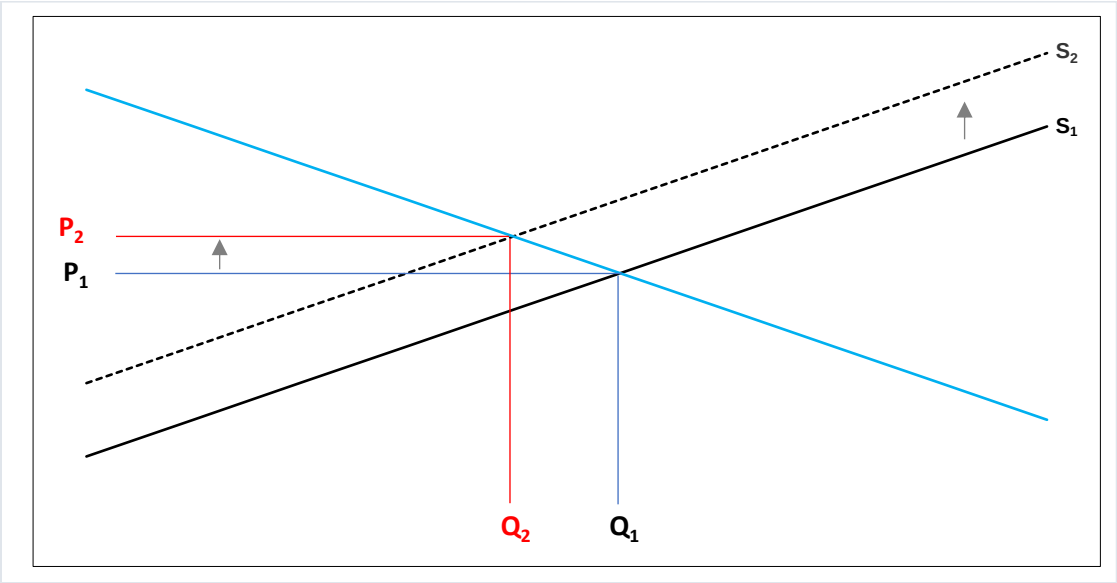

Figure 2: Impact on broadband service prices in rural Canada

Let's assume based on the current service providers, primarily WISPs in rural Canada, the equilibrium prices are **P_1** given the current demand (subscriber shown as **Q_1**). As pointed our above, the WISPs primarily uses FWA (Fixed Wireless Access) technologies including LTE to provide broadband services in rural Canada. Their service delivery is heavily dependent on 3500 MHz spectrum. We believe, if the use of this spectrum is changed it will immediately impact the supply (capability) of Canwisp members and other WISPs to continue providing services as equilibrium prices. This will be due to the following two reasons:

[22] Polykalas and Prezerakos (2015), Telecommunications Policy (39)

- Major wireless service providers will likely acquire most of this spectrum in the forthcoming auction. As a result, they will withhold the use of this spectrum until it becomes feasible for them to deploy their network in rural Canada, if at all. The spectrum asset may end up unused or underutilised for a long period of time, depriving rural Canadian from connectivity.

- Because of multiple use of 3500 MHz spectrum, WISPs will be required to pay high price to use this spectrum for their services.

As a result, the supply curve will shift from **S_1** to **S_2,** resulting price increase from **P_1** to **P_2.** Consequently, the increase price will reduce demand from **Q_1** to **Q_2.** The major implication of this outcome will be that broadband penetration will reduce which will have adverse economic consequences for the rural Canada.

c) Long term implications and the need for a new framework

Globally, mobile data traffic is forecast to increase at an annual rate of 46% in the 2016-2021 period[23] largely due to increased video consumption over mobile devices in the current 4G window. This growth rate is expected to increase at even higher rates with the launch of 5G networks and associated massive deployment of IoT sensor devices, robotics, automated vehicles and other mission-critical, very low latency or remote-control applications. Global application providers and data managers such as Microsoft, Apple, Alphabet/Google, Amazon, IBM, etc. will have a critical role in the rollout and operation of 5G in various sectors of the economy and will thus be key stakeholders in the successful transformation and operation of mobile networks into data-centric, mission-critical platforms.

Whereas global traffic is forecasted to grow geometrically, spectrum - the critical resource in mobile networks, is finite and will increasingly become a bottleneck resource - not only in the ability of telecom service providers to meet demand, but also in the overall development of the 5G economy. If there is a spectrum scarcity, then the cost of spectrum as an input in mobile networks will increase significantly with corresponding negative effects on the business case for applications powered by the Internet of Things or the plain affordability of mobile services for subscribers.

Spectrum regulators across the globe have relied on a licensing framework that awards licence-holders ('lessees') exclusive use of the spectrum - typically over a 10 to 20-year lease period.[24] The bulk of the spectrum, in particular the most valuable lower band spectrum, has mostly been licensed to ILECs – incumbent local exchange carriers.

[23] CISCO 2017 data forecasts for global market Ref. https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/complete-white-paper-c11-481360.html#_Toc484813970

[24] Note: on property rights of spectrum licence holders: Given the licence holder has a 'reasonable expectation of renewal' as long as the conditions of licence are met, the licence holder typically capitalizes the spectrum as an asset on the company's balance sheet. Hence, spectrum has historically been considered by licence holders as an asset even though legally, utilization is based on a lease – subject to residual property right remaining with the spectrum regulator. The regulator's residual ownership is demonstrated in cases where technological evolution allows the emergence of spectrum applications with 'higher economic use', thus displacing current spectrum technologies and applications.

This exclusive use licensing model results in massive inefficiencies in the utilization of spectrum. First, important portions of spectrum are simply warehoused or 'lit' but significantly underutilized by incumbent operators that hold the majority of the commercial spectrum licences.[25] For spectrum that is actually put into service, the utilization is inefficient due to peak/off peak utilization patterns of the licensee's subscribers.

