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July 12, 2018

Via email: ic.spectrumauctions-encheresduspectre.ic@canada.ca

Aline Chevrier
Senior Director, Spectrum Licensing and Auction Operations
Innovation, Science and Economic Development Canada
235 Queen Street, 6th floor
Ottawa, Ontario K1A 0H5

Re: Canada Gazette Notice No. SLPB-004-18: Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band

Attached, please find the comments of Rogers Communications Canada Inc. (Rogers) in response to *Canada Gazette*, Part I, June 16, 2018, *Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band* (SLPB-004-18).

Rogers thanks the Department for the opportunity to provide input on this important issue.

Yours very truly,

Howard Slawner
Vice President – Regulatory Telecom
HS/pg

Attach.

Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band
SLPB-004-18

Comments of
Rogers Communications Canada Inc.
July 12, 2018

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Executive Summary

E1. Spectrum is a critical input for satisfying the growth in demand for advanced connectivity services in Canada. The 3500 MHz and 3800 MHz spectrum bands are emerging globally as key pioneer bands for enabling the deployment of 5th generation (5G) wireless technology. The propagation characteristics of this spectrum provides facilities-based operators a balance between decent area coverage and greatly increasing network capacity that will support the deployment of advanced next-generation wireless technologies. The arrival of 5G technology, which has the potential to revolutionize how we work, study and play, will only accelerate Canadians' growing demand for mobile data services. As Canada's largest wireless provider and the leader in the Machine-to-Machine market, Rogers continues to invest heavily in advanced communication networks and requires access to additional spectrum.

E2. Innovation, Science and Economic Development Canada has an important role to play in ensuring that Canada continues to be at the forefront of 5G innovation and adoption by providing access to the spectrum bands discussed in this consultation in wide, contiguous bandwidths. In order to do so, the Department should take steps to make 300 MHz of exclusively, licensed spectrum available through this consultation, not simply the 200 MHz proposed. An initial 300 MHz will provide multiple network operators access to the big blocks of spectrum necessary to deliver the benefits of 5G to Canadian consumers and business. Making 300 MHz of spectrum immediately available is critical for the continuation of existing services, competition in the wireless market, and availability of new 5G services for Canadians.

E3. The Department should then move quickly to release additional spectrum in future extensions of the band, expanding the band up to 4200 MHz. Satellite services in the C-band continue to decline in importance and are already migrating to other satellite bands, which can provide the more advanced connectivity services that Canadians are demanding. The marked decline in satellite usage of 3700-4200 MHz is especially true outside of the Far North and remote areas of Canada.

E4. In order to achieve the large, contiguous bandwidths necessary for Canadians to fully benefit from all the innovations and performance that 5G networks can deliver, new blocks auctioned in the future extension bands should automatically be assigned contiguously to the spectrum available through auction and to incumbent licensees through this consultation. The Department should include a spectrum contiguity provision in its new 3500 MHz policy and a condition of licence for the

new 3500 MHz and 3800 MHz flexible use licences, requiring spectrum block exchanges whenever the band is extended.

E5. The immediate increase in the available spectrum, coupled with additional contiguous, spectrum offered in the near future, will provide enough spectrum for both incumbent 3500 MHz licensees and new operators in the bands. Incumbents that have met their licence conditions should be able to retain two-thirds of their spectrum, as they have invested hundreds of millions of dollars in the face of ongoing and significant technology uncertainty. Indeed, incumbents retaining two-thirds of their spectrum was the precedent set by the Department in the 2500 MHz transition, when there was only 190 MHz available. In the current consultation, the Department has proposed to make 200 MHz available and this can easily be increased to 300 MHz. A two-thirds retention of 3500 MHz licenses is both justified and fair. Otherwise, the Department should go with Option 1, the better of the consultation's two proposals but still suboptimal for Canadians.

E6. The 3500 MHz consultation is an opportunity for the Department to foster both innovation and competition in Canada. Increasing the amount of spectrum immediately available to facilities-based operators through this consultation to 300 MHz, moving to rapidly expand the band upwards to as high as 4200 MHz, and implementing spectrum contiguity provisions to ensure spectrum block contiguity for new and incumbent licensees will help protect and promote wireless competition in Canada. These policy actions will also allow incumbent licensees to retain two-thirds of their spectrum, respecting both the Department's own precedent and incumbents' investments in the band. If Canada is to become an innovation and 5G leader, the Department must ensure both incumbents and new operators secure enough 3500 MHz and 3800 MHz flexible use spectrum to address Canadian consumers' almost insatiable demand for data capacity.

Introduction

1. Rogers Communications Canada Inc. (Rogers) is pleased to provide Innovation, Science and Economic Development Canada (ISED or the Department) with the following comments in response to *SLPB-004-18: Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band*[1] (the Consultation), published in the *Canada Gazette*, Part I, June 16, 2018.

2. The 3500 MHz band holds tremendous promise for the near-term implementation of 5th generation (5G) wireless services in Canada. The band offers a relatively large amount of bandwidth, compared to existing mobile spectrum bands. At the same time, its unique propagation characteristics will enable more densely configured radio access networks (RANs). Lastly, and for these reasons, the band is being considered globally as a key pioneer band for the implementation of 5G. It will be used to provide significant additional capacity to support key 5G use cases and its global adoption will drive significant economies of scale and a wide array of equipment and applications. In order to achieve the Department's objective of positioning Canada at the leading edge of the digital economy, ISED should take steps to immediately make available 300 MHz of 3500 MHz spectrum, rather than the proposed 200 MHz. Canada is already in position to make available 3450-3750 MHz as exclusively licensed spectrum with more spectrum made available in the near future by expanding the band up to 4200 MHz. This will put Canada in the forefront of 5G deployment and benefit all Canadian businesses and consumers.

3. Effective spectrum policy frameworks will help Canadian network operators meet the increasing demand for data and innovative new services. Canadians use their mobile devices far more than users in most other countries. Canada's mobile data traffic grew 41% in 2016, and is expected to grow five-fold from 2015 to 2020, a compound annual growth rate of 36%.[2] Facilities-based operators need more spectrum in large, contiguous bandwidths to connect the more than 30.7 million mobile subscribers in Canada.[3] Further, ensuring there is enough spectrum for wireless backhaul for the current and growing capacity demands of 4th generation (4G) Long Term Evolution (LTE) is critical to maintaining effective competition with

[1] ISED, *SLPB-004-18: Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band* (Consultation); http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11401.html.
[2] Cisco, *VNI Mobile Forecast Highlights, 2016-2021*. http://www.cisco.com/c/dam/assets/sol/sp/vni/forecast_highlights_mobile/index.html#~Country
[3] CRTC, *Communications Monitoring Report 2017*; https://crtc.gc.ca/eng/publications/reports/policymonitoring/2017/cmr5.htm#s55.

the local telephone companies, who have extensive wireline backhaul facilities constructed during their monopoly periods.

4. These trends are likely to significantly increase with the advent of 5G, which will provide bandwidth that was previously only available over wired facilities. For instance, dramatic growth in demand for mobile data services will be fuelled by Canadian consumers and businesses embracing the Internet of Things (IoT), with Cisco predicting a Machine-to-Machine (M2M) compound annual growth rate of 77%.[4] Canadians in all regions today have access to world-class mobile voice and broadband data services due to the facilities-based competition between national operators, with the wireless measurement company Open Signal stating that Canadian national operators' network speeds "surpass the majority of the world's operators."[5] A more flexible and effective use of additional spectrum resources will foster innovation, investment, and the evolution of facilities-based wireless networks through the adoption of 5G and other wireless technologies to the benefit of Canadian consumers and businesses.

5. As Canada's largest wireless operator, focused on the provision of advanced new broadband services, including capacity-hungry streaming video services such as 4K programming and distribution, Rogers knows that operators require additional capacity to keep pace with Canadians' demand for data services. In order to address the dramatic growth in demand for data services, Rogers has already made significant investments to deploy 4G LTE mobile broadband technology to approximately 96% of the Canadian population.[6] Rogers was the first wireless carrier to deploy LTE in Canada and continues to deliver innovative broadband services through the trialing and deployment of new mobile technologies such as carrier aggregation of licensed spectrum bands, 256-QAM transmission, and Licence-Assisted Access LTE (LTE-LAA). Such innovation is vital on the march to 5G and new services, such as augmented and virtual reality and autonomous vehicles and manufacturing, while maximizing the efficient use of exclusively licensed, interference free spectrum. Rogers is currently working with our network infrastructure vendor, Ericsson, on 5G trials in Toronto and Ottawa, in addition to select cities over the next year.[7]

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[4] Cisco, *VNI Mobile Forecast Highlights, 2016-2021*.
[5] Open Signal, *State of Mobile Networks: Canada (January 2017)*; https://opensignal.com/reports/2017/01/canada/state-of-the-mobile-network.
[6] Rogers, *2017 Corporate Social Responsibility Report*; https://about.rogers.com/wp-content/uploads/2018/06/2017-Rogers-CSR-Report-en.pdf.
[7] Rogers, *Rogers and Ericsson partner to bring 5G to Canadians*, April 2018; https://about.rogers.com/2018/04/16/rogers-ericsson-partner-bring-5g-canadians/.

6. Yet, for network operators to continue providing Canadians with the most advanced and innovative connectivity technology solutions, spectrum policy must keep pace. Rogers has been a consistent proponent of the importance of making additional spectrum available to support innovation, while ensuring incumbent users are still protected. Facilities-based providers like Rogers continue to invest billions of dollars to provide connectivity to Canadians. According to the Canadian Radio-television and Telecommunications Commission (CRTC), telecommunications investments made in both wireless and wireline networks was $11.6 billion in 2016 for plant and equipment, an increase of 11.3% over 2015.[8] However, in order to enhance consumer experiences and meet evolving usage demands, Canadian spectrum policy must continue to ensure there is enough spectrum that can be effectively used within facilities-based terrestrial networks.

Expansion of the 3500 MHz and 3800 MHz Bands

7. Rogers fully supports the Department's decision to expand this Consultation to include a review of the frequency range 3400-4200 MHz. As demonstrated in the attached report from Lemay-Yates Associates, *Enabling the 3.3 GHz to 4.2 GHz Band for 5G in Canada* (the LYA Report), the opportunity to broaden the 3500 MHz band beyond its current levels certainly exists. Many of the uses in the adjoining frequencies, including radar and C-band fixed satellite services (FSS), can be re-assigned to other spectrum ranges. As a result, 800 MHz, or even 900 MHz of the 3500 MHz and 3800 MHz spectrum bands could be made quickly available as a key 5G band. This will provide multiple carriers with sufficient contiguous spectrum to deliver the high capacity needed by many 5G applications.

8. This possibility has already been recognized around the world. We recommend that the Department follow the lead of Europe, Asia, and the Americas in adopting an expanded and globally harmonized 3500 MHz band to enable 5G wireless services in Canada.

9. The new Canadian 3500 MHz and 3800 MHz bands should be consistent with International Telecommunication Union (ITU) actions and with ongoing standardization efforts in Third Generation Partnership Project (3GPP), which will greatly impact the future 3500 MHz ecosystem. 3GPP has made substantial progress towards developing new standards that will operate in these frequency ranges:

[8] CRTC, *Communications Monitoring Report 2017.*

- For 4G LTE, Band 42 will extend from 3400 MHz to 3600 MHz, Band 43 will extend from 3600 MHz to 3800 MHz;
- For 5G NR, Band n78 will extend from 3300 MHz to 3800 MHz and is intended for European and American markets;
- For 5G NR, Band n77 will extend from 3300 MHz to 4200 MHz and was initially intended for the Japanese market but is quickly becoming a more global band; the extremely wide bandwidth may impair the radio performance somewhat but operators seem willing to make this trade-off in exchange for harmonization with the rest of the world; and
- For 5G NR, Band n79 will extend from 4400 MHz to 4900 MHz and is intended for the Japanese and Chinese markets.

