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February 16, 2018

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Director, Spectrum Regulatory Best Practices
Innovation, Science Economic Development Canada
235 Queen Street
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Re: Canada Gazette Notice No. SLPB-006-17: Consultation on the Spectrum Outlook 2018 to 2022 Canada Gazette, Part I October 21, 2017

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-006-17: Consultation on the Spectrum Outlook 2018 to 2022* (the Consultation), published in the *Canada Gazette*, Part I, October 21, 2017.

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

Regards,

Howard Slawner
Vice President – Regulatory Telecom
HS/pg

Attach.

Consultation on the Spectrum Outlook 2018 to 2022
SLPB-006-17

Comments of
Rogers Communications Canada Inc.
February 16, 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. Continued and growing access to interference free, exclusively licensed spectrum is needed in order to satisfy Canadians' growing demand for mobile data services. Indeed, additional spectrum is key for enabling the deployment of 5th generation wireless technology, which will also increase the need for more fixed service spectrum to provide backhaul to mobile networks. As Canadians connect more and more devices to their home networks, more unlicensed spectrum will also be needed to support the faster wireline speeds Internet service providers are delivering. As Canada's largest wireless provider, the leader in the Machine-to-Machine market, and with the capability of delivering 1Gbps speeds to our entire wireline Internet footprint, Rogers continues to invest heavily in advanced communication networks and requires access to additional mobile, fixed, and unlicensed spectrum.

E2. Rogers supports Innovation, Science and Economic Development Canada's consultation on the overall approach and planning activities related to the release of spectrum for commercial mobile services, licence-exempt applications, satellite services and wireless backhaul services over the years 2018 to 2022. The Department should look to maximize the use and release of low, mid, high, microwave, and millimetre wave spectrum for new services using a technologically-neutral approach while ensuring reasonable protection of incumbent services in order to enable greater spectrum utilization. Increasing and enhancing spectrum availability is vital to supporting the advanced network speeds, capacity, and wireless innovations that Canadians have come to enjoy and demand.

E3. Providing access to additional flexible use, exclusively licensed spectrum in a variety of frequency ranges will allow providers to increase network coverage and capacity while supporting the deployment of advanced next-generation wireless technologies. Canadians already use their mobile devices far more than users in most other countries, which is a testament to the high quality of mobile wireless networks in Canada. This trend will continue with the ongoing deployment of advanced 4th generation Long Term Evolution wireless networks and increase even more with the arrival of 5th generation technology, which has the potential to revolutionize how we work, study and play. Flexible use, exclusively licensed spectrum will allow operators to deploy fixed terrestrial or fixed or mobile wireless access services based on network needs and market demands, acting as a key building block for advancements in wireless technology.

E4. While all wireless services are facing increased pressure on spectrum resources, the Department should carefully weigh the size and importance of the mobile

industry for the majority of Canadians and Canadian businesses when evaluating competing demands for spectrum, especially in urban and suburban areas. Rogers believes there will be significant demand in Canada for the services provided by terrestrial 5th generation fixed and mobile services, and the potential benefits to Canadians and the economy are substantial. The Department has an important role to ensure that Canada continues to be at the forefront of 5th generation technology innovation and adoption by providing access to the spectrum bands discussed in this consultation as quickly as possible.

E5. Access to spectrum is essential but equally important is access to infrastructure. The Department needs to take steps to ensure a level playing field for infrastructure access if Canada is to become an innovation leader. 5th generation wireless technology will result in a large increase in network base stations and the amount of traffic they carry, all of which must be carried back to the carrier's core network. The Department must work with the Canadian Radio-television and Telecommunications Commission and all levels of government to ensure carriers have access to the poles (hydro and telecom), ducts, streetlights, and municipal property that are needed to place antennas and wires. Further, it is essential that the Department ensure that any Federal, Provincial or Municipal accesses or infrastructure that local telephone companies possess from their monopoly period are similarly made available to all types of carriers in order to increase competition for the benefit of all Canadian businesses and customers.

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-006-17: Consultation on the Spectrum Outlook 2018 to 2022*[1] (the Consultation), published in the *Canada Gazette*, Part I, October 21, 2017.

2. As the Department correctly observes, as the demand for digital connectivity grows, so will the demand for spectrum. The Department should look to maximize the use of spectrum in Canada, including low, mid, high, microwave, and millimetre wave (mmWave) bands, to support the deployment of next-generation connectivity technologies such as 5th generation (5G) wireless networks and systems. Increasing and enhancing spectrum availability is vital to supporting the advanced network speeds and new digital technologies that Canadians have come to enjoy

[1] ISED, *SLPB-006-17: Consultation on the Spectrum Outlook 2018 to 2022* (Consultation); http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11333.html.

and demand. In order to achieve the Department's objective of positioning Canada at the leading edge of the digital economy, ISED should make additional spectrum available, including exclusively licensed spectrum, as rapidly as possible using a technology-neutral approach while ensuring reasonable protection of incumbent services. Such actions will enable greater spectrum utilization and allow Canadian consumers to benefit from wireless innovations. ISED also should look at harmonizing spectrum policy wherever possible with regional and global ecosystems, especially those of the United States (U.S.), to ensure economies of scale and minimize cross-border interference issues. However, it should not hesitate to make spectrum available ahead of international agreements, such as the International Telecommunication Union's (ITU) World Radiocommunication Conference 2019 (WRC-19), when doing so will provide tangible, early adoption benefits to Canadians.

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] While usage is rapidly growing on cellular networks, off-loading of traffic to Wi-Fi networks is an important and growing compliment. The ability to augment facilities-based cellular service with Wi-Fi will become even more valuable as Canadians continue to connect more and more devices to their home Internet networks. Further, ensuring there is enough spectrum for fixed wireless backhaul for the current and growing capacity demands of 4th generation (4G) Long Term Evolution (LTE) is critical to maintaining effective competition with 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%.[3] Wi-Fi and other unlicensed spectrum technologies will continue to augment the world-class, facilities-based wireline and wireless networks that Canadian network operators are constantly expanding. As more spectrum is used for greater bandwidth amounts and number of connections, fixed wireless capacity will become even more crucial to meet the massive backhaul requirements for 5G connectivity and achieving the Department's goals for facilities-based competition.

[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] Ibid.

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 a large wireless and fixed Internet 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 95% of the Canadian population.[4] On the fixed Internet side, over 45% of Rogers' residential Internet base is using speeds of 100 Mbps or higher and our Ignite Gigabit Internet service, capable of delivering 1Gbps speeds, is now available to our entire footprint of over four million homes.[5] Rogers was the first 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) while on the wireline side being the first operator to offer gigabit speed fixed Internet to its entire service area. 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 both licensed holdings and unlicensed spectrum.

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.[6] 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.

[4] Rogers, *Rogers Communications Reports First Quarter 2017 Results*, April 2017.
[5] Ibid.
[6] CRTC, *Communications Monitoring Report 2016*, http://crtc.gc.ca/eng/publications/reports/policymonitoring/2017/cmr5.htm#s50vi.

7. According to the Consultation, there is only 648 MHz of licensed commercial mobile radio spectrum available at present.[7] While the Department is freeing up 70 MHz of spectrum for exclusively licensed commercial mobile use in the pending 600 MHz band, the amount is quite small when compared to the 27,817 MHz of spectrum already available to the satellite industry,[8] 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.

8. 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.[9] 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%. Further, the mobile industry's direct contribution to the Canadian economy was $13.4 billion to GDP, and directly responsible for 31,000 FTEs.[10] On a purely objective comparison, the value of the spectrum 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.

9. The additional licensed flexible use spectrum the Department is proposing to make available in the *Consultation on Releasing Millimetre Wave Spectrum to Support 5G* (5G mmWave Consultation) will be beneficial.[11] However, it must also be noted that the Department is proposing in that consultation to designate 7 GHz of spectrum as licence-exempt, compared to the proposal to open less than 4 GHz of exclusively licensed flexible use spectrum – and that the exclusively licensed spectrum must be shared between terrestrial and satellite users. While terrestrial operators will also be able to make use of licence-exempt spectrum in their networks, exclusively licensed spectrum bands will continue to be a key input for ensuring that service providers can offer a high quality of service that, in turn, allow

[7] ISED, *Consultation*, para 11.
[8] ISED, *Consultation*, Table 3.
[9] 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.
[10] 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.
[11] ISED, *SLPB-001-17: Consultation on Releasing Millimetre Wave Spectrum to Support 5G* (5G mmWave Consultation); http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11298.html.

Canadian companies to take advantage of the latest technologies to better compete globally.

10. ISED can enable new 5G and other connectivity technologies by developing flexible use licensing models for fixed and mobile services in a range of spectrum bands to help bring Canada to the forefront of digital development and adoption through the creation and strengthening of world-leading wireless infrastructure. This Consultation is an important part of ensuring additional low, mid, high, microwave, and mmWave band spectrum (both paired and unpaired) is made available for operators to continue expanding 5G coverage and capabilities. A flexible use licensing model for spectrum bands will allow new technology and innovations to evolve without overly prescriptive requirements, while meeting a variety of different needs and use-cases.

11. However, innovation policy in Canada's wireless space must be more holistic than releasing additional spectrum or simply reducing spectrum costs for non-national carriers 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.

12. Finally, ISED's spectrum policies should consider the future of Canadian over-the-air (OTA) television broadcasters who are being displaced and relocated into other bands. Local television is a foundational element of the Canadian broadcasting system, which provides significant value and is a low-cost means for access to television, in rural and urban markets across Canada. However, systemic changes in local OTA television's business model have posed a significant challenge to the sector's financial health. As recently as 2011, these broadcasters were required to incur substantial costs to transition from analog to digital technology and to implement the current digital television (DTV) allotment plan. These investments have not been fully depreciated. The Department's new DTV allotment plan that incorporates the 600 MHz repacking process affects virtually all OTA broadcasters, meaning that these companies will be required to incur additional substantial costs above and beyond those that they have already incurred to implement the current allotment plan. These costs will further erode the already unsustainable economics associated with the OTA television broadcasting market. The Government should

cover the costs incurred by local television stations to vacate the 600 MHz spectrum in order to accommodate the plan to re-allocate the spectrum.

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

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

14. Rogers supports efforts by the Department to maximize the economic and social benefits that Canadians derive from the use of the radio frequency spectrum resource through the development of policies and licensing frameworks to make additional spectrum available. Having market forces determine the outcome of spectrum licensing ensures 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.

15. ISED should continue to release spectrum in a timely manner to ensure Canadians can continue to access the latest advanced connectivity services and contribute to innovative global technology development. In order to achieve the Department's objective of positioning Canada at the leading edge of the digital economy, ISED should release spectrum to support 5G and other next-generation wireless technologies ahead of ITU World Radiocommunication Conferences when there is an expected radio equipment ecosystem or when it is clear that there will be global standards in the respective bands. Spectrum should be made available as rapidly as possible using a technologically-neutral approach while ensuring reasonable protection of incumbent services to enable greater spectrum utilization and allow Canadian consumers to benefit from wireless innovations.

16. As discussed in more depth below in Q4, Rogers recommends that ISED examine the regulatory impediments that exist which obstruct, slow, or raise the cost of deploying wireless infrastructure. Where impediments are identified, the Department should work with other levels of government and the CRTC to make any changes to legislation, regulatory frameworks, and land use rules to streamline the regulatory process. In the U.S., the Federal Communications Commission (FCC) has recently addressed such issues with FCC *Report & Order 17-153* (17-153). The scope of this proceeding was very broad and covered federal, state, local, and tribal impediments. A key outcome of FCC 17-153 is the elimination of

barriers to the deployment of small facilities, which includes small cell base stations along with associated antenna, tower, and backhaul facilities. Rogers anticipates that a significant portion of our future investments will be in the form of small facilities, especially as we move into the 5G mobile era.

17. Rogers also proposes that the Canadian government consider establishing a collaborative regulatory approach to emerging Vehicle-to-Everything (V2X) technologies. V2X services hold tremendous potential to enhance the capacity and safety of Canada's roadways. ISED should collaborate with Transport Canada to develop a harmonized regulatory environment for both wireless and vehicle regulations. A novel licensing arrangement could be developed wherein commercial mobile operators build and operate V2X facilities under an operating licence that covers all aspects of operation (spectrum, siting, radio regulations, land use, etc.).

18. Rogers further supports the Department when it states that, “the process for making spectrum available should be open, transparent and reasoned to promote predictability and therefore business and investment certainty for stakeholders.”[12] However, consultations for mobile spectrum must be more than simply protecting the regional carriers, who are all large, diversified communications companies that do not require any protection. Spectrum should be assigned to wireless providers to enable their continued growth using objective metrics such as the number of customers being served, spectral efficiency, traffic growth rates, etc.

19. ISED should instead re-focus its attention to the state of competition in the marketplace as a whole, especially between the three national carriers. The continued use of set-asides and caps in recent licensing processes have favoured Bell and Telus. Through the joint national Bell-Telus network (the “Belus network”), they are able to mitigate the impact of ISED’s spectrum aggregation limits by combining their spectrum into a single network. ISED’s efforts to assist the new entrants have unintentionally assisted two of the largest carriers in Canada. The playing field must be re-balanced to foster sustainable competition.

20. While ISED has been successful in introducing new entrants into the Canadian wireless industry, it did come at a considerable cost. Spectrum acquisition costs (including annual fees), particularly for national carriers, are very high in Canada. In fact, since 2001, licensees have spent more than $16 billion on spectrum at auction and in annual fees, with the bulk of auction costs occurring since 2008.[13] This amount does not include the cost of spectrum acquired through transfers (including spectrum sold by set-aside speculators) nor the $1.537 billion reserve

[12] ISED, *Consultation*, para 19.
[13] ISED, *Spectrum Auctions*; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01714.html. Note: $16B is nominal and does not account for inflation. Spectrum fees calculated based on industry holdings.

price for the upcoming 600 MHz spectrum auction. While spectrum is undeniably a valuable public resource, it must be recognized that artificially high spectrum prices are bad for the Canadian economy, the wireless industry, and for consumers and businesses, the end users who ultimately pay for the high spectrum costs.

21. A 2017 report from the GSMA highlighted recent academic work that links upfront input costs to depressed investment and reduced price competition.[14] The report presented evidence linking high spectrum spending with lower quality and reduced take-up of mobile broadband services, and higher consumer prices for mobile broadband data. A central recommendation of the report was that regulators should take great care to avoid actions that could distort auction outcomes and lead to prices that exceed a fair market level. The report also identified Canada as having the highest spectrum spend per person in the world over the last decade. 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. While operators directly pay these costs to the government in auctions, Canadian consumers ultimately bear a significant share of these high costs. If Canadian government policy is to encourage lower broadband wireless costs to end users, reducing spectrum cost is an effective way to "walk the talk".