Where spectrum is shared by multiple service providers, the efficiency in utilization climbs significantly. In a whitepaper published in 2016 CISCO indicated that the integration of unlicensed network technologies such as Wi-Fi for use with conventional licensed cellular networks is now largely accepted as an essential ingredient of mobile network evolution.[26] In the current ISED licensing framework, only the bands 3650- 3700 MHz and 5150 to 5250 MHz have been designated as 'lightly licenced' (a term adopted by the Canadian Industry to refer to spectrum that is inexpensive, non-exclusive and licenced for 1-year periods) and therefore available to small service providers.[27] ISED designated these shared bands in order to meet the needs of ISPs and other smaller service providers and to foster the competition and introduction of new services in rural areas. Unfortunately, this might no longer be the case with reallocation of 3800 MHz band to flexible use. CarWISP therefore urges the Department to show special consideration to the WBS portion of the band as it reviews the 3800 MHz policy framework.

Technology advances that enable spectrum sharing

Both technology and regulatory changes are required to enable better spectrum efficiencies.

Dynamic sharing of spectrum on a 'as needed' basis by multiple service providers has been enabled by various technologies:

- Spectrum access system (SAS) software applications that enable dynamic management and sharing of spectrum based on a prioritization of access[28] by multiple users controlled by centralized data bases.
- Spectrum controlled in a decentralized manner (e.g. LBT or 'listen before talk' feature of LAA 'Licenced Assisted Access' standardized in 3GPP release 13);
- Multi-band devices; and,
- Spectrum hopping.

Dynamic SAS systems have been applied to manage TV whitespace spectrum in the US and elsewhere and more sophisticated versions will manage the US CBRS spectrum. Further development of algorithms to enable real time access and dynamic sharing of spectrum are expected - with corresponding advances in data base management, cloud storage, advances in spectrum utilization sensors, etc. These developments will make it technically feasible to share virtually all commercial spectrum available today.

[25] In extreme cases, ISED has taken back warehoused or underutilized spectrum or required the licensees to sell it to other service providers. This was the approach taken by ISED with Bell and Rogers for the Inukshuk spectrum.
[26] *Cisco 5G Vision Series: Licensed, Unlicensed, and Access-Independent Networks* CISCO report – Reference: https://www.cisco.com/c/dam/en/us/solutions/collateral/service-provider/ultra-services-platform/5g-vision-series.pdf. Note: Also quoted in Microsoft submission to Spectrum 2018-22.
[27] *ISED Consultation on the Spectrum Outlook 2018 to 2022* see: http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11333.html
[28] Vanu Inc. Spectrum Access System patent pending: https://patents.google.com/patent/US20140237547

The efficiency gains of multiple operators sharing spectrum on an 'as needed' or 'spectrum as a service' basis would be even greater in licensed than for unlicensed spectrum given the much larger coverage areas involved and the protocol-driven operational approach of incumbents to ensure their subscribers' service quality is maintained. The spectrum as a service approach would potentially resolve spectrum accessibility and affordability bottlenecks that could arise from the rollout of 5G technologies.

Spectrum as a service framework - a better regulatory mousetrap

ISED has proposed consideration of the spectrum access system and reallocation of spectrum for the 3800 MHz spectrum.

In this section, we provide a conceptual economic model to assess impacts of Alternative Licensing Scenarios: Exclusive 5G MNO Scenario vs. 4G and 5G Sharing with Rural Exception Scenario. This model would apply not only to the 3800 MHz but also 3500 MHz and other bands such as the 5GHz.

Under the spectrum as a service framework, the spectrum access system dynamic database allocates spectrum to multiple users categorized in 3 tiers according to their spectrum access priority status: Public safety, Security and Incumbents (including subordinate users); Priority Access Licences and, General Authorised Access (unprotected).

The FCC has been a leader in developing the data base software necessary for dynamic spectrum sharing as well as the SAS spectrum licensing and management model. The FCC first announced in 2015 that it *made the 3550–3700 MHz band (150 MHz) available for flexible use on a shared basis through a database-supported authorization system, known as the Citizen Broadband Radio Service (CBRS). Specifically, the FCC created a three-tiered framework to coordinate shared use of the band. According to this framework, incumbents, including United States radar systems and fixed satellite service earth stations, will comprise the first tier and receive protection from all other users, followed by priority access licences (PAL), the second tier, and general authorized access (GAA), the third tier. PALs will receive protection from GAA operations whereas GAA users must accept interference from all other users. Automated frequency coordinators, known as Spectrum Access Systems (SAS), will coordinate operations between and among users in different access tiers. The FCC was planning to auction up to 70 MHz of spectrum for PALs for commercial mobile use for 3-year terms with limited options for renewal. In October 2017, the FCC launched a consultation on potential changes to the licensing rules in this band to support 5G deployments, as the framework was initially developed before it was apparent that the 3500 MHz band would play a significant role as one of the key mid-range bands for 5G network deployments throughout the world. The FCC is consulting on increasing the length of licence terms for PALs from the initial proposal of three years to ten years, including an expectation of renewal, larger geographic licence areas, and auction methodology. An FCC decision on the changes is expected in 2018.*

In October 2017, the FCC announced it will employ the 3-tier priority access licensing (PAL) approach for

CBRS spectrum.[29] Other countries such as Mexico, are considering similar frameworks. [30]

A phased-in transition approach that accommodates stakeholder needs and recognizes the property rights of existing spectrum licensees is a perquisite for successful implementation of a SaS regulatory and spectrum management framework.

- For new spectrum releases by the Regulator, the spectrum could be awarded by auction on a lease basis to single bidders or consortiums - subject to wholesale access for 3rd party users on the same terms and conditions as provided for their own use. The licensees would also be subject to standard conditions of licence: roll out, quality of service and public safety requirements.
- For existing spectrum licenses, the licensee would be given priority access to the spectrum; however, unused or underutilized spectrum would be subject to a wholesale access regime. similar to that for new spectrum after a transition period.

Key to ensuring 'buy-in' from current licensees is the assurance that their economic interests are fairly compensated through a wholesale access regime in which the primary licence holder would be paid a market-based rental fee by third party service providers for the utilisation and management of the spectrum.