10. It is not surprising therefore that a number of European countries are moving forward with the licensing of 3500 MHz spectrum with 5G applications in view. As noted in the LYA Report, the European Radio Spectrum Policy Group (RSPG) notes that the band 3400-3800 MHz will enable wide channel bandwidth and therefore considers the band as the key spectrum band for putting Europe at the forefront of 5G deployment.[9]

11. The FCC has been consulting since 2017 on rapidly moving towards opening the entire 3700-4200 MHz range to terrestrial wireless broadband services, in addition to the previously released U.S. 3550-3700 MHz band. The FCC consultation has sought comment on "proposals for transitioning all or part of the band for flexible use, terrestrial mobile spectrum, with clearing for flexible use beginning at 3.7 GHz and moving higher up in the band as more spectrum is cleared."[10] As discussed below, we believe the Department should move quickly to adopt similar rules to free up an additional 500 MHz of spectrum for exclusively licensed flexible use.

12. We note further that the U.K. regulator, Ofcom, is in the process of making the 3400-3800 MHz band available for mobile services with a preference for 5G technology.[11] The German spectrum regulator, the Bundesnetzagentur, is also in the process of making spectrum in the 3400-3800 MHz band available for "future-proof business models – most notably with a view to 5G applications (e.g., Industry 4.0, Internet of

[9] Lemay-Yates Associates Inc., *Enabling the 3.3 GHz to 4.2 GHz Band for 5G in Canada*, July 2018, p. 116.
[10] FCC, *NOTICE OF PROPOSED RULEMAKING AND ORDER 18-122,* para 2; https://docs.fcc.gov/public/attachments/DOC-351868A1.pdf. [Note, this is the unofficial version of the Order, which may be adopted as is or amended as part of the vote.]
[11] Ofcom, *Improving consumer access to mobile services at 3.6GHz to 3.8GHz;* https://www.ofcom.org.uk/__data/assets/pdf_file/0017/103355/3-6-3-8ghz-statement.pdf.

Things)".[12] Ireland auctioned their 3.6 GHz Band (3410-3435 MHz and 3475-3800 MHz) in 2017, a band the Irish spectrum regulator, ComReg, highlighted as being identified "as a primary band suitable for the introduction of 5G in Europe".[13] France, Italy, Austria, Switzerland, and Australia are also taking steps to license this spectrum, and some plan to do so before the end of 2018.[14] Worldwide, fourteen countries are currently planning to allocate at least 70% of the spectrum in 3400-3800 MHz for 5G and eight of these countries will allocate more than 80% of this spectrum.[15]

13. Over time, as the 3500 MHz and 3800 MHz bands in Canada are extended upwards to as high as 4200 MHz, and as manufacturers develop solutions for the extremely wide bandwidth, we expect that band n77 will emerge as a global 5G band. The wide bandwidth channels already available in the Canadian 3500 MHz band is critical to its value as a 5G band, which will allow for an important balance between the 600 MHz band's strong 5G coverage characteristics and the millimetre wave (mmWave) bands' high capacity 5G characteristics. Fragmenting the band through smaller bandwidth allocations will prevent Canadians from fully benefiting from 5G connectivity in the 3500 MHz band. As the LYA Report explains, a key characteristic of 5G technology is the need for large channels, such as 50 MHz, 100 MHz, or 200 MHz, or more, to leverage its full benefits.[16]

14. The 3650-3700 MHz band should be immediately reallocated for exclusive use as part of the 3500 MHz band and users moved to the 3400-3450 MHz band. Moving current Wireless Broadband Services (WBS) licensees now as part of an overall 3500 MHz Fixed Wireless Access (FWA) transition plan is optimal in order to transition those users to the new 3500 MHz and 3800 MHz band plans. This ensures continued dedicated spectrum for the many small and rural operators currently operating in the 3650-3700 MHz while not dividing the broader 3500 and 3800 MHz frequency range, which would result in inefficient spectrum policy.

15. Expanding the band will enable the licensing of relatively wide spectrum blocks to multiple competitors, ensuring the successful development of multiple competing 5G

[12] Bundesnetzagentur, *Key Elements for the rollout of digital infrastructures and Identification of Demand for nationwide assignments in the 2 GHz and 3.6 GHz bands*; https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/Telecommunications/Companies/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/201070704_KeyElementsDemandIdentification.pdf?__blob=publicationFile&v=1.
[13] ComReg, *Five Winning Bidders in ComReg's 3.6 GHz Band Spectrum Award*; https://www.comreg.ie/publication/media-release-results-3-6-ghz-band-spectrum-award/.
[14] LYA Report, pp. 120-124.
[15] LYA Report, pp. 19-20.
[16] LYA Report, p. 8.

networks in Canada. Making a contiguous 300 MHz immediately available would accommodate four competitors with approximately 75 MHz of contiguous spectrum each. This can be increased to 100 MHz per competitor and beyond if the band is further expanded. The Lemay-Yates Report demonstrates one way that the Department can take this action in the short term.[17] Extending the band down to 3300 MHz and up to 4200 MHz could potentially add another 500 MHz for a total of 900 MHz. A band of this size could accommodate four competitors with more than 200 MHz each. Rogers strongly recommends exploring all options for expansion of the 3500 MHz and 3800 MHz bands.

16. According to the *Consultation* on the *Spectrum Outlook 2018 to 2022* (Spectrum Outlook Consultation), there is only 648 MHz of licensed commercial mobile radio spectrum available at present.[18] While the Department is freeing up 70 MHz of spectrum for exclusively licensed commercial mobile use in the pending 600 MHz band, and a minimum of 200 MHz in the current Consultation, the amount is quite small when compared to the 27,817 MHz of spectrum already available to the satellite industry,[19] which also pays a fraction of the total annual spectrum fees that the mobile industry pays. While the satellite industry does share some of these spectrum bands with other services, it is still nearly 43 times the spectrum available for commercial mobile services to date. Finally, as further discussed below, the CRTC has documented the declining importance of the C-band to the satellite industry as they migrate to different satellite bands, particularly outside of Canada's Far North.

17. It should also be noted that although the satellite industry provides a vital role in providing information to businesses and government, and connecting remote Canadians, it plays a smaller overall role in the Canadian economy than the mobile industry. In 2015, total revenues in the Canadian space sector totalled $5.3 billion, a decrease of 1.6% year-over-year and contributing to an average annual growth rate of the space sector at just 0.4% between 2010 and 2015. The industry also numbered 9,927 space-related full-time equivalent jobs (FTEs) in 2015.[20] Comparatively, the mobile industry's impact on GDP for 2016 was $25.21 billion through direct, indirect and induced contributions, an increase of 1.9%. The mobile industry's direct contribution to the Canadian economy was $13.4 billion to GDP,

[17] LYA Report, p. 35-36.
[18] ISED, *Spectrum Consultation on the Spectrum Outlook 2018 to 2022* (Spectrum Outlook Consultation), para 11; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11333.html.
[19] ISED, *Spectrum Outlook Consultation*, Table 3.
[20] Canadian Space Agency, *State of the Canadian Space Sector Report*: *2015*; http://www.asc-csa.gc.ca/eng/publications/2015-state-canadian-space-sector.asp.

and directly responsible for 31,000 FTEs.[21] On a purely objective comparison, the value of the spectrum, including the 3700-4200 MHz range, is greater to Canada in the hands of the mobile industry and this is a strong reason why more spectrum needs to be provided to facilities-based terrestrial wireless network operators.

18. The Department should increase the amount of spectrum immediately available for exclusive licensing flexible use to 300 MHz through a repack of any satellites operating in 3700-3750 MHz to higher in the band or another band entirely, and make every effort to relocate grandfathered earth stations to rural areas, backhauling them with microwave or fibre facilities. As the FCC states in their NPRM on the 3700-4200 MHz band, even two of the largest FSS operators in the band acknowledge that at least 100 MHz can be made available for wireless broadband use, with others supporting expanded terrestrial use with adequate protection for incumbents.[22] Reallocating 50 MHz immediately in Canada should be eminently feasible, and the Department can consult more extensively on how to expand flexible use higher.

19. In the near term, the Department should take additional steps to open as much spectrum as possible in the 3300-4200 MHz band for exclusively licensed flexible use. Such policy action is vital to supporting the advanced network speeds and new digital technologies that Canadians have come to enjoy and demand. In addition, the Department should provide guidance on when extension bands moving higher in the 3750-4200 MHz frequency range will be auctioned, so those participating in the initial 3500 MHz flexible use auction will have a better understanding of valuations.

20. Finally, new blocks auctioned in the future should automatically be assigned contiguously to the spectrum immediately available through auction and to incumbent licensees. To assist this process, the Department should include a spectrum contiguity provision in its new 3500 MHz policy and a condition of licence for the new 3500 MHz and 3800 MHz flexible use licences, requiring spectrum block exchanges, whenever the band is extended and new spectrum blocks are auctioned, to ensure spectrum block contiguity for new and incumbent licensees. For clarity, mandatory exchanges to ensure contiguity should also occur as part of the exchange of FWA licences for flexible use licences. We expect the initial 5G equipment to be deployed in Canada will be in Band n78 (3300-3800 MHz), and Band n77 (3300-4200 MHz) to be available shortly after 3500 MHz flexible use

[21] Nordicity, *Benefits of the Wireless Telecommunications Industry, 2016*; https://www.cwta.ca/wp-content/uploads/2017/07/2017-Report-on-Wireless-Industry-Final-July-27.pdf.
[22] FCC, *NPRM 18-122*, para 14.

licences are issued to incumbent licensees and through the competitive licensing process. As such, there should be enough frequency agility to accommodate such measures.

21. Without such regulatory certainty, facilities-based operators may not be able to achieve the large, contiguous bandwidths necessary in order for Canadians to fully benefit from all the innovations and performance that 5G networks can deliver in the 3500 MHz and 3800 MHz bands. Increasing the amount of contiguous spectrum in large bandwidths available to facilities-based network operators will help the Department also maximize the efficient use of spectrum in Canada, resulting in a win-win-win situation.

Expanding the Band provides enough Spectrum for Incumbents and other Carriers

22. The Department has previously determined that all existing 3500 MHz Fixed Wireless Access (FWA) licensees that are in compliance with all existing licence conditions will be eligible for a new spectrum licence under the future 3500 MHz flexible use policy.[23] Rogers agrees that the Department should provide incumbent 3500 MHz licensees currently holding fixed service Tier 4 licences with the opportunity to apply for new flexible use licences in all service areas in which they have satisfied their conditions of licence, including the spectrum implementation requirements as set out in Annex A of the *Decisions Concerning the Renewal of 2300 MHz and 3500 MHz Licences*.[24] However, Rogers believes that no more than one-third of the spectrum held by an eligible incumbent should be required to be returned to the Department. A return of one-third of spectrum by incumbent licensees in exchange for flexible use licences aligns with the precedent established by the Department in the 2500 MHz transition. Further, a return of one-third of 3500 MHz spectrum is more stringent than regulators in other jurisdictions have required, such as the U.K. and Spain, who will permit incumbent 3500 MHz licensees to retain all their spectrum and implement 5G in the band.[25]

23. The successful implementation of 5G technology and applications in the 3500 MHz band will contribute to the successful development of the IoT, both for consumer-oriented applications and those that cater to industries. 5G is expected to enable a

[23] Industry Canada, *Decisions Regarding Policy Changes in the 3500 MHz Band (3475-3650 MHz) and a New Licensing Process (DGSO-007-14)*, December 2014, para. 39 (see also Decision 6).
[24] Industry Canada, *Decisions Concerning the Renewal of 2300 MHz and 3500 MHz Licences (DGSO-004-13)*, November 2013, *Annex A — Tier 4 Deployment Requirements for 2300 MHz and 3500 MHz Licences*; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10705.html#annexA
[25] LYA Report, p. 19.

wide array of applications spanning many sectors, including manufacturing, resource development, agriculture, transportation, health care, public utilities, and education. It will enable mission-critical applications, industrial automation, drone control, new medical applications, and self-driving cars.[26] As a result, 5G has the potential to truly transform the way many industries operate, enabling new services and applications, transforming business models and creating new opportunities. For these reasons, governments around the world view the implementation of 5G as a strategic tool for enhancing national competitiveness and prosperity.

24. Rogers considers itself a major enabler of these necessary developments. Rogers is willing to take the necessary risks by investing in this crucial new technology that will position Canada for success. In fact, Rogers has already invested heavily in developing the 3500 MHz band in Canada through our involvement in the Inukshuk Wireless Partnership (Inukshuk). Inukshuk is a partnership between Rogers and Bell Canada (Bell) whereby the partners have jointly built and operate a fixed wireless network that extends across Canada.