22. Backhaul licence fees are also too high in Canada and are a major impediment to the efficient use of spectrum for wireless backhaul. Rogers recommends spectrum fees in Canada should be modernized and based on cost recovery, moving towards a U.S. or U.K. model that covers administrative fees and are significantly lower. For example, the annual licence fee for a 1 Gbps microwave radio link in Canada currently costs $14,000. In comparison, the FCC currently charges $700 (Canadian) for a national licence with a 10-year term,[15] making Canadian backhaul fees 200 times more expensive on an annual basis. Deploying more advanced technology with greater bandwidths for a 10 Gbps backhaul link would result in the Canadian fee being $140,000 versus the same $70 annual cost in the U.S., making the equivalent fee 2000 times higher in Canada. The current Canadian pricing model does not give operators sufficient incentive to maximize spectral efficiency; in fact, it penalizes efficient backhaul operators.

23. Further, Rogers recommends that spectrum licence fees in general be based on a fairer basis that rewards users who employ technologies and practices that yield maximum spectral efficiency per unit area. This would encourage users to take advantage of the latest technology developments, such as massive multiple input,

[14] GSMA, *Effective Spectrum Pricing: Supporting better quality and more affordable mobile services*; https://www.gsma.com/spectrum/effective-spectrum-pricing/.
[15] FCC, *Wireless Telecommunications Bureau Fee Filing Guide Effective September 26, 2016*, pg 27; https://apps.fcc.gov/edocs_public/attachmatch/DOC-343611A1.pdf. Note: Fee is USD$545, currency conversion based on spot conversion as of 2017-12-14.

multiple output (MIMO) antennas, spot beam antennas, carrier bonding, beam forming antennas, and others.

24. Rogers notes that ISED is conducting a request for information (RFI) for a Spectrum Monitoring System as part of the Promoting Regulatory Innovation for Spectrum Management (PRISM) initiative. Our understanding of PRISM is that it would allow use of higher frequencies previously thought to be impractical for widespread wireless communication, allow the sharing of frequencies between different uses and providers, and allow greater use of unlicensed frequency bands. Rogers generally supports initiatives aimed at enabling the use of new spectrum bands for wireless services.

25. However, the Department should take a very cautious approach when exploring opportunistic access so as not to negatively affect the advanced mobile networks that already provide connectivity to digital technologies and services that is a defining feature of the digital economy. Technologies and techniques may one day provide new opportunities for optimizing the use of spectrum through intelligent decision-making solutions and geographic/operational awareness of the radio environment. However, opportunistic sharing technology is still years away from commercial deployment and has substantial technical, regulatory, and business challenges to overcome before it can become a reality.

26. Once these technical challenges have been solved, trials should be restricted to bands with open spectrum designations, lightly licensed mobile bands or bands with limited users in restricted geographic areas that will be protected from interference. This will allow the Department to trial new spectrum management technologies and policies in bands that do not pose large risks to incumbent licensees and the extensively deployed communications infrastructure already providing advanced connectivity to Canadians. Given the unproven nature of opportunistic sharing mechanisms and technologies, a cautious approach is especially true when the Department is already looking to increase the amount of flexible uses between different services within licensed spectrum bands. The technical challenges related to opportunistic sharing – and the interference risks to licensees – will be even greater when trying to account for multiple uses in the band (e.g., fixed, mobile, fixed-satellite service (FSS), space research service (SRS), and mobile-satellite service (MSS)). The Department should also recognize the large amount of spectrum already available for unlicensed use vis-à-vis the much smaller amount of licensed cellular mobile radio spectrum.

27. Once trials have proven successful and stakeholders have a better understanding of the implications of the technology, the Department should launch a comprehensive consultation process to ensure such a fundamental change in spectrum planning and usage is in the public interest. Mobile spectrum licensees

have spent over $14 billion at spectrum auctions since 2001 on acquiring exclusive licences and more than an estimated $2.3 billion in spectrum fees since 2004.[16] The total amount of the proposed opening bids for the 600 MHz spectrum nationwide is $1.537 billion, with the actual amount spent likely to be much higher. Licensed operators have invested a further $44.8 billion since 1985 to construct world-class networks and infrastructure to service Canadians.[17] Canadian wireless providers, and other licensees, must clearly understand all of their rights, obligations, and terms of licence upfront.

28. Exclusively licensed spectrum bands are key inputs in current networks and create a more certain spectral environment. This will be crucial as operators roll out 5G infrastructure and overcome any engineering challenges that would result from the unprecedented densities and usage, especially with the usage of mmWave spectrum. These licences should be flexible for service providers to deploy different services including fixed or mobile wireless access or wireless backhaul or fronthaul, or even dynamically change between usage depending on network need and user demand.

29. The Department should also not pursue any dynamic access (nor opportunistic access) database system in the bands where there are no incumbents. The main purpose of a dynamic access database is to protect incumbents that have variable usage conditions (location, time etc.). If there are no incumbents in the band, the additional costs and complexity associated with dynamic or opportunistic access would not be justified. Additionally, if the U.S. or another large region does not adopt any dynamic access database system for a particular band, there would be no economies of scale for the technology. This would make it very costly for a "Made in Canada" solution with seemingly no strong policy reason to do so.

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

30. Rogers agrees that subscribership, traffic growth, and technology advancements will continue to heavily influence the future spectrum requirements for commercial mobile services. Ten years ago, Rogers had 7.155 million postpaid and prepaid wireless customers. A year later, on July 11, 2008, we launched the Apple iPhone

[16] ISED, *Spectrum Auctions*. Note: $14B is nominal and does not account for inflation. Spectrum fees calculated based on industry holdings.
[17] CWTA, *Facts & Figures: Investment and Job Creation in Canada*; https://www.cwta.ca/facts-figures/.

3G and activated approximately 255,000 of the devices during the quarter to usher in the modern smartphone era in Canada. Ten days later, Rogers won 20 MHz of AWS-1 spectrum that would serve as the foundation of Canada's first LTE network to support the increasingly data-intensive usage of all wireless subscribers.[18] Today, Rogers continues to be Canada's largest wireless provider with more than 10.625 million wireless customers and continues to be a leader in deploying advanced network services to our data hungry customers.[19]

31. In addition to being Canada's largest wireless provider for traditional consumer users, Rogers is the leader in the M2M market and we continue to invest heavily in advanced wireless networks in order to satisfy its customers' growing demand for mobile data services. The introduction of 5G services and the massive machine type communications (mMTC) use-case will see 10-100 times more devices connected to the network, with some M2M/IoT devices having 10-year battery lives. IoT will empower a wide variety of sectors to increase their productivity and develop new business models. In the healthcare sector, medical and e-health services will be enabled along with a diverse range of wearables. In the transportation sector, Connected Cars will possess increasing self-driving capabilities as well as advanced logistics, robust mobility functions, and enhanced location services. For public services, sensor networks for Smart Cities and remote sensing will enhance the abilities of governments of all levels to deliver services to citizens.

32. Mobile data consumption is already growing rapidly, with North American data growth in particular driven by video. However, networks will continue to evolve to satisfy varying requirements of diverse services and there are multitudes of use-cases that 5G technology will enable. Enhanced mobile broadband (eMBB) will provide peak data rates of greater than 10 Gbps with 100 Mbps as average throughput, resulting in 10,000 times more traffic carried on networks. Several technologies enabled or enhanced by 5G connectivity, including virtual reality (VR), and augmented reality (AR), are expected to offer Canadian consumers and businesses advanced products and applications in many verticals and will also drive the massive growth the Department notes in the consultation paper. While many individual IoT devices will have low bandwidth requirements, the shear number of devices with mMTC will mean significant aggregate traffic growth to networks. Ultra-reliable low latency communications (urLLC) that demands immediate, synchronized eye-to-hand feedback to remotely control robots and deliver the tactile internet with latency below one millisecond will also drive innovation in Canadian industry.

[18] Rogers, *Rogers Reports Third Quarter 2008 Financial and Operating Results,* October 2008.
[19] Rogers, *Rogers Communications Reports Third Quarter 2017 Results*, October 2017.

33. Rogers agrees with ISED's assessment on the future demand for commercial mobile services. Our expectation is that demand for mobile data and for mobile spectrum will grow rapidly over the period 2018-2022 and beyond. However, the growth in demand far outstrips the revenue generated currently in the industry and the business case for specific 5G use cases remains uncertain, especially in light of the high spectrum costs Canadian mobile network operators pay to acquire and retain licences. Further, we believe the actual growth in demand for mobile spectrum far exceeds ISED's current and planned future spectrum releases and that the growth is exponential, which makes conventional approaches to capacity planning impractical.

34. As one example, Rogers believes that V2X services are going to drive additional demand for spectrum going forward. V2X services will include a broad range of use cases and will operate across multiple frequency bands. Vehicle-to-Vehicle (V2V) services will allow autonomous and connected cars and trucks to communicate with each other to support self-driving operation. Vehicle-to-Infrastructure (V2I) services will allow those same cars and trucks to communicate with the transportation infrastructure itself, to manage traffic flow and enhance safety. Vehicle-to-Network (V2N) services will allow passengers in those vehicles to enjoy information, entertainment, and navigational services while riding. Vehicle-to-Pedestrian (V2P) services will allow cars, trucks, pedestrians, bicycles, and other roadway users to share the roads safely. V2X services are likely to operate in conventional, licensed mobile bands, in the licence-exempt 5 GHz band, and in mmWave bands. Rogers expects that V2X services will begin to drive significant demand for spectrum in the 2018-2022 period.

35. Rogers is pleased to provide the following additional information on spectrum demand as provided by the ITU in several reports.

36. The ITU published the report *ITU-R M.2290*, *Future spectrum requirements estimate for terrestrial IMT,* in 2013, which provided a forecast of spectrum demands for 2G, 3G, and 4G networks in various settings.[20] Report M.2290 provided separate forecasts for 2G and 3G networks (Radio Access Technology Group 1, or RATG1) and for 4G networks (Radio Access Technology Group 2, or RATG2). The report also differentiated between countries with advanced economies, such as Canada, with higher user density settings and less advanced countries, with lower user density settings.[21] As seen below in Table 1, the ITU forecast total spectrum requirements for both RATG1 and RATG2 in the year 2020

[20] ITU, *ITU-R M.2290, Future spectrum requirements estimate for terrestrial IMT*; http://www.itu.int/pub/R-REP-M.2290-2014.

[21] Note: While Canada is indeed an advanced economy with higher user densities in our urban areas, where spectrum crunches exist, Canada is also faced with the challenges of low density over our greater landmass. This can result in a “worst of both worlds” for Canadian wireless policy.

as 1960 MHz. Although the methodology used in the writing of this report has faced some criticism, Rogers believes that ITU is "on the right track" with this demand forecast.

37. Rogers notes that the demand for 1960 MHz forecasted by the ITU is far in excess of the 648 MHz allocated by ISED to date, or even the 750 MHz originally forecasted to be available by the end of 2017. Rogers' view is that this "spectrum gap" partially explains why licensed mobile spectrum is so costly in Canada, along with measures such as spectrum set-asides and caps, which create even greater scarcity. The spectrum gap presents a barrier to operators like Rogers that wish to expand and enhance commercial mobile radio services in Canada. Rogers recommends that ISED continue to make additional spectrum available for commercial mobile services to "close the gap".

Table 1. Total spectrum requirements for both RATG1 & RATG2 in the year 2020

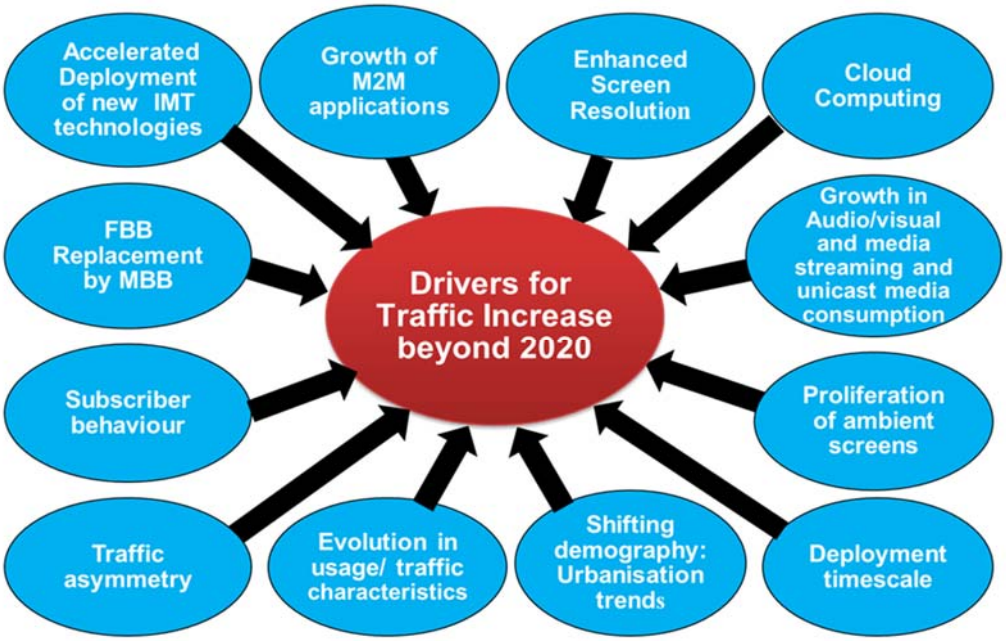
	Total Spectrum Requirements for RATG1	Total Spectrum Requirements for RATG2	Total Spectrum Requirements for RATG1 & RATG2
Lower User Density Settings	440 MHz	900 MHz	1,340 MHz
Higher User Density Settings	540 MHz	1,420 MHz	1,960 MHz

Source: Excerpt from *ITU-R M.2290, Future spectrum requirements estimate for terrestrial IMT*.

38. The ITU published ITU-R M.2370, *IMT Traffic estimates for the years 2020 to 2030,*[22] in July 2015, which analysed trends impacting future International Mobile Telecommunications (IMT, i.e. 4G) traffic growth beyond the year 2020 and estimates the traffic demands for the period 2020 to 2030. Report M.2370 identifies a number of services that will drive increasing levels of IMT traffic. These are shown in the graphic below, with detailed descriptions of the services provided in M.2370.

[22] ITU, *ITU-R M.2370, IMT Traffic estimates for the years 2020 to 2030*; https://www.itu.int/pub/R-REP-M.2370-2015.