Other key elements required for the functioning of spectrum as a service include administration of the spectrum access system data base, appropriate secondary licensing process(es) and mechanisms for capturing and sharing of the spectrum revenues. Central to all these issues is whether the regulator - which currently has the authority over the spectrum resource - should develop the necessary tools to undertake these responsibilities or should these be devolved alternatively to individual licensees, a stakeholder consortium or independent public agency.

Commercial benefits of an Efficient Spectrum Regulatory and Management Framework

The imminent rollout of 5G networks provides compelling reasons to take active interest in the development of a SaS model as an efficient spectrum regulatory and management framework. The SaS model would open a number of business opportunities for applications and data management firms, including;

- the provisioning of SaS applications, data base management and cloud storage services to spectrum licensees and/or spectrum regulators to enable real time access and dynamic sharing of spectrum in the SaS model;
- Development of IoT sensors, mission-critical applications and other applications associated with provisioning of data base management and cloud storage services to various industry verticals (agriculture, forestry, municipalities, etc.) in the emerging 5G economy.

[29] ISED Notice of Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band, paragraph 17.
Also, FCC: https://apps.fcc.gov/edocs_public/attachmatch/DOC-347045A1.pdf
[30] Mexico has announced 700MHz spectrum auction based on wholesale build-out and open access market structure https://www.mobileworldlive.com/featured-content/home-banner/mexico-postpones-spectrum-auction-to-2017/

Approach & Methodology

In order to enable the discussion of the spectrum as a service model in Canada and other industrialized countries in transition to a 5G economy, Canwisp urges ISED to initiate a study to quantify the potential differences in the national economic performance between the current licensing and the proposed 'spectrum as a service' regulatory frameworks.

We propose a two-step modelling approach. In the first step, using the standard economic analysis (supply and demand) it can be demonstrated that given the emerging socio-economic trends, introduction of the SaS framework will maximize economic welfare of the society. In the second step the analysis can be translated show economic impact in terms of GDP/employment growth and productivity gains across the regional economies of Canada.

Proposed Economic Modelling Approach

Based on industry consensus forecasts of IoT demand, we propose to model demand and supply curve under existing spectrum regime and under the SaS regime. It is evident that new technologies such as 5G will enable new services and applications across different sectors of the national economies. As a result, as shown in Figure 3 below, the demand curve will shift upward. However, under the existing regime spectrum supply will curve will not change.

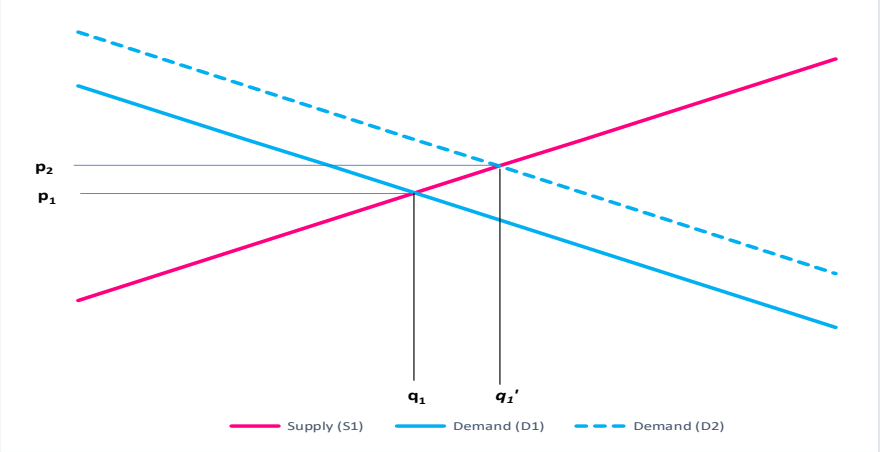

Figure 3: Supply-Demand Curve under existing spectrum regime

To meet the demand for new services and applications from $\mathbf{q_1}$ to $\boldsymbol{q_1'}$ there will be upward shift in the demand curve from D1 to D2. It is worth noting that there is consensus that the demand for new services and application will increase expotentially. To address this demand a significant increase in spectrum supply will be required. However, under the existing spectrum regime (supply curve S1), the price will increase from $\mathbf{P_1}$ to $\mathbf{P_2}$ to meet the increased demand $\boldsymbol{q_1'}$.

This will result in sub-optimal consumer surplus. The reason for this is because under the existing spectrum regime, the utilization of spectrum will be constrained, restricting the supply (full utilization) of the spectrum, and will be subject to profit maximization behaviour of the licensees.

However, with the introduction of SaS regime, the supply will increase i.e. supply curve will also shift from S1 to S2 as shown in Figure 4 below. As a result, new equilibrium at the same price level (**P1**) will be achieved to support increased demand **q_2,** resulting in higher consumer surplus.