25. The Inukshuk partners have taken significant risks and made substantial investments in developing the 3500 MHz band so that the benefits of fixed wireless broadband services have been broadly deployed across Canada. The partners have invested hundreds of millions in extending the network to approximately 19.7 million Canadians. An additional 1.6 million Canadians have access to fixed wireless broadband services provided by two companies[27] to whom Inukshuk has agreed to subordinate some of its 3500 MHz spectrum.

26. In making these substantial investments, Inukshuk has fully satisfied the implementation of spectrum usage condition for every one of the 3500 MHz licences that it holds, despite the lack of a vibrant ecosystem for the band, and in the face of the significant risk and ongoing uncertainty surrounding the technology, future band plan, and future policy. In recognition of this, the Department has renewed Inukshuk's licences every year since the initial licence terms for these licences expired, starting in 2014, and Inukshuk has continued to invest through this period.

27. Rogers is committed to making further substantial investments in the 3500 MHz band in order to leverage all of the advantages of an internationally compatible band plan for the implementation of advanced new 5G wireless broadband services.

28. Rogers, in particular, requires 3500 MHz spectrum in order to compete with Bell and Telus (Belus). The combination of the Belus joint network, auction caps, and set-

[26] Rysavy Research LLC, *Mobile Broadband Transformation – LTE to 5G*, August 2016, p.25.
[27] Corridor Communications Inc. (CCI) and NetSet Communications.

asides has skewed the competition for spectrum in Canada. Rogers is the only national network competitor to Belus and requires similar spectrum resources to be competitive. Facilities-based competition between the two national networks is the reason that Canadians benefit from networks that are "in the top tier of global 4G performance."[28] In order to continue and enhance facilities-based competition and enable Canada to be a leader in 5G deployments, Rogers must have sufficient 3500 MHz spectrum holdings.

29. For these reasons, providing incumbent 3500 MHz licensees currently holding fixed service licences with the opportunity to apply for new flexible use licences for two-thirds of their existing bandwidth in all service areas in which they have satisfied their conditions of licence should be a key component of the Department's transition policy. The Department established this precedent in the 2500 MHz transition where only 190 MHz of spectrum was available.[29] The proposed 3500 MHz band plan is 200 MHz and the Department can take immediate steps to increase this to a total of 300 MHz of flexible use spectrum available to network operators. Even with current licensees retaining two-thirds of their current spectrum, more than half of the new 3500 MHz band would be available for competitive licensing in every service area.

30. Allowing incumbent 3500 MHz FWA licensees to retain two-thirds of their spectrum would therefore not impair other carriers' ability to obtain the spectrum they need as competitors in Canada. This approach will enable the successful development of multiple competing 5G networks in Canada.

Pro-Competitive Measures for Future Auction of 3500 MHz Spectrum

31. The competition issues facing the Canadian wireless industry require a more holistic approach than a simple consideration of a set-aside. Promoting competition is not simply a matter of offering access to spectrum on preferential terms for certain parties. The market has evolved considerably since Industry Canada's initial set-aside in the 2008 AWS-1 auction. Since then, several new entrants went bankrupt while others were purchased. Meanwhile, Bell and Telus (Belus) formed a network sharing arrangement, and Bell acquired MTS. Canada now has four strong competitors in each market supported by two national wireless networks (Rogers and Belus) and, in most provinces, a third regional network supporting a fourth retail competitor. As a result, the state of competition is markedly different than a decade

[28] Open Signal, *State of Mobile Networks: Canada (January 2017)*.
[29] Industry Canada, *Decisions on the Transition to Broadband Radio Service (BRS) in the Band 2500–2690 MHz and Consultation on Changes Related to the Band Plan*; https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09882.html.

ago and requires a broader set of policies than simply reserving spectrum for particular qualified parties.

32. Previous set-asides have come at a significant cost. They have driven up spectrum costs dramatically against Canada's peers, costs which are borne not just by operators but also wireless subscribers, and the economy in general. In fact, since 2008, Canadian operators have paid roughly US$350 per person for spectrum, compared to under US$200 in the United States and just over US$50 in the United Kingdom, making Canada the highest spectrum spend per person in the world for the 4G era.[30] More importantly, they have skewed auction results, causing large variances in what different operators pay. This directly affects the ability of carriers to invest, and thereby compete with one another, especially as facilities-based operators are preparing for deploying the next generation of wireless technology. As the 600 MHz auction looks set to continue the trend, ISED must seriously assess whether such measures remain necessary in future auctions such as the 3500 MHz band or the mmWave bands. The main beneficiaries of set-asides have been speculative acquirers of spectrum who have subsequently sold it for a profit. There appears to be an unintended policy outcome that at a time when the Department has asked the CRTC to look into lower cost wireless options for consumers, ISED spectrum policies continue to drive the cost of one of the most critical inputs, spectrum, much higher for national carriers.

33. Since 2008, the Department has been focused on introducing new competition in the mobile wireless market. This objective has evolved to ensuring there are four strong competitors in each area of Canada. Looking at the competitive landscape today, this goal has been achieved and there is a strong competitor to the national carriers in every region. These fourth carriers are all part of established telecommunications companies that are among Canada's largest providers of quad play services, including telephony, television, internet, and mobile services.

34. It is time to retire set-asides. Several jurisdictions initially used spectrum aggregation rules to support new entry in the wireless industry and then subsequently allowed those carriers to compete on their own. For example, both the U.K. and Denmark had set-asides reserved for a new competitor. However they both ended such privileges over time. In the U.K., Ofcom used set-asides and caps in 2000 and 2013 respectively but their upcoming auction does not reserve any spectrum for new entrants. In Denmark, the wireless carrier "Three" which entered the market with a 3G licence, benefited from a set-aside of 900 and 1800 MHz spectrum in 2010. The

[30] GSMA, *Effective Spectrum Pricing: Supporting better quality and more affordable mobile services*, Figure 11, p.29; https://www.gsma.com/spectrum/effective-spectrum-pricing/

Danish authorities subsequently held open auctions afterwards, allowing Three to compete on its own without artificial support. Despite an open auction, Three still won spectrum in 2016 against the incumbents. It is time Canada followed suit and allowed the regional carriers, who are well capitalized, to compete on their own.

35. All of ISED's recent auction formats provided the same strategic opportunities for set-aside-eligible bidders to drive up the prices paid for non-set-aside spectrum, and this is also true of the auction format that will be used for the 600 MHz auction. These higher spectrum costs are ultimately borne by consumers and negatively impact affordability for all Canadian mobile subscribers and generally hurt competition in the mobile industry. Rogers therefore strongly recommends that the Department not set aside any spectrum in the upcoming 3500 MHz auction.

36. Finally, innovation policy in Canada's wireless space must also consider competition issues beyond spectrum if the Department wishes to stimulate investment in innovative new technologies such as 5G. Spectrum is the lifeblood of mobile networks but spectrum is just one required ingredient for 5G and advanced connectivity. Access to infrastructure is also essential. ISED can increase competition by ensuring that any infrastructure and rights-of-way held by municipalities, hydro utilities, and local telephone companies are made available to all other competitors. The Department should also ensure access to urban real estate (municipal and private sector) for new 5G micro sites (poles, lamp posts, street furniture, etc.) is available. Fair and reasonable access to the public and private infrastructure is essential to the successful deployment of small cell technology required to support 5G and the Internet of Things.

37. The remainder of Rogers' comments will respond to the specific issues raised in the Consultation.

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.

38. Rogers agrees with ISED's assessment of the timelines for the development of an equipment ecosystem for 5G in the 3500 MHz and 3800 MHz bands.

39. Our view is that the equipment ecosystem for 5G in the 3500 MHz band is advancing rapidly and that this band will be one of the first 5G bands to be

commercially deployed in many nations. This activity is complimented by broad, international regulatory support for making this band available for primarily mobile commercial 5G services. Development and trialing of 5G equipment in the 3500 MHz band includes Canadian operators, where a number of facilities-based network operators have been testing 5G technologies using 3500 MHz spectrum. Rogers is actively testing 5G and investing in the modernization of our network to be 5G-ready.[31]

40. While the 3500 MHz band is expected to be a global pioneer band for 5G services, the equipment ecosystem for 5G in the 3800 MHz band is somewhat behind the 3500 MHz band. 5G technical standards have been developed that cover the upper portion of the 3800 MHz band (above 3800 MHz) but it does not yet have the same level of international regulatory support as the 3500 MHz band.

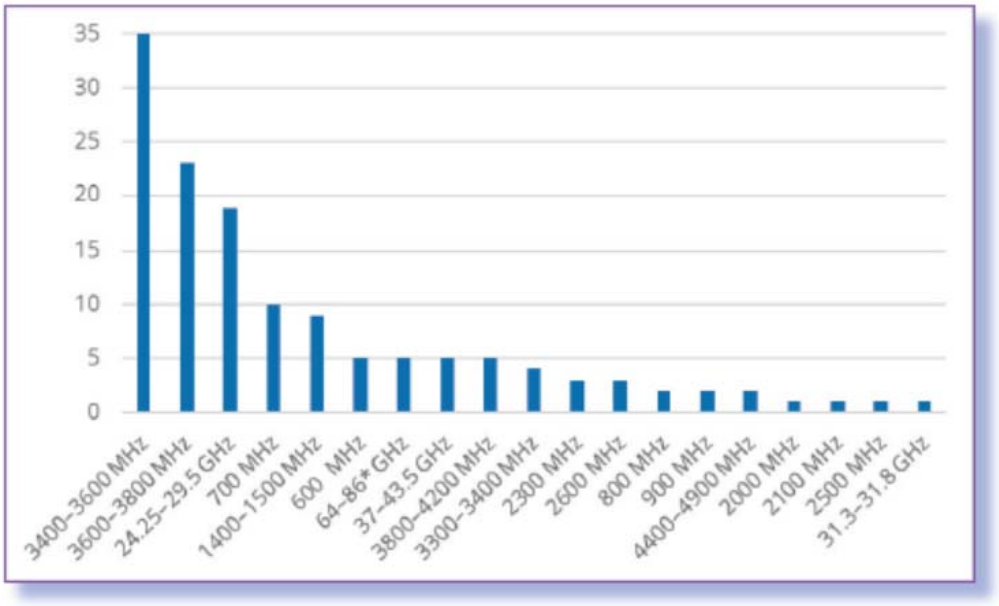
41. Further to the evidence provided in the Consultation document by the Department, there is additional evidence for this view in a report published by the GSM Suppliers Association (GSA), which is a trade association of equipment suppliers for the mobile network operator community. The GSA published a report in January 2018 that stated:

> Worldwide, in terms of total activity, the most common frequency band being considered for use for 5G technology is the 3400–3600 MHz band. At present 32 countries have either announced auctions in that band or are holding consultation talks (this figure excludes countries with operators granted temporary testing licences, accounted for separately under our trials analysis).
>
> The next most common band is the 3600–3800 MHz range and then the 24.25–29.5 GHz range with 20 and 17 countries auctioning, or consulting on use of, this spectrum respectively. At present, telecom regulators around the world are either auctioning or considering auctioning spectrum in 18 different spectrum bands for future 5G services, ranging from 600 MHz to 64–86 GHz.[32]

42. Figure 1, below, shows a count of countries where there is regulatory 5G activity, per band, based on regulator proposals, consultations, or spectrum allocations. Note that these counts exclude countries where there are temporary allocations for testing and trialing purposes.

[31] Emily Jackson, *National Post*, "Rogers, Ericsson to test 5G technology in Toronto, Ottawa", https://business.financialpost.com/telecom/rogers-ericsson-to-test-5g-technology-in-toronto-ottawa.
[32] GSA, *Spectrum for 5G: Plans, Licences and Trials*; https://gsacom.com/.