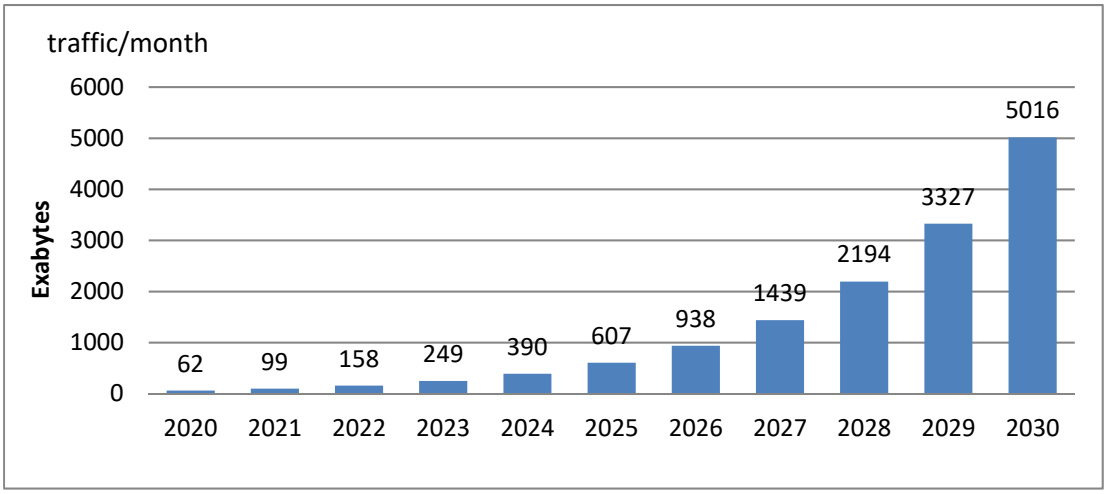
Figure 1: Drivers for Traffic Increase beyond 2020



Source: Excerpt from *ITU-R M.2290, Future spectrum requirements estimate for terrestrial IMT*.

39. Report M.2370 also forecasted the global mobile traffic over the period 2020-2030 as growing from 62 exabytes per month (2020) to 5015 exabytes per month (2030), as seen in Figure 2. Rogers agrees with the ITU assessment provided in M.2370 and with the overall conclusion of this report, which states that "… global IMT traffic will grow in the range of 10-100 times over this period."[23]

Figure 2: Estimations of global mobile traffic in 2020-2030 (M2M traffic included)



Source: Excerpt from *ITU-R M.2290, Future spectrum requirements estimate for terrestrial IMT*.

[23] ITU, *ITU-R M.2370, IMT Traffic estimates for the years 2020 to 2030*; Section 7: Conclusions, para 3.

40. Innovation in digital technologies will require support from device makers, infrastructure providers, network operators, and, not least, spectrum regulators. The Department has an important role to ensure that Canada continues to be at the forefront of 5G system development by providing the mobile industry access to access to new spectrum in low, mid, high, microwave, and mmWave bands in a timely manner. It is Rogers' view that ISED should act sooner, rather than later, to make new spectrum available to meet the traffic growth forecast in M.2370. Such actions will help capitalize on technology advancements to give Canadian businesses, research institutions, and cities a competitive edge.

Q3: What new technology developments and/or usage trends are expected to address traffic pressures and spectrum demand for commercial mobile services? When are these technologies expected to become available?

41. With the introduction of Third Generation Partnership Project (3GPP) 5G wireless technology, we are at the beginning of a new connectivity era. 5G will be far more than just a new radio access technology, known as New Radio (NR).[24] It will combine existing Radio Access Technologies (RATs) in both licensed and unlicensed bands, and it will add novel RATs optimized for specific bands and deployments, scenarios and use-cases. Many aspects of 5G will allow for improvements in spectrum efficiency. NR itself will allow for much wider radio frequency (RF) channel bandwidths (up to 400 MHz), allowing for greater data rates to support existing and new applications such as AR and VR. The use of antennas with beamforming will direct RF energy from base station to specific end user devices while minimizing energy in other directions, thus optimizing spectrum use. 5G will also implement new network architecture options based on Network Function Virtualization (NFV) and Software Defined Networking (SDN) technologies in the access network, which will help address traffic pressure and spectrum demand.

42. The biggest difference between 5G and legacy design requirements is the diversity of use-cases that 5G networks will support compared to today's networks, which were designed primarily to deliver high-speed mobile broadband. Although standards for 5G, or IMT-2020 as it is called by ITU, are still being defined, 5G will be about people and things that can be broadly split into three use-case categories: enhanced mobile broadband (eMBB); massive machine type communications (mMTC); and, ultra-reliable low latency communications

[24] See 3rd Generation Partnership Project: Technical Specification Group Radio Access Network; Study on Scenarios and Requirements for Next Generation Access Technologies; (Release 14): Technical Report 38.913 v.14.3.0 (June 2017); http://www.3gpp.org/ftp/Specs/archive/38_series/38.913/38913-e30.zip.

(urLLC).[25] These new use cases are expected to drive increased traffic pressure and demand for commercial mobile spectrum.

43. ITU Working Party 5D has completed their initial forecast on spectrum demand for IMT-2020 technologies operating in the Millimeter Wave bands. The forecast may be found in ITU Document 5-1/36-E (28 February 2017), *Liaison Statement to Task Group 5/1 Spectrum Needs and Characteristics for the Terrestrial Component of IMT in the Frequency Range between 24.25 GHz and 86 GHz*.[26] For this exercise, the ITU has used four different methodologies to develop their forecast for millimeter wave spectrum. The results are shown below in Table 2.

44. Of the four methodologies used in the forecast, Rogers' view is that the "Application-based Approach" is the preferred methodology for making this forecast. Looking at that part of the ITU forecast, we note that ITU are forecasting demand as follows:

    - 11.4 GHz for a "dense urban" setting, such as downtown Toronto, Montreal or Vancouver;
    - 3.7 GHz for a "highly crowded" setting, such as suburban Ottawa or Calgary; and,
    - 1.8 GHz for a "crowded" area, such as exurban Toronto or Halifax.

    However, Rogers believes that the "overcrowded" setting is for global supercities such as Bangkok or London, and is not currently applicable to any city or region in Canada.

[25] Please refer to Recommendation *ITU-R M.2083* for the definition of these terms and further information on the three main usage scenarios envisioned for IMT-2020 (5G); http://www.itu.int/rec/R-REC-M.2083-0-201509-I/en.
[26] ITU, Document 5-1/36-E (28 February 2017), *Liaison Statement to Task Group 5/1 Spectrum Needs and Characteristics for the Terrestrial Component of IMT in the Frequency Range between 24.25 GHz and 86 GHz*; https://www.itu.int/md/R15-TG5.1-C-0036/en. [Note: Document access restricted to TIES users.]

Table 2: IMT-2020 Spectrum demand forecast from ITU

	Examples	Associated conditions for different examples (For details, please see the corresponding sections in the Annex A)	Spectrum needs in total (GHz)	Spectrum needs (GHz) per range
Application-based approach	1	Overcrowded, Dense urban and Urban areas	18.7	3.3 (24.25-33.4 GHz range) 6.1 (37-52.6 GHz range) 9.3 (66-86 GHz range)
		Dense urban and Urban areas	11.4	2.0 (24.25-33.4 GHz range) 3.7 (37-52.6 GHz range) 5.7 (66-86 GHz range)
	2	Highly crowded area	3.7	0.67 (24.25-33.4 GHz range) 1.2 (37-52.6 GHz range) 1.9 (66-86 GHz range)
		Crowded area	1.8	0.33 (24.25-33.4 GHz range) 0.61 (37-52.6 GHz range) 0.93 (66-86 GHz range)
Technical performance-based approach (Type 1)	1	User experienced data rate of 1 Gbps with *N* simultaneously served users/devices at the cell-edge, e.g., Indoor	3.33 (*N*=1), 6.67 (*N*=2), 13.33 (*N*=4)	Not available
		User experienced data rate of 100 Mbps with *N* simultaneously served users/devices at the cell-edge, for wide area coverage	0.67 (*N*=1), 1.32 (*N*=2), 2.64 (*N*=4)	Not available
	2	eMBB Dense Urban	0.83-4.17	Not available
		eMBB Indoor Hotspot	3-15	Not available
	3	With a file transfer of 10 Mbits by a single user at cell-edge in 1 msec	33.33 GHz (one direction)	Not available
		With a file transfer of 1 Mbit by a single user at cell-edge in 1 msec	3.33 GHz (one direction)	
		With a file transfer of 0.1 Mbits by a single user at cell-edge in 1 msec	333 MHz (one direction)	
Technical performance-based approach (Type 2)	–	Dense urban micro	14.8-19.7	5.8-7.7 (24.25-43.5 GHz range)
		Indoor hotspot		9-12 (24.25-43.5GHz and 45.5-86 GHz range)
Information from some countries based on their national considerations	–	–	7-16	2-6 (24.25-43.5 GHz range) 5-10 (43.5-86 GHz range)

Source: Excerpt from ITU-R WP5D to ITU-R TG 5/1, Document 5-1/36-E (28 February 2017), Attachment 1, Section 4, Table 6. [Note: Document access restricted to TIES users.]

45. Looking just at the dense urban setting, Rogers notes that ITU are forecasting demand in the following bands:

    - 2.0 GHz in the 24.25-33.4 GHz range;
    - 3.7 GHz in the 37-52.6 GHz range; and,
    - 5.7 GHz in the 66-86 GHz range.

46. We note that the Department has already initiated consultation SLPB-001-17, the 5G mmWave Consultation, on those three frequency ranges and we applaud ISED for moving forward on this consultation without waiting for WRC-19.

47. Assuming that the three bands in the 5G mmWave Consultation are made available for 5G in Canada, this would be a significant step towards meeting the ITU forecast. Looking just at the dense urban setting, Rogers believes that Canada would reach 42.5%, 64.9%, and 122.8% of forecast demand for each range, respectively. This would be a significant step forward towards meeting the demand for 5G services in Canada. However, Rogers is concerned that the only mmWave band that will meet forecasted spectrum demand is licence-exempt but the proposed exclusively licensed bands mmWave bands do not meet forecasted demand. While licence-exempt spectrum can be used by facilities-based operators, it will not offer the same quality of interference-free spectrum. Moreover, the potentially available 5G mmWave spectrum is only 89.9% of the aggregate demand across the three bands.

Table 3: ITU 5G spectrum demand forecast vs potential Canadian availability

ITU Range in WP5D study	Bands identified in ISED 5G mmWave Consultation	Potential spectrum available in Canada for 5G	Forecast demand as per ITU Document 5-1/36-E	Percentage of forecast demand
24.25-33.4 GHz	28 GHz	850 MHz	2.0 GHz	42.5 %
37-52.6 GHz	37-40 GHz	2.4 GHz	3.7 GHz	64.9 %
66-86 GHz	64-71 GHz	7 GHz	5.7 GHz	122.8 %
TOTAL		10.25 GHz	11.4 GHz	89.9 %

48. According to the GSMA, North American (i.e., Canada and the U.S.) 5G adoption will occur faster than in any other region, with approximately half of all mobile connections on 5G networks by 2025, compared to only ~30% in Europe and the

leading Asian markets (China, Japan and South Korea in aggregate).[27] Fixed wireless will be the initial use case for early 5G deployments by U.S. network operators, with 5G fixed wireless services to be launched in 2018. "Beyond fixed wireless, US mobile operators are expected to launch their standardised mobile 5G services in 2019, with Canada following a year later."[28]

49. As for availability of 5G equipment operating in the mmWave bands, Rogers expects that commercial "pre-standard" equipment will be available as early as 2018 for the Korean Winter Olympics. Equipment built to the specific 3GPP/IMT-2020 standards will likely be available in the 2019-2020 timeframe.

50. Beamforming antennas are a new technology that will allow the base station to "beam" radio energy towards the target user, and to aim the receiving antennas towards the target user. MIMO antennas are another new technology that can use arrays of antennas in a 64x64 configuration (4096 individual elements) or greater and have the potential to substantially increase coverage and capacity, especially in the mmWave bands where the physical size and cost of such an array is reasonable. As the Department itself states, technology advancements such as massive MIMO technology, full-duplexing, and carrier aggregation techniques, in conjunction with existing technologies, are expected to improve network capacity and spectral efficiency.[29] These technologies will help to address, though not entirely, the demand for new spectrum.

51. However, as noted above, innovation in digital technologies will require support from device makers, infrastructure providers, network operators, and, not least, spectrum regulators. As such, Rogers welcomes the recent announcement by the Communications Research Centre Canada, in collaboration with the City of Ottawa, on the creation of a 5G demonstration site at Ottawa City Hall.[30] The Department can also contribute to Canada continuing to be at the forefront of 5G systems development by providing access to the spectrum bands discussed in the 5G mmWave Consultation prior to WRC-19.

52. Beyond the coming technology developments discussed in response to this consultation, modernization of the Department's Standard Radio System Plans (SRSP) and Radio Standards Specifications (RSS) for the bands currently available for commercial mobile service identified in Table 1 of the Consultation would assist in addressing traffic pressure and spectrum demand. Revision of the relevant SRSP and RSS regulations could take advantage of recent developments

[27] GSMA, *The Mobile Economy: North America 2017*, pg 3; https://www.gsma.com/mobileeconomy/northamerica/.
[28] Ibid.
[29] ISED, *Consultation*, para 38.
[30] ISED, *5G test site*; http://www.ic.gc.ca/eic/site/069.nsf/eng/00083.html.

in areas such as MIMO and beamforming antennas. Harmonization of the various SRSP and RSS specifications could also assist in maximizing use of spectrum and improve service to Canadian consumers. Table 4 below highlights areas of potential work that could be undertaken as early as convenient within the period 2018-2022.

Table 4: Commercial mobile bands that could be harmonized and modernized to enhance efficiency

BAND	E.I.R.P. (W/MHz)	Height Above Average Terrain (m)	MIMO	PAPR	Reliable Service Area	Rural E.I.R.P. (W/MHz)	Flexible Use Allowed
MBS	1640 /MHz	305	YES	YES	−116 dBW/m^2/MHz	3280 /MHz	YES
Cellular	820	150	NO	YES	35 dBµV/m	1640	Not specified
AWS	1640 /MHz	300	YES	YES	−106 dBW/m2/MHz	3280 /MHz	YES (1w)
PCS	1640 /MHz	300	NO	YES	47 dBµV/m	3280 /MHz	YES (2w)
WCS	400 /MHz	NO	NO	YES	−110 dBW/m2/MHz	400 /MHz	YES
BRS	1640 /MHz	300	YES	NO	-116 dBW/m2/MHz	1640 /MHz	YES

53. In order to modernize and harmonize the SRSP and RSS specifications for the bands currently available for commercial mobile services in Canada, Rogers makes the following specific observations and recommendations.

i. We recommend that the Department have consistency in addressing e.i.r.p. (equivalent isotropically radiated power) related to Height Above Average Terrain between all mobile bands. We suggest harmonizing with the most recent band, 700 MHz, and having a consistent height of 305m.
ii. The e.i.r.p. for the cellular band is on a per carrier basis rather than on per MHz, which is disadvantaging the use of wider RF channels in the cellular band. We strongly recommend the Department harmonize with the MBS band W/MHz e.i.r.p. values for both urban and rural areas.
iii. We recommend the Department strongly consider allowing the use MIMO in all bands.

iv. The PAPR (Peak-to-Average Power Ratio), which is specified in the RSS documents, is not identified for the BRS band.
v. For consistency, ISED should consider harmonizing the unit used for the Reliable Service Area values.
vi. The method of determining distance used to allow higher e.i.r.p. in rural areas should be specified. For example, the same distance used is for the MBS band as both the PCS and AWS bands, although distance should be frequency dependent due to the differences in propagation properties.
vii. RSS-118, specified in SRSP-503, is no longer available from ISED's RSS webpage, as it was replaced in July 2013 by RSS-238. The reference should be updated in the SRSP.
viii. The Department should consider permitting Flexible Use, both fixed and mobile terrestrial service, for all commercial mobile bands, including the cellular band. Further, the current restriction for the AWS and PCS bands should be removed to allow the same e.i.r.p. for fixed service as mobile. Providing flexibility to licensees will be beneficial in order to optimally design and deploy depending on end-user demands and network needs.