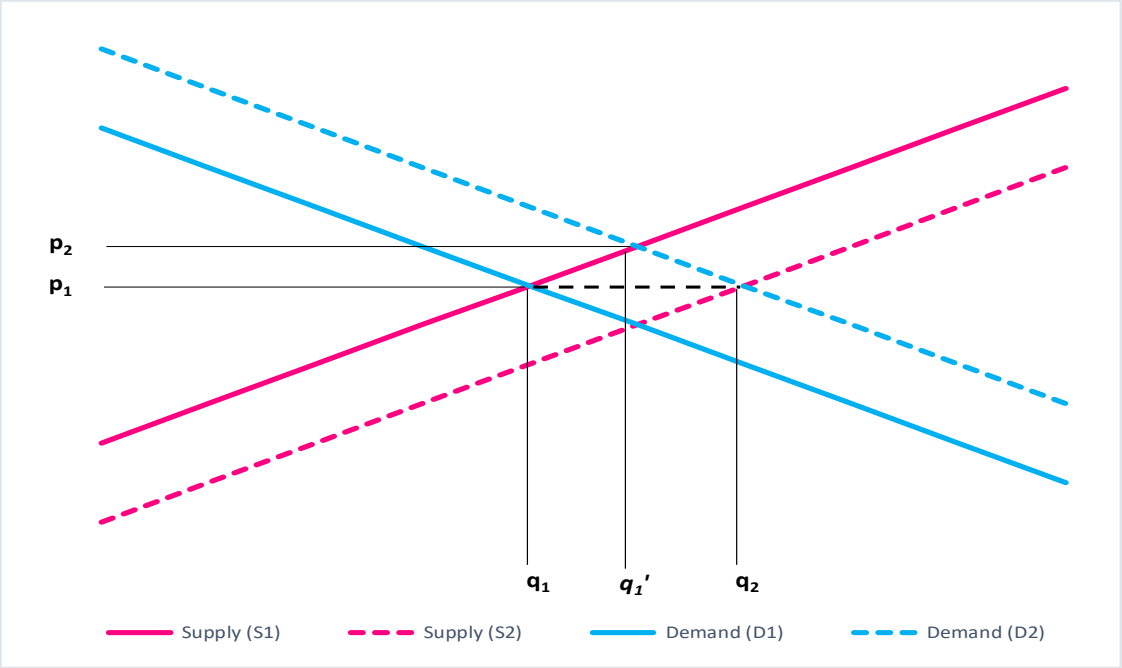

Figure 4: Supply-Demand Curve under existing SaS (Spectrum as a Service) regime

2. Proposed Rural Exception Spectrum Framework for 3450-3650MHz Band

In section 2, we demonstrated that WISPs have a crucial role in the delivery of broadband connectivity in rural areas as innovative, spectral efficient and low cost service providers. With a majority of Canwisp members having adopted 4G LTE technology, WISPs are on the pathway to 5G technology and integrated services necessary for the development of the rural economy.

In the Appendix 1, we demonstrated that for rural Canada there will be negative economic consequences of the proposed reallocation of 3500/3800 MHz spectrum. For example, availability and affordability of broadband services currently offered through Fixed Wireless Access will be severely constrained, which will have a negative impact on the GDP and employment in rural areas of Canada. As a result, overall contribution of rural Canada to Canada's national economic growth will be reduced. We also demonstrated that consumer surplus is maximised under spectrum as a service model.

Therefore, to ensure rural citizens have avoid negative economic consequences of the proposed spectrum reallocation and to maximize consumer welfare, Canwisp requests that ISED adopt the 'spectrum as a service' model with an initial roll out of spectrum access system (SAS) in the 3500 (3450-3650 MHz) band and potential application to other bands in the future.

Going forward in the 5G and mobile data world, current exclusive spectrum licensing model used by ISED and other regulators, will be incapable of accommodating the geometric increases in data usage. The 'spectrum as a service' model for the 3500 MHz and other bands enables significant more efficient spectrum utilization and thus multiple spectrum tiers of users. Under the right licensing conditions, SAS can also enable affordable spectrum access for rural service providers, accommodate the incumbents' 5G spectrum requirements and dissuade spectrum warehousing.

The 3500 MHz band is a good candidate for trialing the implementation of SAS as a general spectrum licensing and management model:

- As indicated in the previous Appendix 1 above, both ISED and the CRTC have underlined the importance of affordable, innovative telecommunications services to rural consumers.
- In the absence of a favourable licensing regime for rural service providers, consumers in rural areas will be deprived of innovative, affordable 4G and 5G services. The economics of the 3GHz bands differ significantly in urban and rural areas. The high costs of build out (Capex for towers), operation and lower ARPU per subscriber make it unlikely that incumbents would roll out service to rural subscribers given their past history and the higher margins for 5G services in urban markets. As pointed out by ISED *''given Canada's geography and widely dispersed population, it can be difficult to make a business case for the deployment of new innovative services in some rural and remote areas of the country''*[31]
- Introduction of 5G services in densely populated areas is compatible with providing Fixed Wireless internet Access and other broadband services in rural and remote areas.

[31] Paragraph 8 of the Consultation paper

- The incumbents' arguments for 3GHz spectrum as expressed by TELUS in ISED's Spectrum Outlook 2018 to 2022 Consultation: *the 3500 MHz band will provide the fundamental and ubiquitous coverage overlay that provides 5G enhanced mobile broadband services to the broader urban and suburban landscape* clearly will not apply to rural areas for several years and perhaps never in the most remote areas.
- There is a global FWA ecosystem for LTE gear in the 3500 MHz band and over half of WISPs are using LTE.
- The spectrum held by major licensees: Xplornet and Inukshuk hold about 80% of the current licences, prior to the identification of 5G needs, and the spectrum is currently lightly used or simply warehoused (unused).
- Other countries such as the US and Australia, with large rural areas similar to Canada are adopting frameworks to protect rural service providers. The U.S created an innovative three-tiered framework to coordinate the use of the CBRS band, protecting incumbent users and ensuring spectrum is accessible through what the FCC named General Authorized Access (GAA). Australia is implementing a seven-year transition period for incumbent users of the 3575-3700 MHz band in its regional areas. Canwisp submits that Canada as well needs to protect existing users of the 3500 (and 3800) MHz bands and limit unnecessary displacements, especially in its rural and remotes areas.

Thus, in considering a SAS licensing regime, Canwisp requests ISED adopt the following specific, proactive licensing and spectrum management measures under the SAS model for the 3500MHz band.

- Licence areas: ISED adopt census tract license areas as the basis for licensing in rural areas for auctioning in the 3500MHz band. As a transition measure, Tier 6 licensing could be used. This recognizes the lower population density in rural areas and the need to ensure affordable license areas for small, rural service suppliers.[32] Canwisp suggests that further discussion will be required in this Consultation in order to find a definition of 'rural' areas for licensing that meets the needs of stakeholders.
- Number of licenses in rural areas: For areas deemed 'rural' at least four (4) census-tract-base primary access licences of 20MHz would be made available along with (4) Tier 4 licences would be made available in the 600MHz auction[33]. The remaining 40MHz would be available for General Authorized Access licensing regime – similar to the existing use of the WBS band (3650-3700 MHz band).
- Spectrum cap: The number of licences available to any one bidder should be capped in rural areas at 40MHz.
- Licence period: The license term for PALs (new Priority Access Licencee) in both urban and rural areas be ten (10) years.