Figure 1. Drivers for Traffic Increase beyond 2020

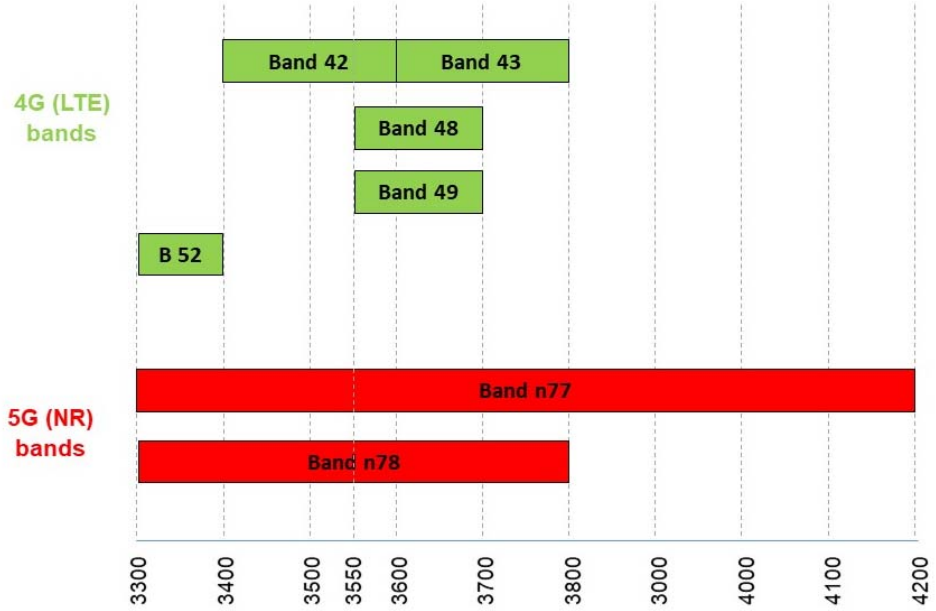


Source: Excerpt from January 2018 GSA report, *Spectrum for 5G: Plans, Licences and Trials*, showing the greatest regulatory activity for 5G occurring in the 3400-3600 MHz and 3600-3800 MHz bands. There is less regulatory activity in the 3800-4200 MHz and 3300-3400 MHz bands at this time.

43. In addition to regulatory activity, there is significant activity in the standardization and equipment manufacturer spheres towards developing 5G ecosystem in the 3500 MHz and 3800 MHz bands.

44. In standardization, Third Generation Partnership Project (3GPP) has developed standards for both 4G Long Term Evolution (LTE) and 5G New Radio (NR) technologies in the 3500 MHz and 3800 MHz bands, as shown in Figure 2. Note that these bands are all Time Division Duplex (TDD) bands.

Figure 2. 3GPP standardized bands for 4G & 5G in 3500 MHz & 3800 MHz



Source: Rogers' summary of 3GPP standardized bands.

45. As depicted in Figure 2, the 3GPP 4G LTE band standards include:

- Band 42, European band (3400-3600 MHz);
- Band 43, European band (3600-3800 MHz);
- Band 48, U.S. "CBRS" band (3550-3700 MHz) for conventional operation;
- Band 49 U.S. "CBRS" band (3550-3700 MHz) for licensed assisted access mode operation; and,
- Band 52, regional band (3300-3400 MHz).

46. As depicted in Figure 2, 3GPP 5G NR band standards include:

- Band n77, initially a Japanese band, later a global band (3300-4200 MHz);
- Band n78, global band (3300-3800 MHz); and,
- Band n79, regional band (4400-4900 MHz) [Note, not shown in Figure 2].

47. In addition, Rogers notes that CITEL is developing a new 3300-3700 MHz Time Division Duplex (TDD) band plan; see CITEL RECOMMENDATION PCC.II/REC. 54 (XXIX-17) *Frequency arrangements for the terrestrial component of IMT in the bands 3 300-3 400 MHz, 3 400-3 600 MHz and 3 600-3 700 MHz, or combinations thereof*

(November 2017), which could assist in developing another globally harmonized band plan.[33]

48. As for equipment manufacturers, Rogers is aware of significant 5G product development in both infrastructure and user equipment. Most product roadmaps from infrastructure and user equipment vendors call for product to be available soon in the 3500 MHz bands, with less product to be immediately available in the upper 3800 MHz bands. However, it is vitally important to clarify that the 3500 MHz 5G equipment that will be immediately available will be Band n78, covering the 3300-3800 MHz frequency range. It is the equipment ecosystem covering the 3800-4200 MHz frequency range that will follow on.

49. In summary, Rogers sees some differences in the timelines for the development of ecosystem in the 3500 MHz and 3800 MHz bands. We see the availability of 3500 MHz ecosystem (3300-3800 MHz) as imminent (within the next two years), and the availability of the upper 3800 MHz ecosystem later (beyond two years).

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

50. Rogers supports the Department's proposal to add a primary mobile allocation to the 3450-3475 MHz band. As stated in the Consultation, making this change would immediately make it possible to expand the amount of spectrum available for flexible use services to at least 200 MHz.[34] Additional changes could make 300 MHz immediately available for exclusively licensed flexible use, as discussed below.

51. We also support the proposal to remove the radiolocation allocation in the 3450-3500 MHz band, given there are no current radiolocation users in this portion of the band and that it will enable flexible use across the entire 3450-3650 MHz frequency range in Canada,[35] or 3450-3750 MHz range as proposed by Rogers.

[33] CITEL, Minutes of Meeting XXIX, October 2017; https://www.citel.oas.org/en/Pages/PCCII/Final-Reports.aspx.
[34] ISED, *Consultation*, para 31.
[35] ISED, *Consultation*, para 32-33.

52. We further support the proposed changes to the Canadian Table of Frequency Allocations, including the suppression of footnote C15 (CAN-14).

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

53. Rogers supports the proposal to allow flexible use in the 3450-3475 MHz band. As 5G wireless access technologies will operate in both fixed and mobile modes of operation, flexible use is the optimum model for all the bands in this Consultation. Flexible licensing allows network operators to evaluate market conditions and deploy the best-suited technology to meet demand, whether fixed services or fixed and mobile access.

54. We recommend that the service rules, when adopted, be aligned across the entire 3450-3650 MHz band (3450-3750 MHz) to provide maximum flexibility to operators and service continuity to users.

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.

55. Rogers agrees with ISED's assessment that new technologies and techniques are being developed that could allow spectrum sharing between radiolocation and other services in the future.[36] However, the technology is still unproven and it will be many more years, at least, until these systems progress enough to be effective in real world conditions. The Department should not pursue any dynamic access (nor opportunistic access) database system in 3400-3450 MHz and instead focus on providing flexible use licences with geographic exclusion zones, limited to coastal areas that may be impacted by naval radars.

56. Spectrum sharing database systems are being developed to support the U.S.'s Citizens Broadband Radio Service (CBRS) band. However, there is still substantial uncertainty around how effective these systems will be in real world conditions and great concern that this will limit the 3500 MHz band's ability to fully deliver 5G

[36] ISED, *Consultation*, para 38.

benefits to U.S. consumers. It is further important to highlight that due to incumbent military and federal users, the CBRS shared access regime may be the only way to provide U.S. mobile network operators access to the 3500 MHz band. It is not optimal in any way and more an option of last resort to U.S. regulators. No such incumbents exist in Canada across the broader 3500 MHz band. Thus, a CBRS-type spectrum sharing regime, and the added complexity and cost it brings, does not provide benefits in Canada.

57. Instead, the Department should focus on the use of exclusion zones to foster spectrum sharing in 3400-3450 MHz. Exclusion zones are geographic territories in which sharing of spectrum is not permitted, or is permitted with specific constraints placed on the secondary user. Rogers expects that exclusion zones for the 3400-3450 MHz band, if any, would be limited to coastal areas, to protect Canadian and Allied naval radar systems, and around military bases, to protect Canadian and Allied army and air force radar systems.

58. Another possible technique is the implementation of a guard band. Although less spectrally efficient than previous alternatives, it may be an appropriate solution to consider in certain cases.

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.

59. As noted above, the Department previously determined that all existing 3500 MHz licensees that are in compliance with all existing licence conditions will be eligible for a new spectrum licence under the future 3500 MHz flexible use policy.[37]

60. With an expanded band plan that includes a total of 300 MHz for initial flexible use licences, the optimal option is that the Department should allow existing 3500 MHz licensees to retain all of their spectrum. This would still provide a minimum of 120 MHz of spectrum in every service area to facilitate additional competition in the Canadian wireless marketplace, while also providing for the continuation of existing services and the availability of new 5G services for all Canadians. Retaining all of their spectrum would be justified, given the substantial investments that have been made in this band by incumbent 3500 MHz FWA licensees, despite the lack of a

[37] Industry Canada, *Decisions Regarding Policy Changes in the 3500 MHz Band (3475-3650 MHz) and a New Licensing Process (DGSO-007-14)*, December 2014, para. 39 (see also Decision 6).

vibrant ecosystem, and in the face of the significant risk and ongoing uncertainty surrounding the technology, future band plan, and future policy for the band.

61. At a minimum, the Department should follow the precedent established in the introduction of flexible use in the 2500 MHz Broadband Radio Service Band. ISED, then Industry Canada, set a precedent by requiring a one-third return of spectrum to the Department as part of the adoption of a new band plan.[38] This was a fair balance to enable the introduction of additional competition from national and regional carriers, including smaller, rural operators, as was subsequently shown in 2015's 2500 MHz and 2018's Residual Spectrum Licences auctions.

62. If the Department immediately expands the 3500 MHz band to 300 MHz for exclusive flexible use licensing, this will provide a minimum of 180 MHz to be available for the future 3500 MHz auction process in each service area. This provides a minimum of 50% more spectrum available in the auction process for each service area than to incumbent licensees. This ensures all of the Department's goals of the continuation of existing services, competition in the Canadian marketplace and availability of new 5G services for Canadians. Allowing incumbent licensees the ability to exchange their current 3500 MHz FWA spectrum licences for flexible use licences and retaining two-thirds of their spectrum in each service area, rounded to the nearest whole block, is the minimal option ISED should take.

63. For clarity, incumbent FWA licensees should also be eligible to participate in any competitive licensing process in order to complement their current holdings or expand service into new licence areas.

64. In our submission on 3500 MHz in 2014, we proposed that the Department adopt the same rules for the introduction of flexible use at 3500 MHz, i.e. a return of one-third of the spectrum.[39] The incumbents, including Rogers through the Inukshuk Wireless Partnership, have made very significant investments in deploying fixed wireless access in Canada in both urban and rural areas using the latest technology standards, TDD-LTE. In many cases, this network equipment is upgradeable to full 5G standards for flexible use. Combined with a band plan of 300 MHz of spectrum for exclusive licensing, such a policy is fully justified when compared to the 2500 MHz transition policy, where a total of only 190 MHz was available.

[38] Industry Canada, *Decisions on the Transition to Broadband Radio Service (BRS) in the Band 2500–2690 MHz and Consultation on Changes Related to the Band Plan*; https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09882.html.
[39] Inukshuk Comments, *Consultation on Policy Changes in the 3500 MHz Band (3475-3650 MHz) and a New Licensing Process in Rural Areas,* para 15.

65. As noted above, Rogers, in particular, requires 3500 MHz spectrum in order to compete with Belus. The combination of the Belus joint network, auction caps, and set-asides has skewed the competition for spectrum. Further, as a result of the unintended consequences of auction rules that result in massive tax-payer subsidies to some of Canada's largest telecommunication conglomerates (e.g., Shaw and Quebecor), the costs of spectrum for national carriers have been increasing since the 2008 AWS-1 auction. Such policy actions have undoubtedly contributed to the GSMA's findings that identified Canada as having the highest spectrum spend per person in the world over the last decade.[40] While spectrum is undeniably a valuable public resource, it must be recognized that high spectrum prices are bad for the Canadian economy, the wireless industry and for consumers and businesses, who ultimately pay for them.

66. In regards to the options presented in the Consultation, Option 1 is the superior of the two.

> **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.

67. As the Department states, Option 1 generally provides more spectrum to those with larger holdings.[41] As such, it will recognize the significant spectrum investments that some licensees have made in both auctions and in the secondary market, not to mention their ongoing investments in providing service. In addition, Option 1 still ensures that all current licensees receive a minimum amount of 20 MHz in any licence area, which the Department believes is sufficient for small service providers in rural areas to maintain service offerings in the new band plan.[42] As such, this option would generally result in between 120 and 140 MHz in each service area for a future licensing process. Further, Option 1 could see up to 220 and 240 MHz of spectrum per licence area should ISED immediately increase the amount of spectrum available for exclusive licensing to 300 MHz (3450-3750 MHz).