54. In addition to the technological solutions facilities-based operators will continue to deploy, ISED will need to consider regulatory and policy frameworks that support 5G development and deployment and will not foreclose competition between national carriers. The affiliated and associated entities rules and the rules prohibiting collusion should be clarified and strengthened for all auction processes. The ongoing coordination between certain bidders should be prevented so that other bidders will not be placed at a disadvantage. Further, the Department should also ensure that any facilities advantages that local telephone companies possess are made available to all other competitors in order to increase competition for the benefit of all Canadian businesses and customers. These areas are discussed in greater detail below, in response to question Q4.

Q4: Recognizing the trend of increasing commercial mobile traffic, what operational measures (e.g. densification, small cells or advanced traffic management) are being taken to respond to, and support, increasing traffic? To what extent are these measures effective?

55. Rogers makes significant, ongoing investments in our network to serve Canadians, which includes densification and backhaul augmentation programs in order to add further capacity to our network by splitting cells into smaller areas and by increasing the number and size of backhaul facilities. In addition, we have

undertaken a wide range of measures to respond to and support increasing traffic, including carrier aggregation, distributed antenna systems, network off-load to Wi-Fi, and advanced interference management technologies that support frequency re-use factors of 1:1.

56. These measures have been very effective and have allowed Rogers to satisfy soaring traffic demand despite constraints in the amount of available commercial mobile spectrum. We invest in these measures not only to improve our customers' wireless experience but also in our capacity as responsible stewards of Canada's spectrum resources. Yet, despite these substantial efforts, Rogers will require additional low, mid, high, microwave and mmWave band spectrum to provide additional access and backhaul capacity in order to keep pace with the unprecedented demand for mobile broadband services that will continue over the next several years, especially with the introduction of 5G services.

57. Looking forward, Rogers is planning to deploy more advanced technologies, in order to increase coverage, capacity, and spectral efficiency of our wireless networks. Self-Organizing Network (SON) technology will make the planning, configuration, management, optimization and healing of mobile Radio Access Networks (RANs) simpler and faster. SONs will allow a mobile network operator to dynamically alter the radio network configuration to meet the constantly changing needs of mobile users, shifting radio resources around "on the fly". Centralized RANs will allow the use of centralized baseband components and distributed Remote Radio Heads to more efficiently use network resources. In early 5G networks, Rogers anticipates using "Dual Connectivity" technology in which the mobile is simultaneously connected to both 4G and 5G radio, with the existing 4G radio network providing broad coverage and control, while new 5G radio sites provide local capacity.

58. Regarding the effectiveness of these measures, Rogers believes that the telecommunications site acquisition situation will only grow worse in the coming months and years, meaning that it will be even more difficult to secure new sites in the future. This will significantly limit our network densification efforts in urban and suburban areas – the very areas where additional capacity and coverage will be essential in order to provide the bandwidth-intensive and latency-sensitive services that will be enabled by 5G technology.

59. The need to densify network infrastructure deployments by several orders of magnitude using new small cells and related technologies – and the accompanying siting challenges – was an issue raised by Nokia in the Department's recent 5G mmWave Consultation. Nokia suggested that, in light of increased pressure on local governments to review applications for siting, "ISED should consider a national policy framework of best practices that local governments can adopt to

speed consideration of siting applications and the ultimate availability of 5G."[31] Rogers remains supportive of any role the Department can play in facilitating the rapid deployment of 5G infrastructure, beyond simply allocating more spectrum.

60. These efforts should also include making any facilities advantages that local telephone companies possess available to all other competitors in order to increase competition in the provision of 5G services for the benefit of all Canadian businesses and customers. These facilities advantages are as a result of having built their own network of structures during their monopoly period, and accompanying pole-sharing arrangements with hydro utilities. Access to (wireline) local connectivity is critical to 5G deployments. The other key to 5G deployments in urban areas is access to real estate (municipal and private sector) for new micro sites (poles, lamp posts, street furniture, etc.). The Department should ensure that any facilities advantages by ex-monopoly local telephone companies are made available to all other competitors in order to increase competition for the benefit of all Canadian businesses and customers.

61. Building telecommunications networks is enormously costly and challenging. Governments, at all levels, need to adopt policies that will spur deployment and construction of broadband networks and not restrict them. Ubiquitous broadband networks, both wireline and wireless, are required as the foundation for greater information and communication (ICT) adoption and digital innovation. Making it easier for telecommunications carriers to build and operate world-class wireless and wireline broadband services will enable the successful development of IoT and drive greater levels of productivity and employment throughout the Canadian economy. It will also help rural Canadians to benefit from the digital economy.

New wireless transmission sites

62. Wireless service is not possible without towers. New wireless sites are required to improve the signal quality of voice calls and data sessions, as well as add much needed capacity that allows customers to stream and share higher quality videos and pictures. In recent years, as more and more Canadians have adopted wireless services for their homes, the demand for better coverage and additional capacity has increased significantly in residential areas.

63. Unfortunately, this need for more tower sites has led to local opposition. Some municipalities in Canada have implemented onerous wireless tower and site guidelines (known as protocols), and prohibitive zoning bylaws and land use requirements, that prevent wireless carriers from improving wireless coverage in residential areas. At the same time, some residents vocally challenge any attempt to build a new site. Network operators are caught between these competing demands, where communities want better quality wireless services and yet many

[31] Nokia, *5G mmWave Consultation Comments*, pg 3.

are not prepared to allow wireless companies to build the necessary facilities. The federal government needs to help communities better understand the benefits of wireless services and to dispel misplaced apprehension related to health and safety associated with wireless services.

64. Government support will be essential going forward. The need for wireless infrastructure will become even more crucial as Canada transitions to 5G. The implementation of 5G technology will enable much faster wireless broadband speeds. However, in order to achieve these higher data speeds, wireless carriers will need to increase network capacity by significantly adding wireless transmission sites. These sites will be smaller than current sites but network providers will need far more of them. 5G will simply not be possible without them and Canada will fall behind.

Reasonable access for telecommunications carriers

65. In the coming years, more broadband capacity will be required to satisfy the exploding demand for video streaming. This can only be achieved through the successful deployment and expansion of telecommunication networks (both wireline and wireless), which, in turn, are dependent on the ability of telecommunication carriers to obtain fair and reasonable access to municipal roads and rights-of-way, public property, and a variety of utility support structures. Without proper regulatory oversight, the owners of these properties can impose unreasonable terms and rates that can act as a barrier to construction of telecommunication networks. However, providing carriers with more reasonable access to existing support structures, such as utility poles, is more efficient, will reduce costs and speed up deployment. It will also result in fewer roadways being dug up for the purpose of running fibre facilities.

66. For example, access to roadways and other municipal property is, for the most part, regulated by the CRTC. Under the *Telecommunications Act*, telecommunications carriers have a right, overseen by the CRTC, to access streets and other public property for the purpose of installing, maintaining and operating their networks (referred to as “transmission lines” in the Act). It is this regulatory oversight that has allowed carriers to build out their fibre networks in municipalities across the country in an efficient and economical manner.

67. However, towers and antennas have not been treated the same as wireline facilities, and wireless carriers have faced, and continue to face, much more unfavourable terms when they try to deploy their wireless infrastructure on municipal property. There is no reason to treat wireless transmission facilities differently than wireline transmission facilities when it comes to access to municipal streets and public places. Accordingly, the *Telecommunications Act* should be

interpreted such that the right to construct “transmission lines” applies equally to wireless facilities and antennas.

68. Building a robust telecommunications network often requires access to, and the use of, existing infrastructure such as telephone and utility poles, streetlights and underground duct. While the CRTC regulates access to the poles and underground duct of the telephone companies (including the rates other telecommunications providers pay to attach their wireline facilities), it has no jurisdiction over the poles and ducts owned by the hydro and electricity companies. This lies with the provincial utility boards. As a result, telecommunications carriers are faced with a patchwork of pole attachment rates across the country and, in some cases like the Province of Ontario, pole attachment rates that are three to four times higher than the rates the CRTC has approved for telephone poles.

69. In order to correct this inequity, the CRTC should be granted the authority to regulate the use of hydroelectric utility poles and ducts by telecommunications carriers in order to attach their cables and other transmission facilities, such as wireless antennas, just as they do for telephone companies. Similarly, and for the same reasons, the CRTC’s regulatory oversight of access to telephone poles owned by the incumbent telephone companies should be extended to include the attachment of wireless equipment, including antennas, so that wireless carriers that do not own their own poles will be provided with fair and reasonable access to the poles of incumbent telephone companies.

70. Rogers believes specific recommendations that the Department and the Government of Canada could enact to improve the deployment of wireless infrastructure in Canada would include the following.

    i. Grant wireless carriers better access to public rights-of-way.
    ii. Facilitate greater cooperation from municipalities for the establishment of wireless radio transmission sites.
    iii. Interpret the statutory right under the *Telecommunications Act* to construct “transmission lines” to include wireless facilities, including antennas.
    iv. Grant statutory authority under the *Telecommunications Act* to the CRTC to regulate the use of hydroelectric utility poles and duct by telecommunications carriers.
    v. Extend the CRTC’s regulatory oversight of access to telephone poles to include the attachment of wireless equipment, including antennas.

71. In April 2017, the FCC launched wireless[32] and wireline[33] proceedings to examine the regulatory impediments to network infrastructure investment and deployment, and how such impediments might be removed or reduced in order to promote the rapid deployment of advanced broadband services. The wireless proceeding will examine the clarification of siting rules at local, state and federal levels, streamlining historic preservation, tribal and environmental reviews, and, enabling proposed sites to move forward if local governments do not act within mandated timelines. For the wireline proceeding, the FCC is seeking comment on reducing timeframes for carriers to access utility poles and decreasing fees utilities charge for access to utility poles. Similar actions in Canada would be beneficial to the deployment of mobile wireless and fixed (wireless or wired) Internet services.

72. U.S. wireless carriers are supportive of the FCC proposals to reduce red tape and commenters have proposed additional strategies to remove barriers to the rapid deployment of networks. These issues are also highly relevant to Canadian network deployment, and are very similar to what Rogers proposes to the Department and the government. Some of FCC proposals include:

    i. Local government right-of-way management cannot be discriminatory;
    ii. Providers deploying wireless facilities cannot be singled out for more onerous regulations than other telecom providers;
    iii. Telecommunications and wireless carriers should not be treated any differently than hydro companies and other utilities when it comes to rates and access to municipal property; and,
    iv. Local governments cannot charge any more than their direct and actual costs.

73. Providing Canadian wireless carriers with better and more timely access to public and private infrastructure at economical rates is critical to 5G deployments and ISED should pursue similar policies in order to support competition and the provision of high quality and innovative wireless services to Canadians. The Department should monitor the FCC wireless and wireline proceedings examining the regulatory impediments to network infrastructure investment and deployment, and look to adopt best practices where impediments might be removed or reduced in order to promote the rapid deployment of advanced broadband services in the Canadian context.

74. However, as demand continues to grow – especially with the introduction of 5G services, Rogers will require more spectrum despite densification and efficiency efforts. Additional spectrum is needed to continue to offer customers high-quality and innovative services. Consumers expect continuing evolution of technologies

[32] FCC, *FCC 17-79: Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment*; https://ecfsapi.fcc.gov/file/0421294395880/FCC-17-38A1.pdf.
[33] FCC, *FCC 17-84: Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment; https://ecfsapi.fcc.gov/file/0421885402163/FCC-17-37A1.pdf*.

and services, but there will be no improvement in networks or services without more spectrum.

75. Further, as highlighted above, the current backhaul spectrum fee structure penalizes efficient microwave operators looking to use their current holdings to increase capacity. If rights-of-way access are only provided to former monopoly local telephone companies, then wired backhaul solutions will be more challenging. If wireless backhaul can be a technical alternative – or a superior option due to the speed in which it can be deployed or augmented – than the fee structure should not stand in the way of facilities-based competition between networks.

76. It is important for the Department to note that improved access for infrastructure deployment and a more reasonable microwave spectrum fee regime is not an either/or policy decision but, rather, a both/and. Improved infrastructure access, including rights-of-way and similar treatment as other utilities, is particularly critical for wireless carriers because in a dense small cell environment, wireless fronthaul will become more important for all mobile wireless networks. In addition, a more reasonable microwave spectrum fee regime will benefit all types of carriers including wireless carriers, local telephone companies, and small wireless Internet service providers, thereby enhancing competition. It is essential that facilities-based carriers are provided improved access and reasonable fee regimes, as well as additional exclusively licensed spectrum, in order to continue improving coverage and capacity for Canadians.

77. The Department should take a very cautious approach when exploring opportunistic sharing so as not to negatively affect the advanced mobile networks that already provide connectivity to digital technologies and services that is a defining feature of the digital economy. Exclusive-licensed mobile bands are key inputs into the wireless networks that allow Canadian companies to take advantage of the latest technologies to better compete globally. ISED should maintain the exclusive nature of these licences in order to minimize the potential for interference to the mobile communications infrastructure that Canadian consumers and businesses rely on.

78. Encumbering exclusive-use bands with opportunistic sharing requirements will ultimately damage the use and value of future spectrum licences. Licensees have spent over $14 billion at spectrum auctions since 2001 on acquiring exclusive licences.[34] If existing exclusive licences could become subject to opportunistic sharing in the future, spectrum valuations and bidding in future auctions, including the upcoming 600MHz spectrum auction, will be significantly diminished. Furthermore, any mandatory opportunistic sharing imposed on exclusive-licensed bands would warrant a sizable reduction in annual spectrum fees that licensees

[34] ISED, *Spectrum Auctions*. Note: $14B is nominal and does not account for inflation.

pay. It would also require some mechanism to ensure that “opportunistic spectrum takers” paid some measure of market value for their spectrum usage. Opportunistic sharing therefore has several economic impacts and issues that must be considered.

79. Additionally, opportunistic sharing within exclusive-licensed bands appears inconsistent with a coverage requirement condition of licence, due to the uncertainty it would create in the economics of any particular service area, or portion thereof. In remote and rural areas that are currently uneconomical for licensees, subordination and other commercially negotiated options provide ways to make spectrum available that do not create the interference and other risks to exclusive licence holders inherent with opportunistic sharing. In urban areas, where capacity demands are greatest and the spectrum crunch most acute, there would be limited actual opportunities for sharing.

80. The economics of opportunistic sharing are most likely to affect the newest carriers, and thus challenge the Department’s continued focus on facilities-based investment and coverage to increase competition. The auctioning of exclusive use spectrum has enabled the entrance of sustained competition in all regions from a fourth facilities-based carrier. (It should be noted that set-asides and other “pro-competitive” measures in recent spectrum auctions also introduced unsustainable competition, resulting in spectrum being not deployed or underutilized for years until market corrections.) As the regional carriers look to build out their networks and start deploying newer LTE technologies, opportunistic sharing could jeopardize their business cases and slow facilities-based investment.