[32] We note that WISPA the US WISP Association has proposed 5 PALs to be licenced at the county / CMA level and 2 PALs to be licensed at the census tract level. See http://www.wispa.org http://www.wispa.org/Wispa-News/ArtMID/13028/ArticleID/501/CategoryID/50/CategoryName/FCC-Filing/WISPA-CALLS-FOR-INCREASED-SHARING-OF-PRIME-SPECTRUM-OPPOSES-GLOBALSTAR-REQUEST-FOR-INQUIRY

[33] We note that the proposed ISED band plan for 3450-3650 MHz includes 20 blocks of 10 MHz each

- Deployment Requirements and Penalties: PALs that acquire new spectrum in the 3500 MHz bands and subsequently do not meet their licence conditions including roll out requirements would be subject to a financial penalty and the spectrum would be subject to take back by ISED.

- Spectrum return policy: ISED adopt a spectrum return policy that consider continuity of service for all actual spectrum users including subordinate licensees, as per Canwisp's proposal under **Option 3** of its answer to Question Q6 of this Consultation.

3. Evaluation of best practice standards setting and regulatory approaches in the 3GHz bands

Globally, 3GPP is the standard setting body for 4G and 5G applications in the 3.5GHz and C-band frequencies (4 GHz-8 GHz)[34]

3GPP has standardised Band 42 (3400 MHz to 3600 MHz) and Band 43 (3600 MHz to 3800 MHz) for use by 3GPP TDD technology and currently these bands are used for LTE-A networks.

The 3.5 GHz band (3GPP Bands 42 and 43) has been identified by the European Commission as a 5G "pioneer" band. There is considerable interest globally in this band as well as the so-called C-Band, particularly in around the 5.9 GHz sun-band. The 3.5 GHz band has already been assigned in a number of markets including the UK, Japan, Spain, Hungary, Latvia, Slovakia and Ireland and future awards are planned in Switzerland and other markets despite a high degree of uncertainty over standards, spectrum availability, use case and business models. There are currently a small number of commercial Band 42 networks operational with the largest being in London and Tokyo. Globally, a large number of other markets will also be assigning these frequencies over the coming years.

Countries with large rural areas have adopted frameworks to protect current spectrum users in their remote areas. The U.S created an innovative three-tiered framework to coordinate the use of the CBRS band, protecting incumbent users and ensuring spectrum is accessible through what the FCC named General Authorized Access (GAA). Australia is implementing a seven-year transition period for incumbent users of the 3575-3700 MHz band in its regional areas. Canwisp submits that Canada as well needs to protect existing users of the band and limit unnecessary displacements, especially in its rural and remotes areas.

In this section, we examine the experience of regulatory agencies and stakeholders in 4 countries: US, UK, Australia & Germany in the equivalent of the 3500 MHz and 3800 MHz bands.

3.1 US

In the US, The FCC has initiated measures that favour access to spectrum by WISPs as smaller, cost efficient rural service providers in both the CBRS 3550-3700 as well as in the 3700-4200MHz bands.

First, in the Citizens Broadband Service (CBRS) 3550-3700MHz 'innovation band', FCC has adopted a spectrum access system (SAS) to manage the band. The SAS system incorporates a dynamic database and, potentially, other interference mitigation techniques.

The FCC has set up a three-tier hierarchy in the authorization framework for the CBRS (Citizens Broadband Radio System):

- Incumbent Access in which incumbents are protected from interference from the lower tier operators,

[34] **Valuing 5G Spectrum: Valuing the 3.5 GHz and C-Band Frequency Range** *(http://www.coleago.com/wp-content/uploads/2018/02/5G-and-3.5-GHz-Spectrum-Valuation-Paper.pdf)*

- Priority Access Licensees (PALs), which win spectrum in an auction (multiples of 10MHz channels in census tract areas); and,
- General Authorized Access (GAA) – lowest tier users which obtain free access but no interference protection.[35]

This framework is designed to accommodate a wide variety of commercial users operating TD-LTE systems, individuals operating citizen band radio, etc. in the 3.5GHz to 3.65GHz band on a shared basis. The SAS ensures that Citizens Broadband Service users operate only in areas where they would not cause harmful interference to incumbent users and also helps manage interference protection among different user tiers. Under SAS, WISPs are able to either use the spectrum without cost as GAA users or most importantly, win spectrum at a reasonable cost due to the application in the auction framework, of small census tract license areas and caps on the number of licences to prevent scooping of available spectrum by the large incumbent operators.

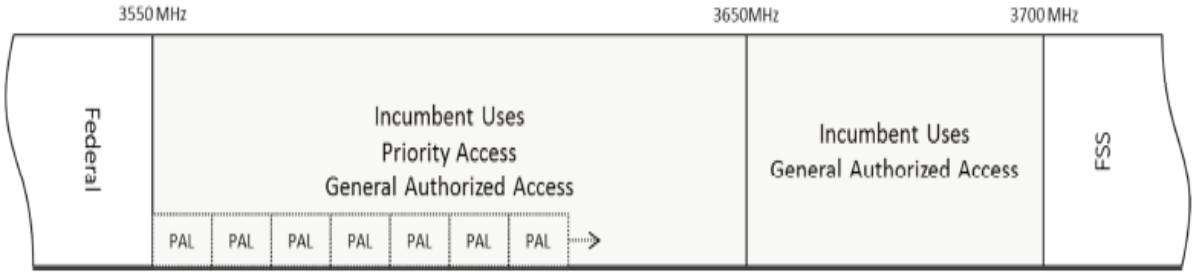

Figure 5 Potential Band Plan[36]

This plan builds on existing database-based spectrum sharing frameworks and allows three tiers of users to share 150 MHz of spectrum in the 3.5 GHz band through a software-based spectrum access system. The model protects co-primary incumbents and new entrants while also providing general authorization for spectrum which is not being used, thereby introducing the potential for license-exempt use. [37]

Spectrum blocks of 10MHz will be automatically assigned on request subject to availability of spectrum within 150MHz (3550 – 3700 MHz bandwidth assigned to CBRS applications.[38]

In the following diagram, the functional architecture and different user tiers are summarized.