[40] GSMA, *Effective Spectrum Pricing: Supporting better quality and more affordable mobile services*.
[41] ISED, *Consultation,* para 47.
[42] ISED, *Consultation,* para 47.

68. However, such an option is sub-optimal for ensuring 5G facilities-based competition between the national carriers and does not respect the ongoing investments current licensees have made. The Department should instead allow FWA incumbents to retain two-thirds of their current holdings. Combined with the Department immediately expanding the 3500 MHz band to 300 MHz for exclusive flexible use licensing, this would still provide a minimum of 180 MHz to be available for the future 3500 MHz auction process in each service area.

69. Should ISED decide to adopt Option 2, it should recognize the actual nature of the licensees. As the Department is aware, Inukshuk, the largest holder of 3500 MHz licences, is a partnership between Rogers and Bell. Rogers and Bell, however, are the true beneficiaries of the licences, each independently offering service. All the conditions attached to the licences are the responsibilities and obligations of the two partners. ISED has always treated Rogers and Bell as the de facto licensees. This treatment should be extended into the re-designation of the licences. Rogers and Bell should each be considered licensee to half the spectrum held by Inukshuk and then have Option 2's formula applied. The Department should be consistent in its treatment of the licences.

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.

70. In order to best ensure the continuation of existing services, competition in the Canadian marketplace and availability of new 5G services for Canadians, the Department should provide incumbent 3500 MHz licensees currently holding fixed service Tier 4 licences with the opportunity to apply for new flexible use licences for two-thirds of their 3500 MHz spectrum, rounded to the nearest whole block, in all service areas in which they have satisfied their conditions of licence, including the spectrum implementation requirements as set out in Annex A of the *Decisions Concerning the Renewal of 2300 MHz and 3500 MHz Licences*.[43] As highlighted above, regulators in other jurisdictions, such as the U.K. and Spain, are permitting incumbent 3500 MHz licensees to retain all of their spectrum and implement 5G in

[43] Industry Canada, *Decisions Concerning the Renewal of 2300 MHz and 3500 MHz Licences (DGSO-004-13)*, November 2013, *Annex A — Tier 4 Deployment Requirements for 2300 MHz and 3500 MHz Licences*; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10705.html#annexA

the band.[44] As such, Rogers believes that the return of one-third of the spectrum held by an eligible incumbent should be required to be returned to the Department is more than reasonable based on domestic and international precedent.

71. If the Department increases the amount of spectrum immediately available for exclusive licensing to 300 MHz, this will result in a minimum of 180 MHz of spectrum being available for competitive licensing in each service area. There would be 50% more spectrum available through competitive licensing than incumbent licensees would receive in new flexible use licences. A return of one-third of spectrum by incumbent FWA licensees would ensure that all of the Department's policy objectives of innovation and investment in the latest 5G technologies, facilities-based competition amongst multiple providers, and the timely deployment of services across the country would all be met.

72. For clarity, incumbent licensees should also be eligible to participate in any competitive licensing process in order to complement their current holdings or expand service into new licence areas.

73. As the Department continues to expand the band plan for exclusive flexible use licensing up to 4200 MHz, this will result in up to an additional 450 MHz of spectrum – potentially up to a total of 630 MHz – being available through competitive licensing processes. This would mean that nearly 90% of spectrum in the 3500 and 3800 MHz bands would eventually be made available through new competitive licensing processes for the flexible use licences, in addition to the competitive licensing processes used to award much of the original 3500 MHz FWA licences.

74. Using this approach of a one-third return of FWA licences for new flexible use licences for the transitioning of the 3500 MHz band would be justified, given the substantial investments that have been made in this band by incumbent licensees, despite the lack of a vibrant ecosystem, and in the face of the significant risk and ongoing uncertainty surrounding the technology, future band plan, and future policy for the band.

75. As noted above, Inukshuk has taken significant risks and made substantial investments in developing the 3500 MHz band so that the benefits of fixed wireless broadband services are available across Canada. Inukshuk's fixed wireless broadband network is one of the largest of its kind in Canada. The partners have invested hundreds of millions in extending the network to approximately 19.7 million Canadians. An additional 1.6 million Canadians benefit from the fixed wireless broadband services provided by companies to whom Inukshuk has agreed to

[44] LYA Report, p. 19.

subordinate some of its 3500 MHz spectrum. Inukshuk has fully satisfied its conditions of licence, including the spectrum implementation requirements, for every one of the 3500 MHz licences that it holds. In recognition of this, the Department has renewed Inukshuk's licences every year since the initial licence terms for these licences expired, starting in 2014, and Inukshuk has continued to invest through this period.

76. Rogers is committed to making further substantial investments in the 3500 MHz band in order to leverage all of the advantages of an internationally compatible band plan for the implementation of advanced new 5G wireless broadband services in the band.

77. For these reasons, allowing eligible licensees to retain the majority of their spectrum is justified. It would also be consistent with the approach taken by the Department in similar circumstances. For example, in the Department's policy for the reallocation of the 2500 MHz spectrum, the Department permitted eligible incumbent licensees in that band to apply for new flexible use licences for approximately two-thirds of their 2500 MHz spectrum holdings, and the remaining one-third of their holdings was returned to the Department and re-licensed using a spectrum auction.[45] Retaining spectrum in transition policies has played a key role in Rogers' ability to be the sole national competitor to the Belus network, which has benefited all Canadian wireless consumers through facilities-based competition.

78. A return of one-third of spectrum by incumbent licensees will allow the Department to achieve all of its goals for transitioning the 3500 MHz band, including the continuation of existing services, competition in the Canadian marketplace, and availability of new 5G services for Canadians. As an example, in Toronto, the incumbent licensee, Inukshuk, would retain 120 MHz out of the current band plan and there would be 180 MHz available for competitive licensing. Both national wireless networks would than have 60 MHz of 3500 MHz flexible use spectrum, with 180 MHz available through auction.

79. While Rogers believes that the one-third precedent set by the Department in the 2500 MHz transition policy is the fairest option for both incumbent 3500 MHz licensees and ensuring enough spectrum is available for competitive licensing, the Department should fully reject any proposals to return all current 3500 MHz FWA licences. Such actions will penalize all 3500 MHz licensees that have continued to invest and operate networks using the 3500 MHz spectrum in the face of significant

[45] See Industry Canada, *Policy Provisions for the Band 2500-2690 MHz to Facilitate Future Mobile Service (DGTP-002-06)*, March 2006, p. 3; and Industry Canada, *Consultation on Transition to Broadband Radio Service (BRS) in the Band 2500-2690 MHz (DGRB-005-09)*, March 2009, p. 3.

technological challenges due to the lack of a vibrant ecosystem in the current band plan. Rogers echoes the comments of Seaside Wireless Communications in their recent Spectrum Outlook reply comments, when they stated, "Liberating and reassigning this spectrum would be unfair to current licensees, when just two years ago Telus transferred its remaining 3500MHz licenses to Xplornet. It is completely inappropriate for Telus (in particular) now to suggest that spectrum be expropriated and re-auctioned."[46]

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

80. Rogers supports ISED's proposal to use unpaired blocks of 10 MHz in the 3500 MHz and 3800 MHz bands. As the Department states, "The adoption of the proposed band plan does not preclude ISED from licensing blocks as aggregated packages of multiple 10 MHz blocks to facilitate large bandwidth channels for 5G technologies."[47] For clarity, Rogers' support of the proposed band plan of unpaired 10 MHz blocks is contingent on the auction software automatically creating contiguity and combined with the Department facilitating contiguity with flexible licences issued to incumbent 3500 MHz FWA licensees.

81. Although larger blocks would provide superior spectral efficiency and performance compared to 10 MHz blocks, aggregated blocks of contiguous spectrum should be able to provide facilities-based operators with the spectral efficiency and greater throughput that enable 5G technologies to deliver increased performance.

82. According to 3GPP standards, all radio frequency (RF) channels must have an internal guard band to ensure interference free coexistence with adjacent RF channels.[48] Thus, one 20 MHz block would have two guard bands (one above and one below). Two 10 MHz blocks covering the same 20 MHz bandwidth would have four guard bands, one above and one below for each of the two 10 MHz RF channels. Rogers' preliminary assessment is that there could be approximately 10% more spectrum required for guard bands – wasted spectrum in other words – in the case of two blocks of 10 MHz compared with a single 20 MHz block. This would lead to a reduction of throughput of potentially 10% in addition to more

[46] Seaside Wireless Communications Reply Comments, *Spectrum Outlook Consultation*, para 12.
[47] ISED, *Consultation*, para 51.
[48] 3GPP, *TS 38.101-1 – Section 5.3.3 Minimum guardband and transmission bandwidth configuration 3GPP*; http://www.3gpp.org/ftp//Specs/archive/38_series/38.101-1/38101-1-f10.zip. .

complexity in devices, which will reduce performance and increase costs. Rogers' support of using 10 MHz blocks in the band plan is from a licensing policy perspective. However, the Department should ensure that all relevant technical documents, including the Standard Radio System Plan (SRSP) and Radio Standards Specifications (RSS) are developed in such a way that will not impose such an efficiency penalty.

83. Assuming the Department maintains the use of Tier 4 service areas for licensing in the 3500 MHz band, 10 MHz blocks means there will be 172 licence areas with 20 licences per area, equalling 3,440 licences for the proposed frequency range. While this may increase the complexity of auction processes and administrative requirements for both the Department and operators, it should still be manageable in light of the number of licences being auctioned in the U.S. 3500 MHz auction. Further, presuming that licensees in a given service area will be aggregating a number of blocks, the technical and logistical burdens of interference management between operators should be not be greatly different than with larger blocks. This will especially be true in urban or suburban service areas.

84. In more rural areas, 10 MHz blocks may decrease barriers to entry for smaller operators, by potentially making spectrum less costly. Having 10 MHz blocks, especially should ISED immediately open 300 MHz to exclusive licensing as proposed by Rogers, will further increase the amount of spectrum to enhance facilities-based competition in each licence area.

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

85. Rogers agrees that mitigation measures will be required to prevent interference issues with the proposed TDD band plan. Rogers has had first hand experience dealing with interference issues in the current 3500 MHz FWA band. Signals at 3500 MHz can propagate over long distances even without atmospheric issues and we have seen numerous cases of interference at distances over 40 km, some as much as 80 km. The vast majority of our interference experience has been base-station-to-base-station but we have seen issues of interference into customer premises equipment (CPE).

86. Interference between incompatible 4G-equivalent technologies is one issue with which operators must contend. As an example, even though both TDD-LTE and

WiMax (in its various versions) are both TDD technologies and use orthogonal frequency-division multiple access (OFDMA) waveforms, they are not compatible with different radio frequency (RF) channel bandwidths or frame structures. As such, they cannot be fully synchronized; although, with careful attention to sub-carriers and timing offsets, it can help. However, the Department's current Spectrum Management System (SMS) database does not currently allow operators to upload this data, so operators may not know in advance if they will run into issues when expanding their network coverage or deploying new technologies.

87. Going forward, there also exists the potential of new interference challenges for network operators between 4G and 5G technologies. The 5G NR air interface is different from 4G LTE but has been designed by 3GPP with overlay deployments in mind. However, some incumbent 3500 MHz FWA licensees have deployed various types of legacy technologies that may potentially result in greater interference issues in the future. Some or all of the following mitigation measures may be required.

Frequency co-ordination

88. Frequency co-ordination is a key factor in limiting interference issues and not all operators are familiar with the rules defined in SRSP 303.4. ISED should revisit this as part of its broader update of various radio regulations and explore a more simplified approach and strengthen enforcement.

Use of guard bands

89. Licensees with adjacent blocks should be permitted to use external guard bands between blocks to mitigate adjacent channel interference. The use of guard bands should be voluntary except where licence holders cannot agree, in which case ISED may impose the use of a guard band. The size of the guard band should be determined by RABC through industry agreement and should be as small as feasible in order to preserve the greatest amount of useable spectrum.

90. The 3GPP standard for 5G NR specifies the recommended internal guard band for TDD.[49] For a block size of 10 MHz, the recommended minimum guard band ranges from 312.5 kHz to 1010 kHz, depending on the Sub-Carrier Spacing (SCS) used.

[49] 3GPP, *TS 38.101-1 – Section 5.3.3 Minimum guardband and transmission bandwidth configuration 3GPP*.