81. Further, opportunistic sharing itself has several technical issues that must be resolved before it can be implemented. There are currently two primary approaches to opportunistic sharing, Cognitive Radio and Licensed Shared Access. Cognitive Radio, in which the mobile device looks for and is able to use any vacant radio channel, has substantial technical, regulatory, and business challenges to overcome before it becomes a reality. It has also yet to be evaluated by 3GPP. Licensed Shared Access is further along but still remains years away from commercial deployment.

82. If the Department is committed to exploring opportunistic sharing, it should be limited to bands with open spectrum designations, lightly licensed mobile bands or bands with limited users in restricted geographic areas that will be protected from interference. This will allow the Department to trial new spectrum management technologies and policies in bands that do not pose large risks to incumbent licensees and the extensively deployed communications infrastructure already providing advanced connectivity to Canadians.

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

83. As noted above, off-loading of traffic to Wi-Fi networks is an important and growing compliment to the rapid growth in data usage on cellular networks. Further, as our competitors look to match Rogers' ability to offer speeds of 1 Gbps across our entire footprint, the demand on current Radio Local Area Network (RLAN) spectrum bands for Wi-Fi will only increase. In fact, of all Internet traffic (fixed and mobile) in 2016, 42% was Wi-Fi and its proportion of traffic is expected to increase to 55% in 2021.[35] Wi-Fi technology is augmenting the world-class, facilities-based wireline and wireless networks that Canadian network operators continue to build.

84. The importance of Wi-Fi will continue to increase as Canadians continue to connect more and more devices to their home Internet networks. As the CRTC has stated, "Over the past few years, the numbers of connected devices and applications used in a household have grown significantly, and these numbers will likely continue to grow. Consequently, the need for bandwidth is also growing."[36] According to recent survey data from the Canadian Internet Registration Authority, "Nine per cent [SIC] of Canadians report having 10 or more Internet-connected devices in their household, a number that is likely only to rise with the proliferation of smart-home technology and applications."[37]

85. These findings align with statements by the Department itself in the recent *Consultation on the Technical and Policy Framework for Radio Local Area Network Devices Operating in the 5150-5250 MHz Frequency Band* (5.2GHz Consultation), which noted that the fast growing number of consumer Wi-Fi-enabled devices is putting pressure on the current capacity of RLAN bands and that service providers are deploying hot-spots to off-load traffic from their commercial broadband networks.[38] Both these trends are expected to continue over the next few years.

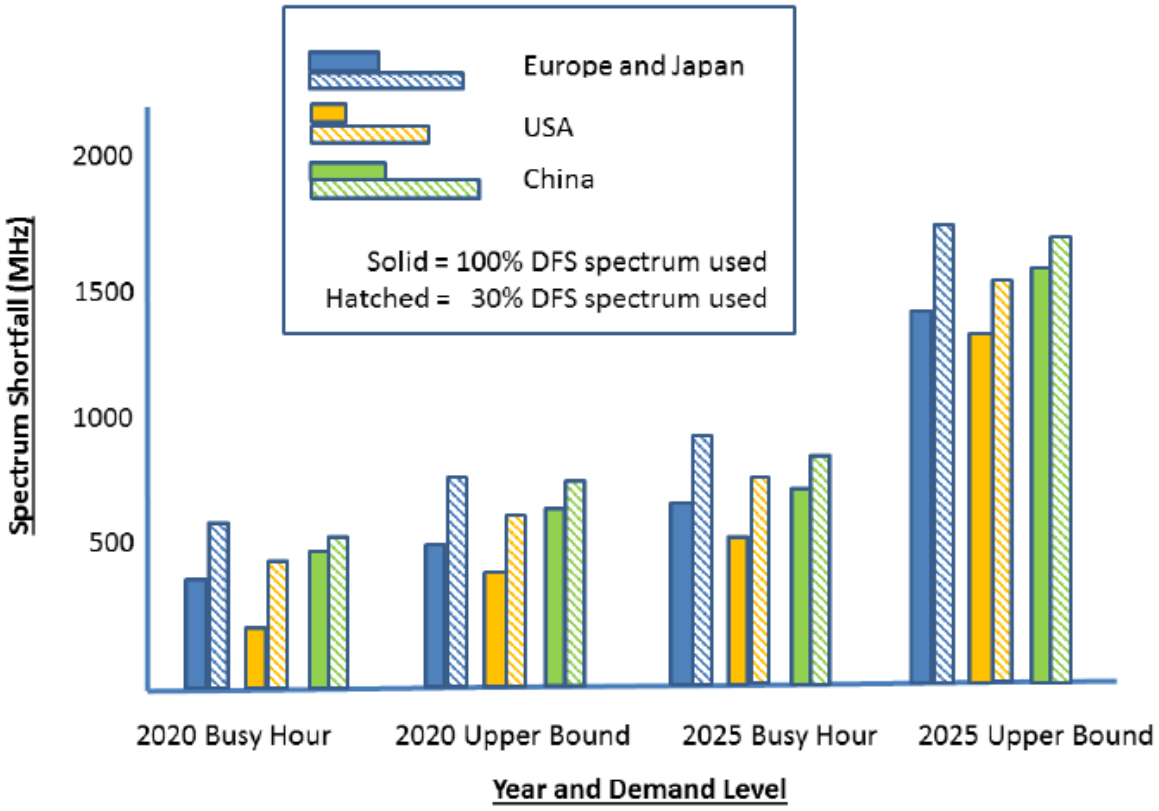
86. The Wi-Fi Alliance, a trade association that works on various aspects of Wi-Fi technology and services on behalf of their members, recently published a report *Wi-Fi Spectrum Needs Study* produced by Quotient Associates. The study

[35] Cisco, *VNI Mobile Forecast Highlights, 2016-2021*; http://www.cisco.com/c/dam/assets/sol/sp/vni/forecast_highlights_mobile/index.html#~Country.
[36] CRTC, *Telecom Regulatory Policy CRTC 2016-496*; http://www.crtc.gc.ca/eng/archive/2016/2016-496.htm.
[37] CIRA, *CIRA Internet Factbook 2016 – Internet use in Canada;* https://cira.ca/factbook/domain-industry-data-and-canadian-Internet-trends/internet-use-canada.
[38] ISED, *Consultation on the Technical and Policy Framework for Radio Local Area Network Devices Operating in the 5150-5250 MHz Frequency Band* (5.2GHz Consultation), para 20; https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11246.html.

forecasts the amount of Wi-Fi (licence-exempt) spectrum that will be required to satisfy user demand in 2020 and 2025.[39] The study considered various use cases and settings and looked at demand in three major regions around the world (Europe and Japan, U.S., and China). The study also considered technical factors such as the use of Dynamic Frequency Selection (DFS), the availability of next generation Wi-Fi based on the Institute of Electrical and Electronics Engineers (IEEE) 802.11ax standards, the potential for using Wi-Fi in the emerging 60 GHz range, and others. Their conclusion was that between 500 to 1000 MHz of new licence-exempt spectrum will be required by 2025 to satisfy the anticipated busy hour traffic. If some novel, unanticipated service emerges between now and 2025, the shortfall could be even larger, with 1.3 to 1.7 GHz of new spectrum required.

87. The results of the study are summarized in Figure 3 below and show the forecast spectrum shortfall for 2020 and 2025, for both busy hour and upper bound scenarios. In Rogers' view, the Wi-Fi Alliance study is credible, and we believe that the Canadian market will experience a similar spectrum shortfall if current trends continue.

Figure 3: Wi-Fi Spectrum Needs, 2020-2025



Source: Wi-Fi Alliance, *Wi-Fi Spectrum Needs Study*.

[39] Wi-Fi Alliance, *Wi-Fi Spectrum Needs Study*; https://www.wi-fi.org/file/wi-fi-spectrum-needs-study.

88. The Wi-Fi Alliance study showed that the most traffic demand in the United States market would occur in the 5150-5250, 5250-5350, 5475-5725, and 5725-5850 MHz bands. It assumed that the 2400-2500 MHz band is saturated and that there was little opportunity to expand or extend this band. It assumed that the 60 GHz range, while useful for certain specific applications such as in-home gaming and virtual reality, holds little potential for providing relief due to its inability to penetrate walls (for indoor services) and high rain attenuation (for outdoor services).

89. While most Wi-Fi networks use Access Points connected to wired broadband networks, there are situations where an unlicensed wireless backhaul option is desired. As stated in the Radio Advisory Board of Canada's (RABC) response to the 5.2GHz Consultation, "outdoor RLAN devices are used to provide low cost connectivity to users for backhaul, in addition to high speed internet services" in the 5725-5850 MHz frequency range.[40] In the same document, CanWISP (Canadian Wireless Internet Service Providers) operators were advocating for the use of 5150-5250 MHz to backhaul as well to address congestion experienced in the 5.8 GHz frequency range.[41] Spectrum suitable for this purpose could be taken from existing unlicensed bands but with detrimental impact on overall Wi-Fi system capacity. Hence, finding additional spectrum for Wi-Fi backhaul is highly desirable. In its 5.2GHz Consultation decision, ISED did authorize the use of 5150-5250 MHz outdoor for point-to-point applications, which will support backhaul. This is a welcome development but will also increase aggregate demand in this frequency range.

90. Facilities-based providers like Rogers continue to invest billions of dollars to provide connectivity to Canadians. As noted above, telecommunications investments made in both wireless and wireline networks was $11.6 billion in 2016 for plant and equipment,[42] and this number does not include the significant amounts paid for licensed spectrum. However, in order to enhance consumer experiences and meet evolving usage demands, Canadian spectrum policy must also continue to evolve.

91. The recent decision to allow higher power and outdoor RLAN devices to operate in the 5150-5250 MHz band before WRC-19 is a positive step by the Department to enable more efficient use of spectrum for the services that Canadians are demanding. Harmonizing rules with the U.S. for higher power devices, both indoor and outdoor, will enable service providers to provide a wide array of advanced connectivity services to Canadians, from the latest Wi-Fi standard (802.11ac, designed for gigabit speed that providers like Rogers are offering) to emerging

[40] RABC, *5.2GHz Consultation Comments*, para 13.
[41] Ibid, para 41.
[42] CRTC, *Communications Monitoring Report 2016*, http://crtc.gc.ca/eng/publications/reports/policymonitoring/2017/cmr5.htm#s50vi.

mobile standards like LTE-Unlicensed (LTE-U) and LTE-LAA. Further, it will provide additional spectrum that can be used as a backhaul medium to transport the increasing amounts of bandwidth that both fixed and mobile Internet users need.

92. However, Rogers has seen little demand for spectrum in the Television White Space (TVWS) bands, despite the fact that the band is available in several global markets, and there are technical standards for both the TVWS radio interface and for the requisite geolocation database. Nonetheless, Rogers believes that the band has potential to provide service to rural Canadians at some point in the future.

93. Rogers anticipates that there will be great demand for licence-exempt spectrum with few restrictions, as these will allow greater innovation and utility. ISED should avoid placing restrictions such as “indoor use only”, or low transmit power, or limiting certain bands to specific applications, wherever possible. Such policy frameworks would align with the federal government’s broader innovation agenda and will contribute to productivity increases, support connected city initiatives, and the ongoing development of the Internet of Things.

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

94. Rogers is seeing many new technologies and sharing techniques emerging that may aid in relieving traffic pressures and addressing demand, and we are pleased to provide the following brief descriptions of these.

95. LTE-U and LTE-LAA technologies will allow the use of 4G/LTE technology in licence-exempt spectrum. Both LTE-U and LTE-LAA will allow LTE devices to equitably share the spectrum with Wi-Fi devices. 3GPP and other technical organizations have completed much of the standardization work associated and we expect a large ecosystem of both base stations and mobile devices to emerge over the next five years. First generation devices are available now, and Rogers and other global mobile network operators have been testing these devices.

96. 3GPP has an active study item ongoing to evaluate the feasibility of using 5G New Radios in licence-exempt spectrum. 5G/NR is expected to outperform 4G/LTE in certain aspects, such as low-latency applications for automated factories and self-driving cars. Work on normative standards for the licence-exempt version of 5G/NR has not yet started, so we do not expect any commercial products until around 2022 at the earliest.

97. 3GPP has also considered development of a modified form of their Narrowband Internet of Things (NB-IOT) radio access technology that would operate in licence-exempt spectrum. NB-IOT is a modified form of LTE that operates in narrow carriers, as little as 200 kHz, and is optimized for small, battery-powered IoT devices. We expect that 3GPP will develop normative standards for this technology in the next few years with commercial products. Such a technology would be most effective operating in the lower frequency bands where radio propagation is good and the amount of spectrum is limited.

98. Low Power Wireless Access technologies such as LoRa and SigFox are emerging that will allow IoT traffic to be steered into licence-exempt spectrum, such as the 902-928 MHz band in Canada. IEEE has developed standards for a modified form of Wi-Fi called HaLOW, which is also designed for IoT applications and can operate in the 900 MHz band.

99. As noted above, the Department should take a very cautious approach when exploring opportunistic sharing so as not to negatively affect the advanced mobile networks that already provide connectivity to digital technologies and services that is a defining feature of the digital economy. Exclusive-licensed mobile bands should not be used.

100. Opportunistic sharing itself has several technical issues that must be resolved before it can be implemented. There are currently two primary approaches to opportunistic sharing, Cognitive Radio and Licensed Shared Access. Cognitive Radio, in which the mobile device looks for and is able to use any vacant radio channel, has substantial technical, regulatory, and business challenges to overcome before it becomes a reality. It has also yet to be evaluated by 3GPP. Licensed Shared Access is further along but still remains years away from commercial deployment.

101. If the Department is committed to exploring opportunistic sharing, it should be limited to future bands with open spectrum designations, lightly licensed mobile bands or bands with limited users in restricted geographic areas that will be protected from interference. This will allow the Department to trial new spectrum management technologies and policies in bands that do not pose large risks to incumbent licensees and the extensively deployed communications infrastructure already providing advanced connectivity to Canadians.

102. While the mobile industry has commented in numerous recent ISED consultations on the unproven nature of dynamic access database systems within mobile exclusive bands, this view has also been shared by both the satellite and licence-exempt industries. In the 5G mmWave Consultation, the satellite proponent BSO Coalition highlighted that the technical challenges would be even greater to try and manage multiple uses in the band (e.g., fixed, mobile, FSS, SRS and

MSS).[43] In the same consultation, the licence-exempt proponent Wi-Fi Alliance stated, "Requiring dynamic access systems and databases can increase the cost and complexity of these devices, making them difficult to market for consumer and even most commercial uses. If ISED hopes to make maximum use of licence-exempt spectrum, it should do so using device-based contention mechanisms alone."[44]

103. As such, the Department should not implement opportunistic systems until more international information and experience has been gathered. The additional costs and complexity associated with dynamic access systems (devices, database etc.) are not justified at this time.