[35] https://www.fcc.gov/wireless/bureau-divisions/broadband-division/35-ghz-band/35-ghz-band-citizens-broadband-radio
[36]REPORT AND ORDER AND SECOND FURTHER NOTICE OF PROPOSED RULEMAKING, FCC 15-47, p22.
[37] DSA-response-to-ACMA-outlook-consultation.
[38] https://www.thinksmallcell.com/Technology/europe-plans-for-cbrs-style-shared-spectrum-in-2-3ghz-band.html

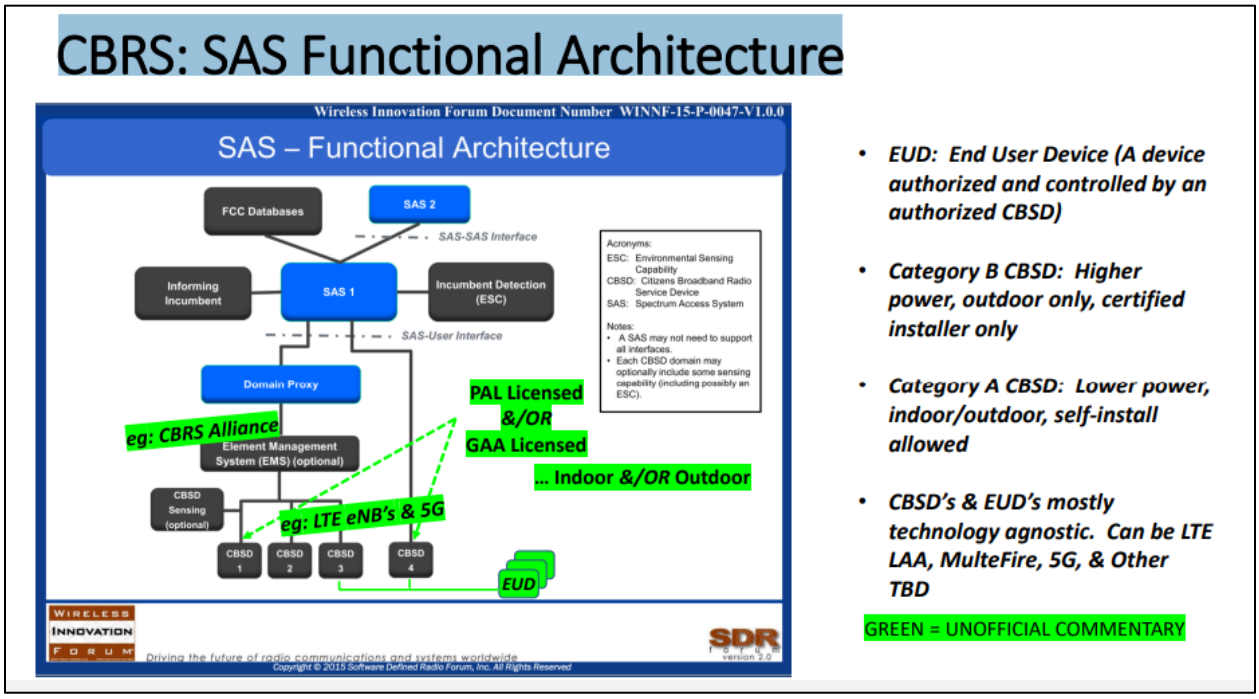

Figure 6 CBRS: SAS Functional Architecture[39]

While the FCC has made provision to auction spectrum to priority access licensees (PALs), it has not yet auctioned PALs and there is not yet commercial deployment in the Citizens Broadband Radio Service. In the *Notice of Proposed Rulemaking and Order Terminating Petitions*[40] released in October 2017, the FCC sought comments on several proposed changes to the rules governing Priority Access Licenses (PALs) - including longer license terms, renewability, larger geographic license areas, and auction methodology.

Under the current rules, Priority Access licensees would not bid on specific spectrum blocks. Rather, SAS Administrators assign frequencies based on the amount of spectrum that the PAL licensee is authorized to use in a given license area. Licensees may request a particular channel or frequency range from the SAS, however, they are not guaranteed a particular assignment.[41] Each License Area consists of one Census Tract. The census tracts in rural areas are significantly larger than in urban areas reflecting population densities. A PAL applicant must demonstrate it is qualified in regard to citizenship, character, financial, technical and other criteria established by the Commission, and that the public interest, convenience and necessity will be served[42].

In the *2017 Notice and Order*, FCC sought comment on increasing the geographic licensing area of PALs[43]. In response, various stakeholders including current spectrum incumbents: operators, ISPs, citizen

[39] https://www.aglmediagroup.com/wp-content/uploads/2016/11/AFTERNOON-KEYNOTE-PRESENTATION.pdf
[40] *https://ecfsapi.fcc.gov/file/1024196454861/FCC-17-134A1.pdf*
[41] NOTICE OF PROPOSED RULEMAKING AND ORDER TERMINATING PETITIONS, FCC 17-134, p18. https://www.fcc.gov/document/fcc-moves-promote-investment-35-ghz-band-0
[42] https://www.ecfr.gov/cgi-bin/text-idx?SID=12210475af05d699ffbbf3278724ab62&mc=true&node=se47.5.96_17&rgn=div8
[43] Ibid, p10.

band users, etc. as well as potential spectrum users such as Microsoft, Amazon, Google have made submissions to the FCC. The interests of the potential spectrum users and rural Dynamic Spectrum Alliance (DSA).

Critical to the success of the SAS model in rural areas in the US (and for that matter, Canada) are active licensing measures to prevent incumbents from 'scooping' the entire CBRS spectrum as well as measures to favour rural service suppliers in recognition of their inherent viability requirements (costs and revenues).