Use of time synchronization

91. Licensees in the same or adjacent geographic areas will likely need to synchronize the timing of the TDD transmit/receive cycles. This can be done using GPS-based or master clock-based synchronization. Licensees may also need to agree on the transmit/receive duty cycle. The use of synchronization should be voluntary except where licence holders cannot agree, in which case ISED may impose the use of synchronization. Rogers expects that synchronization will be required in most markets in Canada and operators will voluntarily coordinate.

Assignment of common blocks to licensees across adjacent licence areas

92. Licences should be assigned so that licensees hold common channel blocks across licence areas. This will reduce the potential for interference between licensees.

Assignment of contiguous blocks to licensees

93. Licences should be assigned so that licensees hold contiguous channel blocks. This will allow operators to aggregate contiguous blocks of spectrum for superior spectral efficiency and throughput, and also reduce the occurrence of interference between adjacent blocks.

94. In order to maintain and maximize contiguity across the 3500 MHz and future 3800 MHz bands, the Department should be rationalizing the band plans as more spectrum becomes available by mandating spectrum swaps. Blocks obtained in future auctions should automatically be assigned next to the spectrum licences obtained in this auction and through exchange of FWA and flexible use 3500 MHz licences. Since 4G LTE and 5G NR equipment will be frequency agile, this will allow operators to maintain contiguous spectrum across the broader 3400-4200 MHz frequency range. This will have the added benefit of allowing multiple operators to potentially obtain contiguous 100 MHz bandwidths and maximize the benefits of 5G technology.

Use of larger service areas

95. By using Tier 3, rather than Tier 4 service areas, the potential for interference between adjacent licensees will be reduced by reducing the number of boundaries between licensees. Regardless of tier size, Rogers proposes that the boundaries of some service areas should be considered for adjustment to avoid falling in populated areas, such as Ottawa/Gatineau.

Reasonable transmit power levels

96. Transmit power levels should be regulated to allow higher power and broader coverage in rural areas where interference is less likely, and lower power in urban areas where interference is more likely. Rogers notes that 3GPP has standardized High Power User Equipment (HPUE) in certain bands, and we suggest that use of these devices in Canada be carefully monitored to avoid interference.

Use of advanced antenna and radio technologies

97. The use of advanced antenna technologies such as massive Multiple Input Multiple Output (MIMO) and beam forming will allow the network to direct energy to specific users, and minimize the energy to other users. Advanced interference cancellation technologies will allow the radio to detect interference from other service providers, and use schedulers to alter the delivery of data to the user, attempting to find "clean" frames of spectrum. The use of higher order (two-dimensional and three dimensional) MIMO will also help, but we expect these enhancements over time.

Site engineering best practices

98. Licensees should use the following best practices in order to prevent interference into adjacent licensee's territories. This can be done by:
    - using directional antennas, to steer radio energy away from adjacent territory;
    - placing antennas as low on the tower as practical, to minimize radio energy carrying into adjacent territory;
    - judicious transmit power settings, to reduce the amount of energy reaching into adjacent territory;
    - using RF filters to reduce the transmission of out-of-band energy (OOBE);
    - using shared towers, or shared base stations, to facilitate coordination between licensees; and,
    - using Self-Organizing Network (SON) technology, which can allow the network operator to automate the planning, configuration, management, and optimization of the radio network.

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.

99. Rogers supports ISED's 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, especially as such actions will assist the Department in making 300 MHz in the 3450-3750 MHz range immediately available for exclusively licensed flexible use.

100. As the Department states, industry is aiming to make 5G mobile equipment available in the 2019-2020 timeframe and 3500 MHz will be one of the global pioneer bands.[50] Delaying the issuance of flexible licenses until the completion of a 3500 MHz auction in late 2020 or early 2021[51] penalizes incumbents, like Rogers, that have continued to invest in their spectrum holdings despite the lack of a vibrant ecosystem in the current band plan, and in the face of the significant risk and ongoing uncertainty surrounding the technology, future band plan, and future policy for the band.

101. However, delaying the issuance of flexible use mobile licences until the auction has three distinct advantages. First, this will provide enough time for the Department to open the 3400-3450 MHz range to current WBS licensees and begin transitioning them out of the 3650-3700 MHz. Second, it will allow time for a repack of any satellite users in the 3700-3750 MHz frequency range to higher in the C-band or into another band allocated for satellite services. Third, the longer timeframe will assist smaller incumbent 3500 MHz licensees with a smoother transition between the current fixed FWA band plan and the new flexible use one.

102. With the timeframe the Department has proposed, they will be able to open 300 MHz for exclusive licensing and increase the immediate benefit of 5G in the 3500 MHz and 3800 MHz bands for all Canadian consumers and businesses.

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.

103. Generally speaking, Rogers fully supports the use of open bidding for the licensing of mobile spectrum. The use of auction formats with a price discovery mechanism allows bidders to switch between different sets of licences in response to demand expressed by other bidders. Price discovery allows for the proper functioning of market forces to fully determine the outcome of spectrum licensing, which will

[50] ISED, *Consultation*, para 53-54.
[51] ISED, *Spectrum Outlook 2018 to 2022*, Description of Figure 2.

ensure those companies that value the spectrum the most will be able to acquire it and put the spectrum to its highest use. It also makes certain that all bidders pay the true market value of this scarce and valuable resource to the benefit of Canadian taxpayers.

104. The 3500 MHz band will be the first auction of spectrum that provides a balance between offering the wider bandwidths required to generate the fast download speeds of 5G with a medium range propagation. Allowing for price discovery in the 3500 MHz band will also assist bidders in forming their valuations for the mmWave bands the Department is planning to auction the following year.

105. Price discovery mechanisms are also very important because the Department will be looking to auction additional extension bands at currently unknown later points in time. The specific timing of those releases, combined with operators' 5G deployment plans may result in significant variations in valuations. Further, without a condition of licence to ensure contiguity with holdings from future auctions in the band, the value of blocks adjacent to future extension bands will likely be very high as operators try to move towards securing up to 100 MHz of contiguous spectrum that 5G standards support. As such, the Department should publically announce auction timing guidelines for the extension 3500 MHz and 3800 MHz bands and confirm a condition of licence that provides contiguity with licences obtained through transition from FWA to flexible use licences and the initial 3500 MHz auction with future extension band auctions to assist all participants with price discovery and valuations.

106. Whether the Department ultimately selects a simultaneous multi-round auction (SMRA), simple clock auction or combinatorial clock auction (CCA) format, they should ensure the auction has an appropriate pricing mechanism that does not drive prices above the level needed to achieve efficient allocation of the spectrum. An auction that results in an emphasis of revenue raising above a fair and reasonable market price will not achieve ISED's goals to foster an advanced and competitive communications system, with consumers ultimately paying for this excess revenue in terms of higher prices. Further, this is yet another reason why the Department should not create artificial scarcity in the band through the use of set-asides.

107. Using an auction format that includes a price discovery mechanism will make it easier for bidders to interpret competitive dynamics and refine valuations in each service area, and promote a level playing field across participants. This will be especially true if the Department continues to licence the 3500 MHz band and the future 3800 MHz bands on a Tier 4 basis.

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

108. Rogers generally supports the Department's proposed protection and notification provisions for incumbent licensees. We believe the transition plan timelines for the 3500 MHz band will broadly achieve ISED's objectives of providing timely access to flexible use spectrum in order to facilitate the introduction of 5G technologies for Canadians and accommodating the continued provision of existing fixed wireless broadband services to Canadians who rely on them.[52]

109. Current incumbent FWA licensees are providing fixed service to customers, including in outlying or rural areas of some of Canada's most urban Tier 4 service areas. Providing a minimum protection period of 6 months for sites within the large urban population centres and a 10 km buffer zone, along with a minimum protection period of 2 years for all other sites in these service areas, should balance the ability for incumbent users to continue operating until 5G systems are deployed in their specific area and the reality that 5G services are most likely to be deployed first in the largest markets.

110. However, nothing should preclude voluntarily negotiated business arrangements that could result in incumbent licensees in a particular service area, whether it contains a population centre greater than 30,000 or not, from transitioning faster to accommodate the new flexible use licensee deploying sooner.

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.

111. Rogers does not propose any alternative transition plans or timelines at this time but looks forward to the opportunity to offer comment on any provided through the consultation process.

[52] ISED, *Consultation*, para 62.

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.

112. Rogers is confident that the fixed and mobile equipment using 4G LTE and 5G NR technologies will be able to operate with intermittent interference from the sources identified within the 3450-3650 MHz and adjacent bands.

113. As with any new radio technology operating in a new band, there is likely to be a learning curve as equipment manufacturers and network operators adjust to the new environment. It may take several years before fixed and mobile systems are able to operate unimpaired in the presence of radars and other interferers. During that period it may be that operators will be limited in where and when the systems may operate.

114. However, to date, we note that most of the current 5G testing at 3500 MHz in Canada has taken place below 3475 MHz and are unaware of any interference issues from radiolocation. Further, in the many years of operating the Inukshuk network in the 3500 MHz band, including down to 3475 MHz, we have never observed interference from radiolocation services, including any cross-border interference.

115. The U.S. National Telecommunications and Information Administration (NTIA) produced a number of technical reports prior to the establishment of the U.S. 3500 MHz rules.[53] The reports cover various tests that studied potential interference between military radiolocation systems and terrestrial LTE radios in the 3500 MHz band. When reviewing the U.S. NTIA reports that investigated this phenomenon, especially TR-14-506 that specifically addressed the radar-to-LTE receiver issue, Rogers is confident that the performance degradations observed in those trials can be mitigated. Although the NTIA tests did not consider the lower portion (3450-3550 MHz) of the band, we note that in Canada there will be no radiolocation systems in this portion, and so interference should not be problematic.

[53] For instance, see NTIA, *TR-14-499 Effects of Radar Interference on LTE Base Station Receiver Performance*, *TR-14-506 Effects of Radar Interference on LTE (FDD) eNodeB and UE Receiver Performance in the 3.5 GHz Band*, *TR-14-507 EMC Measurements for Spectrum Sharing Between LTE Signals and Radar Receivers*, and *TR-14-517 3.5 GHz Exclusion Zone Analyses and Methodology*.

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.

116. In order to optimize the use of the 3650-3700 MHz band, the spectrum should be reallocated for the new 3500 MHz band for exclusive flexible use licensing. Current Wireless Broadband Service (WBS) licence holders – a single-year all-come, all-served allocation – should be reallocated to the 3400-3450 MHz. Given the current location of the WBS band in the broader 3400-4200 MHz band, and the need to support large bandwidth channels for 5G, it is more efficient to include WBS licensees in an overall transition plan with incumbent FWA licensees.

117. Such a move is optimal for several reasons. Moving current WBS users to the bottom of the new 3500 MHz band will allow for the immediate release of between 250-300 MHz of contiguous spectrum for 5G implementation, if the Department accepts Rogers' proposals. In the long term, it will also facilitate the eventual implementation of 100 MHz blocks by multiple facilities-based flexible use network operators as the Department is able to clear additional 3750-4200 MHz spectrum. The additional spectrum is also a substantial increase to the amount available for the competitive licensing process and incumbent licensees transitioning to the flexible use band plan, which will allow Canadian operators to take more immediate advantage of the 5G ecosystem that will be available globally.

118. As the Department identifies in the Consultation, the current band plan for WBS is outdated and results in restrictions to licensees,[54] which will almost certainly result in changes to align with either the 3500 MHz or the 3800 MHz bands. Such updates to the current WBS band plan will necessitate equipment upgrades, no different than if current WBS operators re-tune their equipment from the 3650-3700 MHz range to 3400-3450 MHz. However, it should be noted that many of the WBS licensees who have deployed 3GPP-based technologies in the WBS band currently, such as Xplornet, Seaside Wireless Communications, etc, should have minimal challenges with network equipment or user terminals moving to the new range. This means that a movement out of the 3650-3700 MHz range should not materially increase the challenges compared to simply altering the current WBS band plan.

119. Further, if the Department is considering eventually deploying a CBRS-type regime in the 3650-3700 MHz range, a proposal that Rogers strenuously opposes due to its harm in creating large, contiguous 5G bandwidths across the greater

[54] ISED, *Consultation*, para 88.