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

104. Rogers expects that the 900 MHz, 5 GHz, and 57-64 GHz frequency bands will see the most evolution in the next five years.

105. There are a number of emerging technologies that are designed for operation in the 900-928 MHz band, as well as potentially other bands, including LoRa, SigFox, HaLOW, and, potentially in the future, a the licence-exempt version of NB-IOT. All of these technologies are optimized for IoT applications. They are also very versatile and will support a wide range of IoT applications, such as asset tracking, fleet management, smart city, security monitoring, and utility management.

106. The 5 GHz bands will also see significant evolution, as new technologies emerge and existing technologies continue to evolve. For example, Wi-Fi continues to evolve, with the next generation (IEEE 802.11ax) expected to be released in 2019 and commercial products available shortly thereafter. Technical standards for LTE-U and LTE-LAA are complete and commercial products are becoming available. Rogers expects that 3GPP will develop standards for a licence-exempt version of the 5G/NR radio interface operating in the 5 GHz range within 2 to 3 years, and for commercial products based on these standards to become available starting around 2022.

[43] BSO Coaction, *5G mmWave Consultation Comments*, para 55.
[44] Wi-Fi Alliance, *5G mmWave Consultation Comments*, para 5.1.

107. Rogers expects to see significant evolution in the 5850-5925 MHz band over the next five years, driven primarily by developments in Vehicle-to-Vehicle (V2V) technology. V2V will allow cars and trucks to communicate with each other using high-speed, short-range radios. The main applications will be to improve road safety by reducing accidents and to improve road efficiency by allowing self-driving vehicles to travel in a coordinated fashion. Rogers notes that there are two competing technologies that are suitable for this band and for these applications. Dedicated Short Range Communications (DSRC) is based on a modified form of Wi-Fi, as per IEEE standard 802.11p. Cellular Vehicle-to-Everything (C-V2X) is a modified form of LTE, as per 3GPP Release 14 standards. We strongly recommend the Department launch a consultation, as early as possible, to gather industry views and issue a decision. This will provide clarity on whether Canadian policy will align with the U.S., with 3GPP, or, as often promoted by ISED, stay technology-neutral.

108. The 57-64 GHz band is also expected to evolve significantly over the next five years due to the emergence of new wireless technologies such as Wireless Gigabit (WiGig). WiGig is based on an IEEE standard 802.11ad and other standards developed by the Wireless Gigabyte Alliance. WiGig is suitable for short-range, indoor applications such as wireless synchronization of devices, wireless High-Definition Multimedia Interface (HDMI) cable replacement, and local Internet access.

109. Finally, we note that ITU-R is considering the identification of the 66-71 GHz band for licence-exempt access using 5G technology, which would drive significant changes in this band. Although ITU-R is not considering 64-66 GHz band at this time, Canada should consider extending the 57-64 GHz band up to 71 GHz. This is consistent with the United States, which is opening up the 64-71 GHz band for licence-exempt operation.[45]

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

110. Rogers believes that the trend for offering carrier-grade or managed Wi-Fi services will continue to increase over the next five years. The technologies to enable carrier-grade Wi-Fi serve to ensure a more consistent level of service quality and, in the process, achieve a higher degree of spectral efficiency. They

[45] FCC, *FCC 16-89: Report and Order and Further Notice of Proposed Rulemaking Report*; https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-89A1.pdf.

do not, of themselves, increase congestion. However, a more consistent Wi-Fi user experience will encourage its use for applications such as video streaming and so carrier-grade Wi-Fi may lead to higher levels of Wi-Fi traffic. This in turn will lead to the need for more unlicensed spectrum to support the traffic increase.

111. This trend will primarily impact bands in the 5 GHz RLAN bands, as these bands hold substantial amounts of spectrum compared to the other RLAN bands and because many of the newest technologies and Wi-Fi devices are intended to operate primarily in those bands. Importantly, the 5 GHz bands hold large, contiguous swaths of spectrum that can support very high speed services. Next generation Wi-Fi devices will be able to employ contiguous 160 MHz carriers in this band.

112. Carrier-grade Wi-Fi services will be deployed initially in enterprise locations such as industrial areas, commercial areas, and public “hot spots”. As carrier-grade services share the same spectrum as consumer-grade services, these services will come into conflict wherever people’s homes are located close to enterprise locations.

113. We expect that many IoT applications will require carrier-grade Wi-Fi to deliver satisfactory quality of service to users and operators. This is especially true for “smart grid” and “smart city” services which affect critical infrastructure such as pipelines, electricity distribution systems, and public transit systems.

114. Programs such as the Wi-Fi Alliance’s Wi-Fi CERTIFIED Vantage™ (Vantage) program will drive availability of devices that support carrier-grade Wi-Fi service.[46] Vantage will mandate support for a number of technical capabilities that are important for carrier-grade quality of service and will include a voluntary certification program, which will allow users to select equipment that complies with Vantage program requirements.

115. In parallel with developments aimed at the enterprise market, the industry is starting to develop Wi-Fi devices that support managed Wi-Fi in the residential market. These devices may operate autonomously or they may be managed remotely by an Internet or Television service provider.

116. While carrier-grade and managed Wi-Fi services may make more efficient use of Wi-Fi spectrum than conventional Wi-Fi services, we do not expect these efficiencies to materially offset the increased demand for licence-exempt spectrum. We expect that the spectrum shortfall forecast by the Wi-Fi Alliance, as discussed

[46] Wi-Fi Alliance; *Wi-Fi Vantage: Elevated user experience in Wi-Fi® networks;* https://www.wi-fi.org/discover-wi-fi/wi-fi-vantage.

above in our response to Q5, will materialize despite the availability of carrier-grade and managed Wi-Fi services.

Q9: ISED is seeking comments on the above demand assessment for MSS and earth observation applications for the period 2018-2022. Is there additional information on demand, which is not covered above, that should be considered?

117. Rogers notes that satellite operators submit many applications for spectrum, which suggests that more consideration may be warranted by the Department to use auctions for satellite spectrum licences, rather than a first-come, first-served licensing process to award spectrum. As the Department knows, auctions provide much greater incentives to licensees to deploy. While auctions may not always make sense for international satellite operators, the *Framework for Spectrum Auctions in Canada* does state that for domestic or regional satellite systems that cover Canada, auctions may be appropriate.[47]

118. Rogers also highlights the massive disparity between the spectrum costs for mobile spectrum and satellite spectrum. Mobile operators must acquire spectrum through auctions at a very high cost – excepting when regional operators are massively subsidized and able to acquire set-aside spectrum at a discounted rate to the national operators, and that their cost is, relatively, only high compared to satellite providers. Canadian mobile operators currently pay approximately $179M annually for spectrum fees on PCS and Cellular spectrum bands.[48] If the mobile industry was charged the same $120/MHz rate as the satellite industry, all of the spectrum currently available for mobile use in Canada, including that still on auction terms, would cost less than $78K annually.[49] Further reducing their incentives to deploy, satellite operators are only charged annual fees once they have deployed satellites.[50]

119. Although this disparity in actual and potential annual mobile spectrum fees is a result of a fee formula not designed for the mobile industry, there still exists a wide

[47] ISED, *Framework for Spectrum Auctions in Canada*, pg 2; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01626.html.
[48] Calculated based on national holdings of Cellular and PCS spectrum, 2001 Pops, and a fee rate of $0.03512361/MHzPop.
[49] Based on 648 MHz of spectrum available to the mobile industry and a spectrum licence fee for FSS & BSS of $120/MHz, as per *SMSE-008-16 — Fee Order for Fixed-Satellite Service (FSS) and Broadcasting-Satellite Service (BSS) Spectrum in Canada*; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11159.html.
[50] ISED, *Fee Order for Fixed-Satellite Service (FSS) and Broadcasting-Satellite Service (BSS) Spectrum in Canada*, pg 2.

absolute gap between mobile and satellite industries due to their respective annual spectrum fee formulas. Even if the satellite industry held licences covering all spectrum allocated to their industry, the entire, massive 28 GHz of spectrum for satellites works out to just $3,338,040 annually. The satellite industry has nearly 43 times the spectrum as the mobile industry but pays less than 2% the annual fees.

120. Rogers notes that it does not have access to the Northern Sky Research report, *Global Satellite Supply and Demand Study 13th Edition*, referenced by the Department and thus cannot speak to the accuracy or methodology of the forecast demands in the report. However, Rogers does believe that the demand for satellite services, especially outside of rural and remote locations, is overstated by the Department. We note that 4K TV satellite services will lag, as we currently are not seeing vast collection of 4K content for satellite services and thus believe spectrum requirements to support 4K TV are misleading. Further, the Department can also expect that High Efficiency Video Coding (HEVC) and other codex improvements will ease the requirements on spectrum. For example, with the Scalable Video Coding (SVC), one can send Standard Definition (SD), High Definition (HD), Ultra High Definition (UHD) and other subset bitstreams in a single video bitstream, meaning users can be efficiently directed to the same content but get different value services.

121. The initial application for satellite operation as a long distance provider has been replaced. Only rural and remote locations still require satellite access for these services; otherwise, consumers are generally more effectively served by terrestrial connectivity. As such, Rogers believes satellite bands should be repurposed, especially in urban areas. It is unclear if satellite operators have sufficient bandwidth in these bands to provide economical and spectrally efficient broadband services, especially as compared to terrestrial operators in urban and suburban areas, so it would be more spectrally efficient to repurpose for mobile. At the least, the spectrum bands could be converted to exclusive flexible use bands similar to the Department's proposals for the 5G mmWave Consultation bands.

122. In fact, ITU WP5A is developing a report promoting the approach of shared spectrum where satellite services use the spectrum in rural areas and commercial mobile services use the same spectrum in urban areas.[51] Rogers supports such an approach in Canada, as it generally aligns with our approach to geographic restrictions for FSS earth stations in the 28 GHz and 37.5-40 GHz bands shared spectrum in the recent 5G mmWave Consultation.[52]

[51] ITU, *ITU-R M.[GEO.SHARE] Sharing schemes in the land mobile service on the basis of geographical use*, Annex 19; https://www.itu.int/md/R15-WP5A-C-0650/en. [Note: Document access restricted to TIES users.]
[52] See Rogers, *5G mmWave Consultation Comments*, para 46 & 72.

123. Notwithstanding our belief that the satellite industry should be required to pay for their acquisition and holding of spectrum at a level that more accurately reflects the opportunity costs and better incents them to deploy, and that satellite operators should share satellite spectrum in urban areas, Rogers believes that the Department's spectrum policy needs to be sufficiently flexible to allow innovative Canadian satellite services to develop and thrive. Rogers does expect that, as part of the ongoing standards studies, that satellite services will have a part in the various 5G discussions. However, to be clear, satellite services will primarily play a complementary role to terrestrial 5G in rural and remote connectivity areas.

124. As we recently stated in the 5G mmWave Consultation, the terrestrial wireless industry will be the key driver for 5G in urban and suburban areas and along major transportation routes, and the Department must not adopt overly restrictive technical or regulatory barriers that hamper the deployment of 5G terrestrial systems. mmWave spectrum should be made available as rapidly as possible using a technologically-neutral approach while ensuring reasonable protection of incumbent services in order to enable greater spectrum utilization and allow Canadian consumers to benefit from wireless innovations.[53] The Department should use this Consultation process to help redress the spectrum imbalance between the mobile and satellite industries.

Q10: ISED is seeking comments on the above demand assessment for FSS/BSS for the period 2018-2022. Is there additional information on demand, which is not covered above, that should be considered with regards to the below bands?

a. C-band
b. Ku-band
c. Ka-band

a. C-band

125. As the Department highlights in the Consultation, both the CRTC and a third-party have noted the negative demand for satellite capacity for traditional systems in the C-band going forward.[54] Rogers agrees that this band is in decline from traditional satellite services and that the spectrum in 3.4-4.2 GHz should be allocated to the mobile industry, particularly in populated areas. Further, if the band is allocated to mobile, deployment of services in rural areas should be market-driven in competition with satellite services. While incumbent satellite earth stations should have protection, it should not be overly restrictive and nothing should

[53] Rogers, *5G mmWave Consultation Reply Comments*, para 11.
[54] ISED, *Consultation*, para 74-75.

prevent mobile licensees from developing a mutually agreed arrangement, including site shielding or relocation, allowing terrestrial network operators to deploy their services in a geographic area where there is an existing grandfathered earth station.

126. 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.[55]

- 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."

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

127. All these reasons that result in the negative growth of C-band for satellite services support it being repurposed for terrestrial mobile service. At a minimum, it should be done outside of remote areas of Canada.

b. Ku-band

128. Upon review and investigation, Rogers believes that that capacity requirements for 4K may be overstated.[56] Our understanding is the Over The Top (OTT) services that deliver 4K can minimize the impact on spectrum bandwidths through newer codecs, as discussed above. As such, 4K capacity may only be required for real-time live events.

129. In addition to new OTT technologies continuing to make their services more efficient, we expect that satellite services will continue modernize their systems and become more spectrally efficient. The replacement of existing satellite systems with more advanced satellites that could achieve greater efficiencies and higher data rates to meet increasing customer demand will reduce the need for additional spectrum.

c. Ka-band

130. Rogers has no additional information on demand for the Ka-band at this time to provide to the Department.

Q11: What and how will technology developments and/or usage trends aid in relieving traffic pressures and addressing spectrum demand for satellite services? When are these technologies expected to become available?

131. As shared above in response to Q9, Rogers is aware of several new technologies that will aid in relieving traffic pressures and address spectrum demand for satellite services. Advanced new codecs such as SVC and HEVC are available and awaiting commercial deployments. Another technology is Dynamic Adaptive Streaming over HTTP (DASH), an adaptive bitrate streaming technique that enables high quality streaming of media content over the Internet delivered from conventional HTTP web servers. DASH and other mechanisms can assist with delivery of bitstreams and cache data in non-real time compared to the content, which will allow for satellite peak capacity requirements to be mitigated. SVC, HEVC, DASH, and other advanced codec technologies will thus reduce the demand for satellite spectrum going forward.

[56] ISED, *Consultation*, para 79.

132. Satellites designed for Ka-band operation can leverage highly focused spot beams and a large 1500 MHz spectrum channel to provide true broadband Internet service to the Canadian hinterlands. Frequency reuse results in a huge increase in capacity. Consider, for example, a 100-beam Ka-band broadband satellite with 1500 MHz of bandwidth available on two polarizations. Four-color frequency reuse allows 750 MHz to be assigned to each color. The total bandwidth of the satellite, with 750 MHz in each of 100 beams, is a staggering 150,000 MHz counting both forward and return directions. This example shows how Ka-band spectrum, multibeam antennas, and frequency reuse enable extremely high-capacity broadband satellites. ViaSat-1 is a Ka-band satellite of this kind, with 72 spot beams covering Canada and the U.S. ViaSat-2, launched June 1, 2017, more than doubles this Ka-band capacity for a total capacity exceeding 440 Gbps.