The **Broadband Access Coalition** - a diverse coalition of companies, including Google, Frontier Communications, Motorola Solutions, General Electric Company, NCTA – The Internet and Television Association, NTCA – the Rural Broadband Association, Ruckus Networks, Rural Wireless Association and the Wireless Internet Service Providers Association (WISPA), etc., have urged the FCC to adopt a modified licensing framework for the CBRS band that better ensures efficient spectrum usage and sharing. Specifically, this coalition has asked the FCC the following modification to the SAS licensing parameters:

- In every census tract in every U.S. county, there will be two (2) census tract-based CBRS PALs available at auction.
- In the top 30 U.S. Cellular Market Areas (ranked by population), there will be five (5 county-sized PALs available at auction in every county.
- In U.S. Cellular Market Areas ranked 31-306 (based on population), there will be five (5) Metropolitan Statistical Area ("MSA")-sized PALs available at auction.
- In U.S. Cellular Market Areas ranked 307-734 (based on population), there will be five (5) county-sized PALs available at auction in every county.
- The license term for all PALs will be seven (7) years, and PALs will be renewable based on performance criteria.

These companies believe that the proposed elements will meet the business and operational requirements of commercial mobile wireless carriers, cable companies, and other broadband providers serving rural areas that desire larger license areas. They also emphasize that the proposal reflects the diversity of deployment options and network operators that will be required to realize the vision for 5G wireless – ubiquitous wireless services in urban and rural areas, both outdoor and indoor, and involving a breadth of industries (e.g., mobile, cable, industrial, WISPs, and enterprise)[44].

The **Dynamic Spectrum Alliance** (DSA) in its letter of January 2018 to FCC, described a rural project that demonstrates the investments and innovation that rural broadband providers have made since the adoption of the CBRS rules and three-tier structure. DSA indicated that rural broadband providers already invested in deployments in the 3650- 3700 GHz band, in anticipation of access to the expanded CBRS band. For example, Rise Broadband (Rise), the nation's largest fixed wireless internet service provider, is implementing its $16.9 million subsidy under the FCC Rural Broadband Experiment program with base stations that will be capable of operating across the full Part 96 CBRS band of 3550 to 3700 MHz. Once CBRS device-to-SAS protocols are finalized and a SAS is certified, Rise will be able to load new

[44] https://ecfsapi.fcc.gov/file/10529752724369/Coalition%20Ex%20Parte%20filed%20052918.pdf

software on these base stations to provide far greater throughput and more affordable rural broadband service. Rise has already constructed its first six towers in the Provo, Utah area under an experimental license that is delivering 100 Mbps service to its first 100 customers at distances up to 5 km from the tower. And since deployments of 3.5 GHz fixed wireless networks are between one-fifth and one-tenth the cost of fiber, Rise believes it can offer 100 Mbps service at lower prices than any wireline alternative in these areas[45].

WISPA the industry association representing some 4000 WISPs, has objected to proposed changes in FCC CBRS rules[46] which would favour incumbent operators by increase the size of the licence areas from the census tracks to the much larger Partial Economic Areas (PEAs) and extension of licence periods from 3 to 10 years. These changes would effectively negate the advantages of the CBRS SAS framework, revert to the historical exclusive licensing framework and correspondingly, give incumbent operators powers over subordinate licensees such as WISPs. This would make it difficult for WISPs to attract investment for migration from 4G LTE to full 5G services. As stated in the WISPA intervention:

> *"The rule changes sought by the incumbent wireless carriers would undercut each and every one of the important statutory requirements of [CBRS] and the public policy objectives clearly articulated throughout the CBRS Order without producing any alternative public interest benefit.*
>
> *"The spectrum assignment changes they (the wireless carriers) propose … would drive up the costs of initial license procurement and thereby limit the pool of bidders, forcing out smaller and more innovative spectrum users that do not require large geographic areas to implement their business plans. The carriers wish to make the CBRS rules more like every other auctioned spectrum band in which, not coincidentally, the major wireless carriers have obtained the lion's share of the licenses."*[47]

The second initiative of the FCC to favour access to rural spectrum by cost-efficient WISPs was its proposal to create of a point-to-multipoint service in the band from 3700 MHz to 4200 MHz that is currently underused for serving rural areas. WISPs as part of the wider Broadband Access Coalition, have petitioned the FCC to follow through on this proposal to create of a point-to-multipoint service.

> *"The FCC proposal would modernize deployment of high-speed, licensed point-to-multipoint fixed wireless broadband services (i.e., WISPs) while protecting incumbent fixed-satellite service and other incumbents on a shared basis. A significant difference between this allocation and CBRS is that there are no incumbent services to protect, so no complex spectrum management system would be required to eliminate interference.*
>
> *This band has even greater potential benefit for WISPs than CBRS because it provides 500 megahertz of contiguous bandwidth that would accommodate bonding of the 40-, 80- and 160-megahertz-wide channels needed to achieve gigabit-level LTE service. The band also has*

[45] DSA Comments to FCC on 3.5Ghz Band. http://dynamicspectrumalliance.org/wp-content/uploads/2017/04/DSA-Letter-to-FCC-on-3.5GHz-Band.pdf
[46] FCC notice of proposed rulemaking (NPRM) altering the original CBRS rules. http://www.aglmediagroup.com/its-a-watershed-moment-for-wireless-isps/
[47] WISPA June 2018 filing to the FCC

propagation characteristics similar to those of the 3.5-GHz band, so, like CBRS, it would potentially make non-line-of-sight transmission paths possible."[48]

3.2 UK

In the UK, Ofcom has indicated that 3.4 GHz (3410- 3480 MHz and 3500-3580 MHz) spectrum[49] is likely to be used by network operators to deliver both additional capacity for mobile broadband and for 5G services.