3300-4200 MHz range, it is important to note that WBS licensees would still be required to replace all their legacy infrastructure and user equipment to accommodate a CBRS-type regime. It is illogical and bad policy to require WBS licensees to invest in all new equipment that will negatively impact 5G deployments and services to all Canadians when the same investments could allow them to move to the bottom of the band (3400-3450 MHz) to provide the same service to their customers and improve the ability of 5G network operators to provide service to the majority of Canadians. Again, moving out of the 3650-3700 MHz range should not materially increase the challenges or costs compared to altering the current WBS band plan and/or implementing a new sharing regime. At the same time, moving WBS to the bottom of the band would enable the opportunity for larger contiguous blocks for 5G.

120. Radiolocation interference is a non-issue in Canada, so the vast majority of WBS operators would not be impacted in 3400-3450 MHz. Coastal areas with potential, limited, radiolocation interference are primarily expected to be in Vancouver, Victoria, and Halifax, areas that will be well served by exclusively licensed 3500 MHz operators. Long term, as the technology develops, implementing some form of Spectrum Access Sharing (SAS) database system may eventually allow for WBS services in the 3400-3450 MHz exclusion zones.

121. Further, to the extent that ISED is successful in its efforts to expand the flexible use allocation across the entire 3300-4200 MHz range – and SAS technology is able to solve its technology challenges, WBS service should migrate further down the band to increase the amount of exclusively licensed spectrum. We note that WBS was created not to replace 3500 MHz FWA (now flexible use) but, rather, to complement it, so any additional spectrum recovered should be used for expanded exclusive licensing.

122. For those WBS operators who wish to stay in the 3650-3700 MHz portion of the new 3450-3750 MHz band plan, they will be able to participate in the competitive licensing process. This will also provide them with the opportunity to acquire additional spectrum if required for their business plans. At a Tier 4 licensing level and with numerous blocks across the expanded exclusive licensing plan, smaller operators can still be competitive in their rural markets.

123. Rogers proposes that the same notification and relocation periods that will apply to incumbent 3500 MHz FWA licensees should also apply to incumbent WBS licenses. This will allow smaller operators in remote areas to continue operating in the 3650-3700 MHz frequency range until the spectrum is required by the new exclusive flexible use licensees.

124. As can be seen by the challenges that the CBRS regime will pose to U.S. operators in securing the wide bandwidths needed to gain the full benefits of 5G service, using a database access model in the middle of exclusively licensed spectrum would create massive inefficiency and limit the ability for network operators from securing 100 MHz contiguous bandwidths in the 3500 MHz and 3800 MHz bands. Leaving WBS users in the middle of the 3500 and 3800 MHz band will prevent Canadian consumers and businesses from fully benefiting from the capabilities of 5G in these bands, and impact competition between facilities-based operators. By simply moving current WBS licensees into the 3400-3450 MHz range, this will open an additional 50 MHz of spectrum for exclusively licensed flexible use and provide large, contiguous bandwidths, an optimal outcome for Canadians.

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

125. Rogers believes that, overall, the 3700-4200 MHz band is becoming less important to FSS operations. This view is shared by the Department itself, which recently stated their observation that FSS and BSS services in the C-band were migrating out of the band to higher frequencies to better accommodate higher capacity Internet services and video applications that require larger bandwidths.[55]

126. There are two distinctly different geographic markets for FSS operations in the 3700-4200 MHz band in Canada, and the importance of this band is highly dependent on the geographic area in question. Rogers recommends that for southern Canada, where alternatives to FSS operations in this band are available, ISED should initiate the process of clearing FSS operations as soon as practical, including the immediate movement of any satellite operations in the 3700-3750 MHz range. The entire 3450-3750 MHz frequency range should be made available for exclusively licensed terrestrial flexible use. However, in the northern and very remote parts of Canada, ISED should not consider any changes to FSS allocations for the time being.

[55] ISED, *Spectrum Outlook 2018 to 2022,* para 74.

127. From the CRTC's *Satellite Inquiry Report* (October 2014), we see evidence for declining demand for FSS spectrum in the C-Band, as per the following excerpts from that report.[56]

- Page 30 includes this observation regarding C-band having low levels of demand: "A significant portion of C-band capacity on Telesat's satellites remains available (unused), which could be used by providers of telecommunications services to improve telecommunications services to Canadians."
- Page 39 explains that: "However, a significant amount of this unused C-band capacity requires additional hardware at the earth station to support unused polarization. In fact, most earth stations used by providers of telecommunications services only support one of the polarizations offered on Telesat's Anik satellites." The need to build additional facilities to actually use the capacity – and the financial cost from the extra facilities – may explain why local ISPs cite high satellite transport fees as a reason they cannot provide the previous minimum 5/1 Mbps retail Internet service standard previously established by the CRTC (Page 10).
- Page 8: "These estimates also show the huge difference between satellite transport costs compared to costs of terrestrial transport systems, with satellite transport being hundreds of times more costly than fibre-optic-based transport when compared on a per-Mbps basis."
- This cost penalty for C-band is substantiated on page 41: "The average prices for high-throughput satellite (Ka band HTS) in North America are 1/10 of C-band prices when compared on a per-Mbps basis."
- Page 57 makes this observation: "By far, the most significant change affecting the satellite industry is the availability and adoption of HTS, which are expected to improve Internet service speeds, capacity, and costs. HTS presently use Ka-band spectrum, which allows for narrow (spot) beams and frequency re-use, resulting in high capacity satellites and ultimately much lower costs per Mbps in the delivery of high-speed internet. HTS can deliver more data than legacy satellites, at comparable build and launch costs, resulting in a lower cost per bit of data delivered to the customer."

128. These observations are similar to those found in the U.S. during the FCC's *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*

[56] CRTC, *Satellite Inquiry Report*, http://www.crtc.gc.ca/eng/publications/reports/rp150409/rp150409.htm.

proceeding.[57] The Notice of Inquiry sought comment on ways to expand opportunities for next-generation services wireless broadband services in mid-band spectrum bands, including 3700-4200 MHz. As stated by the Dynamic Spectrum Alliance in their comments, the 3700-4200 MHz band is extremely underutilized.

> The record developed this year in two related proceedings demonstrates that the 3.7–4.2 GHz band is extremely underutilized. The primary cause of this underutilization is the existing "full band, full arc" coordination policy for FSS that dates back to the 1960s. FSS earth stations are licensed to use all 500 megahertz of the band, even though individual earth stations typically use only a small portion of the band.[58] [Footnotes omitted.]

They go on to cite an example of earth stations that are licensed for the entire band but only use a single 23 MHz satellite transponder, meaning as much of 477 MHz around the licensee's facilities are not in use.

129. For all these reasons, FSS operations in the 3700-4200 MHz band have a limited, if any, role in providing telecommunications services in southern Canada. This role will increasingly diminish over time. In these regions, there are a number of alternatives to FSS operations that will make it feasible to substitute an alternative form of connectivity for any incumbent C-band FSS operations.

130. One alternative to the use of FSS is fibre optic cable. For earth stations located in urban areas, where fibre optic is widely available at relatively low cost, FSS could be replaced by fibre optic transmission. Such services will provide higher speeds, lower latencies, and highly available connectivity service that is not impaired by weather, compared to current FSS characteristics.

131. Another alternative is replacing the C-band FSS service with Ka-band or Ku-band FSS service. These newer satellite technologies may offer substantial benefits over the current C-Band service. As noted above in the CRTC's *Satellite Inquiry Report*, the evolution of technology like HTS services will provide increasingly better value and capacity in these alternative reports. Since that report was published in 2014, those predications have proven to be correct, as operators such as EchoStar, IntelSat, SES, Viasat, and others have placed new FSS satellites into service, all of them using some form of HTS and spot beams to boost capacity and improve coverage. By speeding up the transition from legacy C-band satellite services to

[57] FCC, *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz;* https://www.fcc.gov/document/fcc-opens-inquiry-new-opportunities-mid-band-spectrum-0.
[58] Dynamic Spectrum Alliance Comments, *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, pg 6; https://ecfsapi.fcc.gov/file/1002973230881/DSA%20Comments%20Mid-band%20NOI_10022017.pdf.

Ka-band or Ku-band HTS connectivity, the Department will be improving high-speed internet access opportunities for Canadians in remote areas.

132. As the demand for telecommunications services shifts from broadcast, voice, and low speed data to streaming video, broadband data, and Internet services, we see that the limited bandwidth available for satellite services in the 3700-4200 MHz band will become a bottleneck to expanding services and the market will eventually demand a switch to Ka-band and Ku-band facilities. However, that 500 MHz spectrum is nearly equal to the current 648 MHz of licensed commercial mobile spectrum.[59] Freeing up an additional 500 MHz of spectrum would provide multiple terrestrial facilities-based operators the opportunity to maximize 5G technology with 100 MHz contiguous bandwidths and deliver the type of innovative services Canadians want and demand.

133. Rogers recommends that for southern parts of Canada, where alternatives to FSS operations in this band are available, ISED should initiate the process of clearing FSS operations as soon as practical from the entire 3700-4200 MHz range. The Department should take all necessary steps to immediately transition satellite operations out of 3700-3750 MHz in order to exclusively license the entire 3450-3750 MHz band for flexible use to incumbent licensees and 3500 MHz auction participants.

134. In northern Canada, and extremely remote parts of southern Canada, FSS operations in this band can be critically important, and will likely continue to be so for many years to come. Very often satellite communications may be the only viable form of connectivity available in these remote communities, as the great distances make other forms such as fibre optic or microwave radio unviable or prohibitively expensive.

135. The CRTC's *Satellite Inquiry Report* supports this finding. That report contained the following.

> Telesat indicated in its submissions that it is acutely aware of the role that satellite transport services play in the North and the increasing demand for high-speed transport. Telesat noted that it has consistently provided high-quality services with an overall C-band reliability of 99.9858% of in-service time. Telesat also noted that it continues to be a challenge to make a business case

[59] ISED, *Consultation on the Spectrum Outlook 2018 to 2022*, para 11.

> to significantly expand transport services in high-cost/low population areas.[60] [Emphasis added.]

136. As such, Rogers recommends that for northern and remote parts of Canada, where FSS operations in this band are essential to providing telecommunications services, ISED should not consider any changes to the FSS allocations for the time being.

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.

137. Rogers supports efforts by the Department to transition the entire 3700-4200 MHz band for terrestrial exclusive licensing and clearing segments of the band as quickly as practical. ISED should immediately transition all users out of 3700-3750 to expand the initially available exclusively licensed spectrum to 300 MHz.

138. TV-receive only (TVRO) stations and cable head ends that are unlicensed currently may not claim protection from other services but should be allowed to continue operating on a secondary basis in or near large urban areas, defined as Census Metropolitan Areas by Statistics Canada, until the issuance of flexible use licences. Unlicensed earth stations near medium size and smaller urban areas, defined as Census Agglomeration Areas by Statistics Canada, or those located in or close to areas where there is expected to be significant 5G mobile traffic, including event venues, major highways or roadways, mass transit systems, passenger railways, airports, or cruise ship terminals should be allowed on a secondary basis until deployment of service by the flexible use licensee.

139. However, unlicensed TVROs and cable head ends in remote areas or in the Far North should be permitted to submit their technical parameters to ISED and assist in frequency management. These services, and licensed FSS services, can provide critical telecommunication services to those Canadians living in rural and remote areas. Spectrum sharing between services in the C-band should only pertain to those remote areas where C-band satellite services are still a necessity. As per the CRTC's *Satellite Inquiry Report*, alternative satellite bands and

[60] CRTC, *Satellite Inquiry Report*, para 168; http://www.crtc.gc.ca/eng/publications/reports/rp150409/rp150409.htm.

terrestrial services are increasingly making 3700-4200 MHz obsolete in much of southern Canada.

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).

140. The Department should take any and all steps required to optimize the use of the 3700-4200 MHz band in Canada as quickly as feasible for terrestrial facilities-based network operators. There is a broad international consensus that 5G fixed and mobile services are going to play an important role in economic growth and social progress going forward and spectrum in this frequency range will be a key input in early 5G systems.