133. Rogers also notes that the market seems to have lost interest in 3D video, which was one of the key drivers for allocation of spectrum for satellite services. With a lack of consumer interest in such technologies, the spectrum demand for satellite services will be further reduced.

Q12: What satellite applications (e.g. broadband Internet, video broadcasting, backhaul, etc.) do you consider a priority for the period 2018-2022?

134. Satellites support broadband, video broadcasting, and telephone services for remote parts of Canada and should be a priority. Rogers does not view satellite as having a truly “killer app”, the consumer value of satellites is primarily their ability to connect those Canadians living in deep rural or remote locations that are uneconomic to build terrestrial facilities.

Q13: Do you agree with the above assessment on demand for backhaul in the next five years? Is there additional information on demand, which is not covered above, that should be considered? If so, please explain in detail.

135. Rogers agrees with ISED's assessment of demand for backhaul, especially the statement that, “the different use cases and high data rates anticipated for 5G commercial mobile services are expected to have a significant impact on the future backhaul spectrum requirements.”[57] While backhaul spectrum congestion is likely to increase in the next five years as the demand for more backhaul capacity grows

[57] ISED, *Consultation,* para 96.

to support the large data demands anticipated for 5G networks, the current backhaul licence fee regime may act as a governor on the efficient deployment of networks.

136. As stated above, current backhaul licence fees are too high in Canada and are a major impediment to the efficient use of certain frequency bands for backhaul. The current Canadian fee model does not give the operator sufficient incentive to maximize spectral efficiency; in fact, it penalizes efficient backhaul operators. Rogers recommends backhaul spectrum fees in Canada should be modernized and based on cost recovery. Further, Rogers recommends that backhaul spectrum licence fees in general be based on a fairer basis that rewards users who employ technologies and practices that yield maximum spectral efficiency per unit area. This would encourage users to take advantage of the latest technology developments to increase backhaul throughputs per occupied bandwidth, such as MIMO, spot beam antennas, beam forming antennas, and co-channel dual polarization (CCDP) features.

137. Although the *Ericsson Microwave Outlook* assessment of the global and North American trends to use fibre for backhaul is no doubt accurate,[58] the share of microwave facilities for backhaul used by Rogers is substantially higher than 20% on a nationwide basis, with variations depending on country location and whether within or outside populated areas. The underlying reason for Rogers' higher usage of microwave backhaul spectrum vis-à-vis some of our competitors is because of their rights-of-way access, which allowed them to construct much of their fibre backhaul facilities during their monopoly phases. Rogers operates a nationwide wireless network, with much of the coverage outside of our fixed network "footprint", and as a result we are forced to use microwave backhaul spectrum to a much greater extent than other Canadian operators.

138. For example, while the Belus joint network is a national network, Bell and Telus disproportionately build out their shared Radio Access Network in different parts of the country, largely along the lines of their incumbent wireline networks – areas where they have operated in some parts for over 130 years. Essentially, they each only build their share of the joint Belus network in areas where they have legacy monopoly rights-of-way access, which, more broadly, skews competition in the mobile wireless market.

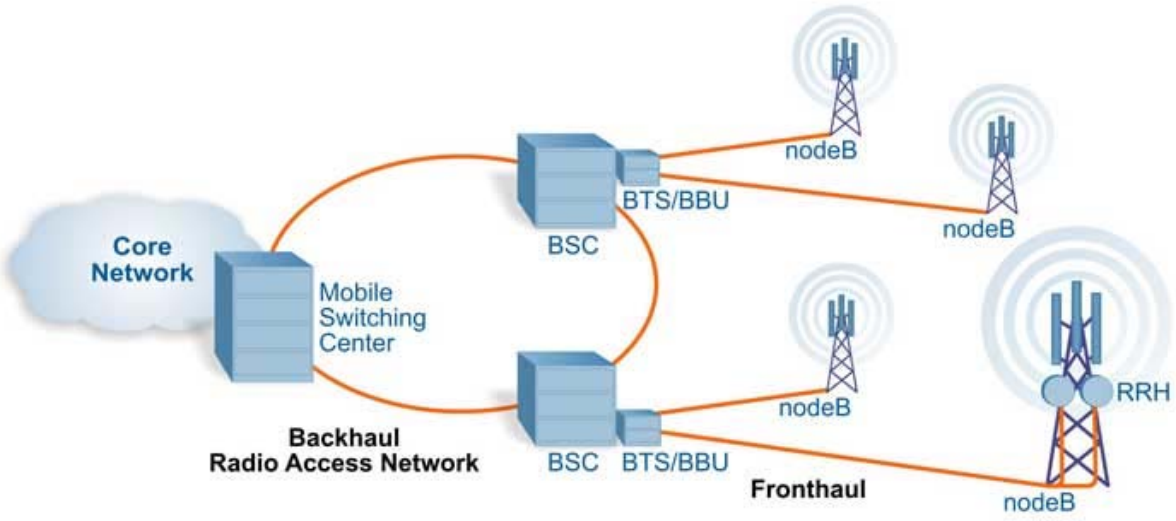
139. In the context of this consultation, it means that the Rogers' national network – Canada's largest single operator network – may experience a much greater scarcity of and need for spectrum for backhaul than other Canadian operators, especially those that emerged from local telephone monopolies. It is therefore essential that, in addition to increasing the amount of backhaul spectrum available,

[58] ISED, *Consultation,* para 97.

the Department ensures that any Federal, Provincial or Municipal accesses or infrastructure that local telephone companies possess from their monopoly period are similarly made available to all types of carriers in order to increase competition for the benefit of all Canadian businesses and customers.

140. There is a new trend in wireless network design towards a Centralized Radio Access Network (C-RAN) architecture, illustrated below in Figure 4. In the C-RAN architecture, the radio elements are split into two parts, a Base Station Transceiver/Baseband Unit (BTS/BBU) part and a Remote Radio Head (RRH) part. This configuration provides increased efficiency and flexibility by aggregating the BTS/BBU elements into large pools. The BTS/BBU and RRH elements require broadband connectivity to support the high bandwidths provided by a 4G or 5G RAN. This connectivity is called fronthaul. Fronthaul can be provided using either an optical fibre or microwave connection. Going forward, as C-RAN architecture becomes more widespread in 4G and 5G networks, Rogers expects that the demand for microwave-based fronthaul will drive an increase in the amount of microwave spectrum required.

Figure 4: Centralized Radio Access Network (C-RAN) architecture

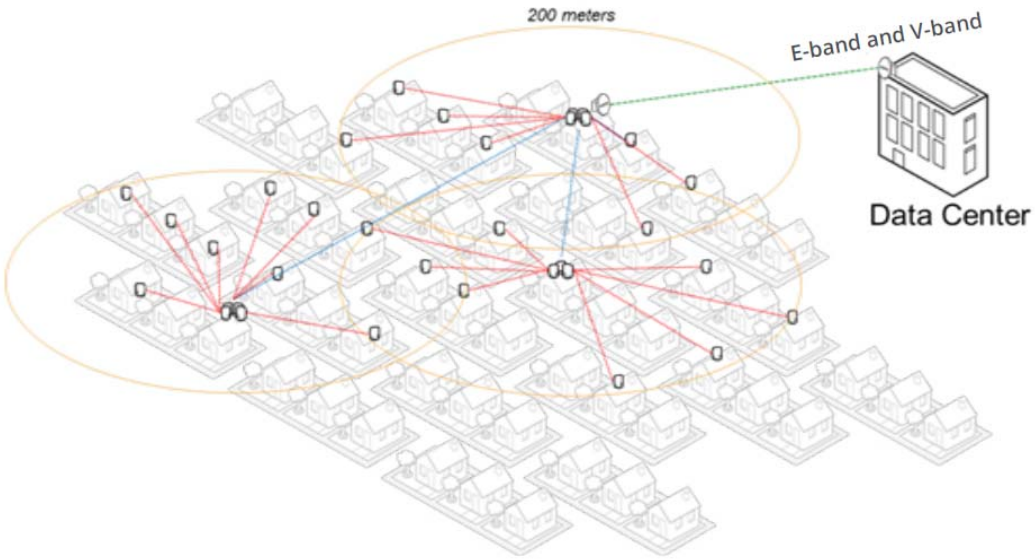


Source: Omnitron Systems, *Migrating to Cloud-Based RAN Fronthaul*; https://www.omnitron-systems.com/cpri-fronthaul/migrating-to-cloud-based-ran-fronthaul.php.

141. Another potential driver for increased backhaul spectrum is Fixed Wireless Access (FWA) services. FWA has the potential to provide “last mile” access to homes, businesses, and commercial enterprises, as an alternative to conventional copper, fibre, or coaxial fixed access technologies. It is widely expected that a fixed version of 5G mobile technology will allow FWA to support the type of speed and reliability normally associated with fibre or coaxial fixed access technologies, and to be cost competitive with those. For residential customers, FWA could potentially

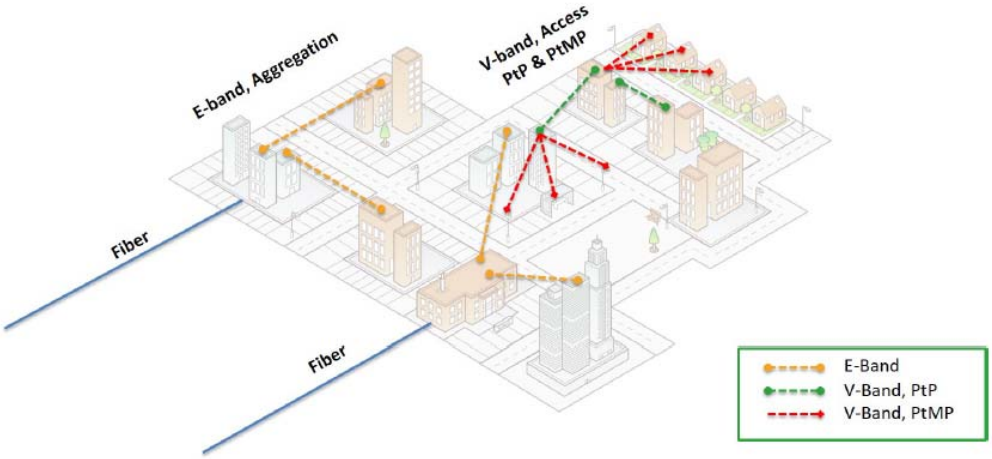
serve both single family neighbourhoods as well as multiple dwelling units (MDU), as shown in the graphics below. In both cases, there will be a need for very high capacity wireless backhaul, for example using E-band or V-band microwave radio links (shown as green and blue lines in Figure 5, as well as yellow and green lines in Figure 6).

Figure 5: 5G-based Fixed Wireless Access network for single family home neighbourhood



Source: Maravedis, *5G Fixed Wireless Access Gigabit Services Today: An Industry Overview*; http://www.maravedis-bwa.com/.

Figure 6: 5G-based Fixed Wireless Access network for multiple dwelling unit neighbourhood



Source: Maravedis, *5G Fixed Wireless Access Gigabit Services Today: An Industry Overview*.

Q14: Backhaul service in Canada is delivered using a variety of solutions, including fibre optics, microwave radio and satellites. What changes, if any, are anticipated to the mix of backhaul solutions employed?

142. Rogers expects that the mix of backhaul solutions will change, driven by a combination of technological change, regulatory environment, and business needs. In urban areas, where there is an abundance of existing copper and fibre-based wired networks, we expect to see these networks increasingly utilized for backhaul. However, providing Canadian wireless carriers with better and more timely access to public and private infrastructure at economical rates is critical to 5G deployments and granting them the same rights-of-way access as local telephone companies is critical in order to support competition and the provision of high quality and innovative wireless services to Canadians. The Department should undertake an examination of the regulatory impediments to wired network infrastructure investment and deployment, and look to adopt best practices where impediments might be removed or reduced in order to promote the rapid deployment of advanced broadband services in Canada.

143. At the same time, wireless solutions are still considered as viable and a very much needed alternative when it is not possible to use a fixed solution for technical, financial, or timeliness reasons. In rural areas, where wired networks are not as prevalent, wireless solutions will continue be the preferred solution for backhaul. Satellite will continue to be an option in deep rural and remote areas where even microwave backhaul is not economical.

144. New technologies such as 5G wireless and Distributed Radio Access Network (D-RAN) topology, will require significantly larger amounts of bandwidth, and will drive a trend towards using fibre-based backhaul and fronthaul. As in the C-RAN example above, fronthaul is also used to connect radio baseband units to RRHs in a D-RAN topology. Wireless-based solutions will remain a viable solution when a wired-based approach is not possible, by using new technologies as described in Q15 below.

145. As demand continues to grow though, additional backhaul spectrum and a new fee regime that does not penalize efficient microwave operators looking to use their current holdings to increase capacity are needed for facilities-based operators to continue to offer customers high-quality and innovative services. Consumers expect continuing evolution of technologies and services, but further improvements in networks or services will be difficult without more spectrum opened, including exclusively licensed spectrum, for backhaul use and more reasonable backhaul spectrum fees.

Q15: What and how will technology developments and/or usage trends aid in relieving traffic pressures and addressing spectrum demand for backhaul services? When are these technologies expected to become available?

146. Rogers has taken, and will continue to take, measures to get the maximum spectral efficiency and capacity from our wireless backhaul links. New technologies and features/techniques are available or being developed for increased capacity and spectrum efficiency, as discussed below. However, these developments will not significantly mitigate the demand for additional spectrum to support the exponential backhaul capacity growth that is occurring now to support 4G LTE mobile wireless. More spectrum for backhaul will become even more critical with the launch of 5G technologies, especially those supporting eMBB – massive mobile broadband.

147. On the technology developments side, Rogers has upgraded our systems with adaptive modulation, higher order modulation, CCDP, and cross-band carrier aggregation. On the spectrum usage side, Rogers is actively investigating the use of the unlicensed 60 GHz band, which has an abundance of underutilized spectrum, for short-distance fronthaul supporting small cell remote radio units, and will not have the efficient operator cost penalty that licensed backhaul spectrum currently possesses due to the current backhaul spectrum licence fee. However, as noted previously, potential usage of unlicensed spectrum for backhaul does not eliminate the need for additional exclusively licensed spectrum for backhaul at reasonable rates.

148. Looking ahead, Rogers expects some new technological developments to support more additional, modest improvements in the efficient use of backhaul spectrum. For example, 3GPP is developing technical standards for Integrated Access Backhaul (IAB), which will allow 5G base stations operating in the mmWave bands to concurrently use spectrum for both access and backhaul. This will relieve the pressure on operators to extend wired backhaul to each and every 5G base station. Rogers recommends that all licences for operation in the mmWave bands should be flexible use licences to allow both access and backhaul (or fronthaul) operation.