Figure 7 3.4 GHz band plan

Ofcom has awarded 3.4 and 2.3 GHz spectrum by auction in 2017. It would appear they did not make specific provision for rural service providers in the 3.4GHz band. However 40 MHz of spectrum already owned by UK Broadband was not part of the 2017 auction and its parent company, H3G, acquired an additional 20MHz. Ofcom applied two separate caps on the amount a single operator may hold:

- A cap of 255 MHz on the amount of mobile spectrum that is immediately useable after the Auction.
- A cap of 340 MHz per operator on mobile spectrum overall after the Auction. This overall cap represents 37% of all the mobile spectrum that Ofcom expects to be useable within similar timeframes to the 3.4 GHz band.

These two caps restricted BT/EE to winning no more than 85 MHz in the 3.4 GHz band and restricted Vodafone to winning no more than 160 MHz across the 2.3 GHz and 3.4 GHz bands together.[50] There were no restriction of the amount of spectrum H3G, O2 or any other bidder could win in this Auction.

3.3 Australia

As indicated above, Australia has recognized the importance of fostering affordable and innovative telecommunications services for consumers and supporting rural service providers.

As part of this strategy, ACMA is implementing a seven-year transition period for incumbent users of the 3575-3700 MHz band in its regional areas. The 3.5 GHz band currently has a mix of apparatus and spectrum licences. ACMA has authorised a variety of services in this band including wireless broadband, fixed, mobile, satellite and amateur services. The spectrum-licensed part of the band is known as the 3.4 GHz band.[51]

[48] "It's a Watershed Moment for Wireless ISPs" See: http://www.aglmediagroup.com/its-a-watershed-moment-for-wireless-isps/
[49] As well as 2.3 GHz spectrum (2350-2390 MHz)
[50] https://www.ofcom.org.uk/__data/assets/pdf_file/0022/103819/Statement-Award-of-the-2.3-and-3.4-GHz-spectrum-bands-Competition-issues-and-auction-regulations.pdf
[51] https://www.acma.gov.au/theACMA/making-the-most-of-the-3dot5-ghz-band-in-future

In the response to ACMA's Five-year spectrum outlook 2016-20 consultation, Dynamic Spectrum Alliance submitted that adoption of a spectrum sharing (SAS) licensing model would promote efficiency in spectrum utilization and not harm incumbent users.

In the response to ACMA on the Spectrum for broadband in mmWave bands consultation in October 2017,

- DSA also argued that ACMA should look to the FCC three-tier framework used the 3.5 GHz band as the model for a sharing framework in the 5G mmW bands[52].
- Microsoft argued for the application of spectrum access database, of which a typical example is SAS system for 3.5 GHz band in US. They highlighted that this kind of system can help provide Australian citizens and industry with access to 5G spectrum as early as possible, while maintaining the flexibility in future adjustments.

From the review of the public record, it does not appear that the incumbent operators have made formal submissions to ACMA for additional spectrum in the 3.5MHz & 3.8MHz bands for 5G services.

3.4 Germany

In July 2017, The German ministry for transport and digital infrastructure has published the national strategy for 5G, with the stated aim of becoming a market leader. The frequency spectrum that will be used internationally for mobile communications in the future will be finalized within the framework of the ITU World Radio Conference in 2019.

As a result of their efforts in the main European standards and spectrum coordination bodies, the European regulators agreed on three 'pioneer bands' for 5G: the 700 MHz band, the 3.4-3.8 GHz band (3.5 GHz band) and the 24.25-27.5 GHz band (26 GHz band). The European Conference of Postal and Telecommunications Administrations (CEPT) is currently developing the technical and regulatory conditions for a technical harmonization of the 3.5 GHz band and the 26 GHz band in the European Union, with Germany as one of the key contributors[53].

3.5 Canada

In its notice of consultation for the 3.5GHz and pre-consultation 3.8GHz bands, *"ISED recognizes that there are new technologies and techniques (e.g. cognitive radio, dynamic spectrum access) being developed that will change the way spectrum is accessed through intelligent decision-making solutions and geographic/operational awareness of the radio environment."*[54]

[52] Dynamic Spectrum Alliance response to consultation on the ACMA Five-year spectrum outlook 2016-20
[53] 5G Strategy for Germany. https://www.bmvi.de/SharedDocs/EN/publications/5g-strategy-for-germany.pdf?__blob=publicationFile
[54] Consultation on Revisions to the 3500MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band. Re. section 6.5 http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11401.html#s6.5

ISED has trialing dynamic spectrum sharing in the 'whitespaces' interstitial TV bands.

In its notice ISED does not explicitly state that it is considering SAS as an alternative model for licensing future spectrum in the 3GHz or other bands.

We note that the definitions in for the 3.5GHz and 3.8GHz bands: **3400–3450 MHz** band and the **3650–4200 MHz** band in the Consultation do not correspond to those adopted the 3GPP. In its release 15 documentation, 3GPP defined two spectrum bands for 5G NR radios[55] overlapping the spectrum under consideration in this Consultation: band n77, ranging from 3300 to 4200 MHz and band n78, which is a subset of n77, ranging from 3300 to 3800 MHz. This appears to be the case of the regulator balancing incumbent use of spectrum with policy development and future use.

In their briefs to the ISED Spectrum Outlook Consultation 2018 to 2022, Canwisp, BCBA and others argued for increased access to secure, affordable spectrum in the 3GHz bands in recognition of the crucial role played by smaller service providers in enabling access to innovative, affordable broadband services by rural citizens.

In the same Consultation, TELUS argued that 3.5 GHz band will be critical to support 5G deployments in Canada and therefore should be designate for 5G on a priority basis.[56] Specifically, the firm argued that whereas the 600 MHz band will be critical for enabling rural 5G, the 3500 MHz band will provide the fundamental and ubiquitous coverage overlay that provides 5G enhanced mobile broadband services to the broader urban and suburban landscape.

[55] https://portal.3gpp.org/ngppapp/CreateTdoc.aspx?mode=view&contributionUid=RP-172475
[56] https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SLPB-006-17-TELUS-CR.pdf/$file/SLPB-006-17-TELUS-CR.pdf