141. The European Commission Radio Spectrum Policy Group states, "The RSPG strategic roadmap towards 5G for Europe aims to facilitate the launch of 5G on a large scale by 2020, thereby ensuring that the benefits of 5G-based services are available to all European citizens. The vision being that 5G will drive industrial and societal transformation and economic growth in Europe from 2020 and beyond."[61] The RSPG considers the 3400-3800 MHz band to be the primary band suitable for the introduction of 5G-based services in Europe.

142. This view of the broad economic and social benefits of 5G is also shared by U.S.

> Industry analysts also expect 5G to boost high-wage employment, lowering job search, match, and telecommuting costs, perhaps of special value in distressed communities with limited job opportunities. In addition, various traditional infrastructure sectors may benefit from the deployment of 5G service, including energy and utilities (e.g., energy-consuming devices in a grid) and transportation (e.g., 5G-powered traffic management systems), as well as public safety (e.g., integration of video surveillance).[62]

143. Other governments and industry analysts have also expressed similar views.

[61] Radio Spectrum Policy Group, *RSPG16-032 Strategic Roadmap Towards 5G For Europe,* November 2016; http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf.
[62] Council of Economic Advisors, *Economic Report of the President*; https://www.whitehouse.gov/wp-content/uploads/2018/02/ERP_2018_Final-FINAL.pdf.

144. In response, governments have been identifying new spectrum for 5G services. Generally, the approach has been to identify low, mid, high, microwave, and mmWave spectrum, similar to ISED's own approach. This diversity of spectrum will allow mobile operators to offer broad coverage with low band 5G, ultra high capacity in densely populated areas with high and mmWave band 5G, and a combination of coverage and capacity with mid band 5G.

145. Rogers' view is that making adequate amounts of mid band spectrum, spectrum between 1-10 GHz as described in *Spectrum Outlook 2018 to 2022*, is critical to the success of 5G in Canada. This is because there is simply not enough low band spectrum currently available or able to be reallocated to address the capacity and speed needs of Canadians and because higher band spectrum is not likely to provide the necessary coverage for a large country like Canada.

146. The FCC is currently seeking input on a proposal to institute a 4-step, market-based transition program to clear the 3700-4200 MHz band for flexible use, that would appoint a facilitator for the incumbents to oversee their internal negotiations to clear at least part of the band for mobile use.[63] The FCC is also seeking comment on band sharing through overlay auctions, band clearing through incentive auctions, and other alternative mechanisms.[64] What all these proposals have in common is clearing as much of the 3700-4200 MHz range as possible for terrestrial flexible use.

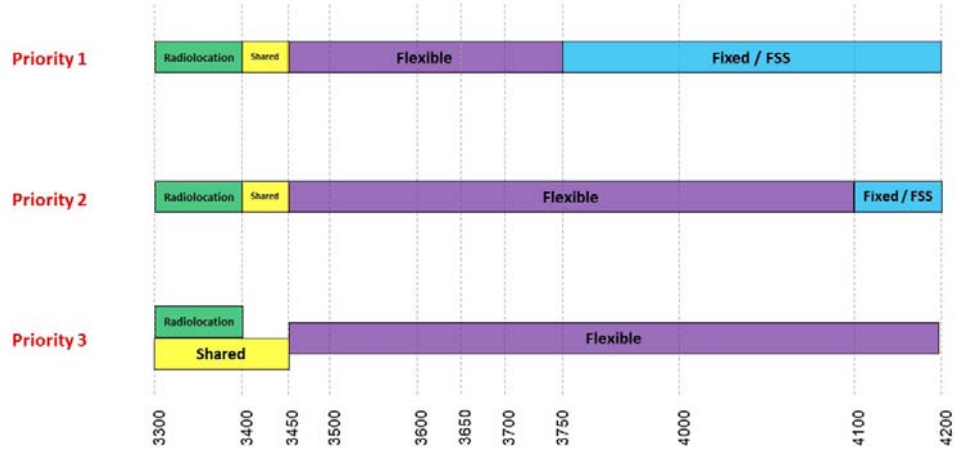
147. The Department should consult to determine if any such transition processes are applicable in Canada for the broader 3700-4200 MHz band in order for Canadian facilities-based terrestrial operators to have access to the large contiguous bandwidths in mid band spectrum that will be critical for 5G. However, the Department has declined to impose market-based solutions or provide compensation for incumbent licensees in similar transitions when incumbents could be easily repacked, like in the 600 MHz transition. As such, the Department should move forward with an immediate reallocation of 3700-3750 MHz for terrestrial flexible use in order to open the entire 3450-3750 MHz range.

148. In the current consultation, ISED has focused on making 200 MHz of 3500 band spectrum available on a Priority 1 basis. Although this is a substantial tranche of new spectrum, it may not be enough to allow operators and service providers sufficient capacity to fully deliver on the economic and social promise of 5G.

[63] FCC, *NOTICE OF PROPOSED RULEMAKING AND ORDER 18-122*, para 68-92.
[64] Ibid, para 93-110.

149. Rogers urges ISED to substantially increase the amount of Priority 1 and Priority 2 spectrum allocated for flexible services by adopting the accelerated program illustrated below in Figure 3. This would provide for an immediate 300 MHz or more available for flexible use. This accelerated program would apply to southern Canada only; northern and remote Canada could be exempt due to dependency on FSS.

Figure 3. Rogers' Proposed Accelerated Spectrum Priorities



Source: Rogers' adaptation of ISED's spectrum priorities in *Spectrum Outlook 2018 to 2022.*

Priority 1 (Planned for Release 2018-2022)

- Upgrade 3700-3800 MHz band to Priority 1 for flexible licensing
- Immediately re-pack affected 3700-3750 MHz FSS operations to upper portion of band, potentially all FSS users in 3700-3800 MHz
- Introduce shared services in 3400-3450 MHz for shared spectrum regime governance development and innovation
- Deadline for WBS licensees to convert to flexible licences

150. Taking such actions would align Canada with Europe and 3GPP to immediately take advantage of Band n78 ecosystem. As a result, a minimal number of existing FSS earth stations would be impacted and it would make over 300 MHz immediately available in the 3500 MHz and 3800 MHz bands for commercial 5G services.

Priority 2 (Begin policy or technical standard development, review uses, international coordination)

- Maintain 100 MHz of FSS spectrum (4100-4200 MHz) for hard-to-relocate services, including any required exclusion zones for those

Priority 3 (Monitor)

- Extend flexible band to 4200 MHz; all FSS earth stations displaced
- Extend shared services band down to 3300 MHz, if sharing technology allows coexistence with radiolocation

151. The Department quickly moving to provide 650 MHz of exclusively licensed spectrum (3450-4100 MHz) in Priority 2 would place Canada at the forefront of 5G spectrum availability in the 3500 and 3800 MHz bands. Enacting the Priority 3 measures would align Canada with ITU radio regulations and with 3GPP band n77 and would maintain Canada as world leader in 5G spectrum availability.

152. As noted above, the accelerated program as depicted in Figure 3 would apply to southern Canada only; northern and remote Canada could be exempt due to its dependency on FSS.

153. In southern Canada, there should be an immediate moratorium on new earth stations in the 3700-4200 MHz frequency range within or near large urban areas, defined as CMAs by Statistics Canada, as well as medium size and smaller urban areas, defined as CAs by Statistics Canada. Further, earth stations should not be located in or close to areas where there is expected to be significant 5G mobile traffic, including event venues, major highways or roadways, mass transit systems, passenger railways, airports, or cruise ship terminals.

154. Any grandfathered earth stations located near these areas should explore site shielding, filters or other interference protection measures so as not to unduly constrain terrestrial 5G deployments. In addition, nothing should prevent commercial negotiation for the relocation of grandfathered sites to assist in the ability of 5G deployment.

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.

155. Rogers fully supports the early introduction of mobile services in the 3700-4200 MHz band to the maximum extent possible. Co-existence issues between mobile and FSS can be worked out and should not delay the introduction mobile services. Canada has the opportunity to lead on this and it should seize the opportunity as part of the Government's broader Innovation and Skills Plan. Releasing additional spectrum in the 3700-4200 MHz band has the dual benefit of allowing more spectrum for competition and creating the additional bandwidth necessary for certain 5G services.

156. In order to provide some regulatory certainty and ensure effective, ongoing facilities-based competition in the mobile industry, the Department should provide greater guidance on which portions of the 3700-4200 MHz band will be auctioned. This is critical in helping operators determine the value of the initial 3500 MHz and 3800 MHz spectrum to be auctioned. Additionally, the Department should include a condition of licence to ensure contiguity of the band as additional spectrum is released, otherwise the value of blocks adjacent to future extension bands will be very high. Further, it could prevent multiple operators from achieving the large, contiguous bandwidths necessary to fully take advantage of 5G technology.

157. Rogers is aware of a number of studies conducted to determine if the 3700-4200 MHz band could be shared between proposed terrestrial, flexible services and incumbent fixed satellite services. One such report was issued by the ITU in 2007, three years prior to the October 2010 approval of IMT-Advanced standards by ITU-R.[65] It considered the possibility of spectrum sharing between IMT-Advanced (what would become "LTE-Advanced", or 4G) and existing FSS satellite/earth station systems.

158. The report concluded that physical separation (in other words, exclusion zones) would be required to allow sharing. To quote the report, "To provide protection of the FSS receive earth stations, some separation distance relative to the stations of the mobile terrestrial network is required. The magnitude of this separation distance depends on the parameters of the networks and the deployment of the two services."[66] The amount of physical separation varied depending on the scenario (in-band co-channel or adjacent channel) but generally was in the "tens of kilometers" range.

[65] ITU, *ITU-R M.2109 Sharing studies between IMT-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 and 4 500-4 800 MHz frequency bands*; http://www.itu.int/pub/R-REP-M.2109.
[66] Ibid, pg 41.

159. Another key conclusion was, "If FSS is deployed in a ubiquitous manner and/or with no individual licensing of earth stations, sharing is not feasible in the same geographical area since no minimum separation distance can be guaranteed."[67] This would be the case for unregistered FSS earth stations.

160. In 2018, another report on this same issue was filed by Ericsson in response to the FCC dockets 17-183 and 18-122. The focus of this report was sharing between 5G systems and FSS in the 3700-4200 MHz range in the U.S. The conclusions of this report could reasonably be extended to Canada as the regulations and technologies are expected to be highly similar.

161. The Ericsson report considered both exclusion zones and database management approaches to spectrum sharing. In Ericsson's submission about the report, they stated the following.

> Specifically, Ericsson analyzed the potential for coexistence between terrestrial base stations and FSS space-to-earth receivers in the 3.7-4.2 GHz band. Its conclusions are applicable to the consideration of 5G air interfaces. Ericsson's analysis shows that the interference from terrestrial base stations is expected to be significantly higher than the interference thresholds at the satellite receiver. The analysis concluded that at least 30 kilometers of separation (best case scenario), and potentially as high as 50-70 kilometers of separation (less favorable conditions), would be needed between a terrestrial wireless base station and a C-band earth station in order for the two services to co-exist on the same spectrum. Considering that most FSS receivers are located in urban/suburban locations, such large separation distances "eliminate possibilities for co-channel sharing in the populated areas."[68] [Emphasis added.]

162. Rogers agrees with Ericsson's recommendations to the FCC that the substantial promise of deploying 5G in this band justifies clearing the band of all fixed and FSS services.

163. Our recommendation is that incumbent FSS C-band operations should be cleared out of the 3700-4200 MHz band with the following possibilities:

- Where there is no viable alternative to C-band satellite delivery, the FSS should be repacked to a smaller portion of the band; or

[67] Ibid, pg 42.
[68] Ericsson Comments, *Report on the Feasibility of Allowing Commercial Wireless Services, Licensed or Unlicensed, to Use or Share Use of the Frequencies Between 3.7-4.2 GHz*, pg. 5; https://ecfsapi.fcc.gov/file/10531134297936/053118%20Ericsson%203_7%20to%204_2%20GHz%20PN%20Comments%20(FINAL)-c.pdf.

- Where satellite delivery is preferred, but not essential, the FSS should be relocated to other satellite spectrum (e.g., the Ka-band or Ku-band); or
- the FSS should be transitioned to another transmission platform (e.g., fibre or fixed service); or
- the FSS earth station should be moved to more remote areas subject to interference protection from new entrants (with fibre or other technologies for backhaul).

164. Rogers thanks the Department for the opportunity to share its views and participate in this consultation process.