149. Another anticipated technical development is in the potential use of MIMO antennas, which has proven its usefulness in mobile services. Although MIMO benefits lie in overcoming non-line-of-sight conditions in mobile services networks, MIMO also has potential for line-of-sight links by potentially increasing capacity (spatial multiplexing) and/or link availability (space coding) in fixed networks. See ITU-R Recommendation F.2323 *Fixed service use and future trends* for additional

information.[59] Line-of-sight MIMO technology is available today with multiple vendors in traditional bands. However, this technology may be especially attractive for future use in the D band (130-174.8 GHz), discussed below, given the small spatial separation requirement between antennas, i.e. the whole assembly could be possibly housed in a small form factor.

150. Other technical developments include multiband bonding, combining 70/80GHz with 15/18/23GHz and 15/18/23GHz with 6/8/11GHz, to alleviate congestion in the lower bands (available today). Another is the use of full duplex radios in the same channel spectrum (overlap in both time and frequency), where both transmitter and receiver operate on same channel. Research and lab evaluations of full duplex radios are on-going and products are expected to be available by 2020 for 5G launch. Additionally, bandwidth adaptive radios could be used to increase link robustness in the presence of interference.

151. In the future, asymmetric frequency-division duplexing (FDD) as opposed to traditional FDD symmetrical bandwidth, could potentially address the current asymmetrical uplink and downlink traffic levels and as a more efficient use of backhaul spectrum. Further, flexible FDD could be used to allow the flexible provisioning of Tx/Rx separation. This could be achieved by using separate transmit and receive antennas instead of diplexers. While this technology is currently available, we are not aware of any practical applications/deployment.

152. Rogers expects the most meaningful expansion of backhaul capacity to come from low-cost access to additional spectrum allocated for this purpose. Wider channel bandwidths support higher capacity for a given radio system, making this particularly attractive for backhaul. E-Band spectrum, recently opened in Canada (SRSP-371.0), is a good example, which is particularly appealing for wireless backhaul in urban and suburban areas. The wide channel bandwidth available supports upwards of 10 Gbps today, and with support for 20 Gbps speeds planned for 2018. However, as with other backhaul spectrum bands, the interim site-specific licensing cost under *SP 70 GHz — Decisions on the Frequency Bands 71-76 GHz, 81-86 GHz and 92-95 GHz*,[60] dated June 2012, for E-band links currently poses a major hurdle to MNOs, as that 10 Gbps link would cost $140,000 per year under the current fee regime. Rogers recommends a reasonable cost-recovery based annual spectrum licensing regime be issued quickly to encourage the use of this band.

[59] ITU, *ITU-R Recommendation F.2323 Fixed service use and future trends*; https://www.itu.int/pub/R-REP-F.2323-2014.
[60] ISED, *SP 70 GHz — Decisions on the Frequency Bands 71-76 GHz, 81-86 GHz and 92-95 GHz*; https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10395.html.

153. Rogers agrees that the recent allocation of the 32 GHz band for backhaul was a positive step for the industry but we note that band usage standards have not been written yet, which may delay utilization of the band.[61] Another frequency range which could help relieve pressure is 40.5-43.5 GHz, which was identified in the *Decisions on Spectrum Utilization Policies and Technical Requirements Related to Backhaul* (Backhaul Decisions) as potentially suitable for fixed point-to-point allocation and would be taken into consideration in future licensing and policy frameworks.[62] Rogers recently recommended, as part of the 5G mmWave Consultation, that the Department move forward quickly with opening one or both of these bands to compensate for the potential loss of dedicated fixed service in the 38 GHz band.[63]

154. Work is progressing on developing backhaul equipment for use in the D-Band (130-174.8 GHz). Prototypes are being tested by some vendors and products are expected before the end of the decade. Rogers recommends that ISED plan the development of a band use policy (a Standard Radio System Plans or SRSP) well in advance to ensure its readiness at the time the products become commercially available.

155. The ITU, under WRC-19 Agenda Item 1.15, is studying a fixed service allocation in the 275-450 GHz range that is expected to lead to the development of microwave links capable of transporting in excess of 20 Gbps up to 0.3 km, which would allow its use for wireless backhaul in IMT-2020 (5G) mobile networks. Assuming that this allocation is approved at WRC-19, Rogers recommends that ISED consider issuing a band use policy for this frequency range at an appropriate time early in the next decade.

Q16: Will the demand for commercial mobile, licence-exempt, satellite, or fixed wireless services/applications impact the demand for backhaul spectrum? If so, how and which of these services/applications will create the most impact?

156. For Rogers, increased capacity in backhaul networks is essential to support the growth in traffic volumes on our mobile network. We depend heavily on microwave backhaul in many areas of Canada and we expect an overall increase in our aggregate bandwidth and capacity requirements over the next 3-5 years for backhaul spectrum across all bands. This is being driven in large part by the

[61] ISED, *Consultation*, para 110.
[62] ISED, *Decisions on Spectrum Utilization Policies and Technical Requirements Related to Backhaul* (Backhaul Decisions); http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10880.html.
[63] Rogers, *5G mmWave Consultation Comments*, para 54.

ongoing deployment of 4G LTE and LTE-Advanced technologies, which have allowed Canadians to access video services and the Internet from smartphones, tablets, portable computers, in-vehicle systems, and other devices, and Canadians have responded by consuming these services in ever increasing quantities. In many cases, the video and data is carried over wireless backhaul, and this has driven the demand for backhaul spectrum. In addition, the FCC has recently approved the operation of LTE-U base stations that operate in unlicensed channels in the U-NII-1 (5150-5250 MHz) and the U-NII-3 (5725-5825 MHz) bands.[64] Licence-exempt access spectrum used by technologies such as LTE-U and LTE-LAA will also increase the demands on backhaul spectrum, as will fixed wireless services. Once 5G deployments begin to be deployed, demand for backhaul spectrum will continue to exponentially increase.

157. Looking forward to the 5G/IMT-2020 era, Rogers notes that ITU has developed three broad use cases for 5G: Enhanced Mobile Broadband (eMBB); Massive Machine Type Communications (mMTC); and, Ultra-Reliable Low Latency communications (URLLC). All three of these 5G/IMT-2020 use cases are expected to drive further demand for backhaul spectrum.

158. eMBB is expected to increase the maximum throughput available to an individual user from about 1 Gbps (the “high end” of what 4G can deliver) to about 10 Gbps. This will allow even more wireless video and data services, as well as emerging services like AR & VR, to be delivered over mobile networks. mMTC is expected to increase the number of connected IoT devices by several orders of magnitude, and with it the amount of IoT data that is transported wirelessly. Although each device is likely to only use a small amount of data, the aggregate amount will be quite large due to the sheer number of devices connected. URLLC is expected to make it possible to enable a wide range of tasks to be performed by machines, tasks that require extremely low end-to-end latency (including the radio link) and extremely high reliability. Being able to support these two URLLC requirements demands that computer processing power be placed near the user, very wide radio channels be used to control the machinery, and that radio networks be very dense. All of these network aspects of the three IMT-2020 use cases will require greater backhaul capacity and spectrum.

159. 5G also holds the potential to support Fixed Wireless Access (FWA) services that can potentially replace a “last mile” wired connection with a wireless equivalent. As noted above, the GSMA states that fixed wireless will be the initial use case for early 5G deployments by U.S. network operators, with 5G fixed wireless services

[64] For example see: FCC, *Grant of Equipment Authorization*, https://apps.fcc.gov/oetcf/tcb/reports/Tcb731GrantForm.cfm?mode=COPY&RequestTimeout=500&tcb_code=&application_id=NvOgdtHmEJsZmr34OrcLMA%3D%3D&fcc_id=TA8AKRD90106083.

to be launched in 2018.[65] FWA services are expected to employ a dense network of 5G base stations operating in the mmWave bands. Servicing this network will require a mix of wired and wireless backhaul, again driving demand for wireless backhaul spectrum.

160. While microwave backhaul is an important part of our network deployment, there are situations where non-radio alternatives such as fibre are more attractive, based on costs and bandwidth. As noted above, Rogers believes the Department should take an active role in facilitating the rapid deployment of 5G infrastructure. This must include making any facilities advantages that local telephone companies possess available to all other competitors and granting all wireless carriers better access to public rights-of-way. Such actions will increase competition in the provision of 5G services for the benefit of all Canadian businesses and customers, as access to (wireline) local connectivity and installation of wireless facilities, including antennas, are critical to 5G deployments. However, as fibre is not readily available everywhere in Canada, Rogers continues to have an ongoing requirement for additional backhaul spectrum.

Q17: Is there a range or ranges of frequencies that will be in higher demand over the next five years? Why is higher demand anticipated for these frequency ranges?

161. Rogers believes that numerous frequency bands will be in higher demand over the next five years. As the Department states:

> The new applications and services that are expected to be made available through 5G technologies will likely need bands in different frequency ranges in order to be realized. 5G networks will require low frequency bands for coverage, mid-range frequency bands to provide both coverage and capacity, and high frequency bands to provide large bandwidths to meet high broadband speeds.[66]

162. Specifically, Rogers believes that all of the following existing and new bands will be in higher demand over the next five years:

- 3700-4200 (rural backhaul only, as the band is converted to mobile in urban areas);
- 5925-6425 MHz;
- 6425-7125 MHz;

[65] GSMA, *The Mobile Economy: North America 2017*, pg 3.
[66] ISED, *Consultation*, para 43.

- 7125-7725 MHz;
- 7725-8275 MHz;
- 10.7-11.2 GHz paired with 11.2-11.7 GHz;
- 12.7-13.25 GHz;
- 14.5-14.875 GHz paired with 14.975-15.35 GHz (14.660-14.820 GHz and 15.135-15.295 GHz allocated for Department of National Defence use);
- 17.8-18.3 GHz paired with 19.3-19.7 GHz;
- 21.8-22.4 GHz paired with 23.0-23.6 GHz;
- 25.25-26.5 GHz;
- 31.8-33.4 GHz (32 GHz Band);
- 38.6-40 GHz; and,
- 71-76 GHz paired with 81-86 GHz.

163. The greatest impact will likely be in frequency ranges above 71 GHz, as 5G/IMT-2020 is expected in urban areas where very small cells will be deployed. As higher frequency ranges support much larger transport capacity at short distance, they are very well suited to provide wireless backhaul to IMT-2020 mobile networks.

164. Currently, RSS-210 Annex J allows use of 57-64 GHz for unlicensed wireless backhaul. Due to radio propagation properties in this frequency range, achievable links' length will be very short (a few hundred meters at the most), making it possible to have close distance reuse. Also, as current products can support capacity up to 1 Gbps, it is expected to be a viable means to backhaul small cell traffic. In addition, as licence-exempt spectrum, this band will not have the efficient operator cost penalty that licensed backhaul spectrum currently possesses due to the current backhaul spectrum licence fee. Therefore, it is anticipated that this frequency range may also be in high demand.

165. Further coverage expansion and capacity increase requirements in rural and remote areas will certainly drive the utilization of lower frequency spectrum bands in these areas even higher. As rural and remote areas are typically outside fibre footprints, operators heavily rely on microwave technologies for their transport needs. We believe that the limited spectrum currently available in frequency bands 6 GHz – 8 GHz may not be sufficient to meet increasing demands for higher capacity long haul microwave systems in next 5 years, but certainly not beyond that time. As discussed further below in Q19, the Department should consider opening the 3700-4200 MHz band for backhaul use in rural and remote areas, as part of a larger consideration of opening the entire 3400-4200 MHz band to exclusively licensed flexible use.

Q18: Will allowing flexible fixed and mobile services within the same frequency band change how backhaul is planned and used?

166. Allowing flexible fixed and mobile services within the same frequency band will indeed change how backhaul is planned and used. Even with flexible licensing, it is important that the spectrum be licensed to a single licence holder and not shared by multiple owners. Exclusively licensed spectrum will continue to be a key input for ensuring service providers can offer a high quality of service that allow Canadian companies to take advantage of the latest technologies to better compete globally. ISED should release additional exclusive backhaul spectrum licences in order to minimize the potential for interference to the mobile communications infrastructure that Canadian consumers and businesses rely on.

167. Flexible use licensing would certainly assist mobile network operators in more rapidly and efficiently addressing backhaul issues, which in turn would allow better customer experience. Flexible licensing will allow network operators to evaluate market conditions and deploy the best-suited technology to meet local demand, whether that be access (fixed or mobile) services or backhaul services to support access in other bands.

168. As such, we support ISED consideration of flexible use policies similar to what is being proposed in the 5G mmWave Consultation and encourage ISED to consider similar arrangements in other suitable bands. Rogers notes that SRSP-517 for the BRS band already supports the use of the band for both mobile or fixed applications, and we encourage adopting a similar approach in other bands which would assist Canadian licensees in making optimal use of this spectrum. Further, as per our response to Q15, Rogers notes that 3GPP Integrated Access Backhaul (IAB) is an emerging technology that will require flexible licensing.

169. If IAB, or in-band self-backhauling, is used, a process where a radio automatically determines the spectrum allocations between access and backhaul, then backhaul planning may not be as intensive. However, there will be other challenges to overcome with this type of backhaul, such as potential limitations on the end user experience (e.g. throughput and latency impacts) or interference due to the sharing of spectrum between access and backhaul. This is where full duplex technology may be required to mitigate self-interference.

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

800 MHz (Section 6.3.1)

170. Rogers agrees with the Department's assessment of this band, and specifically with the determination that the 800 MHz band has high potential for commercial mobile service.[67]

171. The Americas region is split on the way forward for the 800 MHz band. The U.S. embarked on an ambitious and costly transition plan back in 2004, which involved rebanding the 800 MHz band and swapping spectrum in the 1900 MHz band to allow Sprint/NEXTEL to improve their spectrum situation and to relocate public safety users to a new band. This transition is still underway, thirteen years later, and was complex enough that it required the creation of a Limited Liability Corporation (the 800 MHz Transition Administrator) to oversee the process. This process resulted in the creation of a new Band 26 standard for LTE that is being used to deliver commercial mobile services.

172. However, many other countries in the Americas have taken a different approach. CITEL is working to harmonize the 800 MHz band across the Americas and appears to prefer a different band plan than the United States.[68]

173. In Asia, the Asia-Pacific Telecommunity (APT) has made little progress on regional harmonization of the 800 MHz band. To the best of our knowledge, the most recent activity was in 2013 when the APT released the report *APT Report on 806 - 960 MHz Frequency Arrangements, National Allocations and Assignments for IMT* (No. APT/AWG/REP-36).[69]

174. Despite the lack of international harmonization, and even the lack of harmonization within the Americas, Rogers agrees with ISED's proposal to review this band for commercial mobile services in the next five years. The specific issues of cross-border coordination, interoperability, economies of scale and roaming between countries can be addressed as part of a consultation with stakeholders. However, consistent with our position in other bands, the Department should only consider 800 MHz ESMR licensees eligible to exchange their current licences for

[67] ISED, *Consultation,* para 121.
[68] See CITEL Recommendation PCC.II/REC. 35 (XX-12) *Use of the frequency range 807-849 / 852-894 MHz for mobile cellular services*. (see Document CCP.II-RADIO/doc. 3160/12 rev.1); https://www.citel.oas.org/en/Pages/PCCII/Final-Reports.aspx.
[69] APT, *APT Report on 806 - 960 MHz Frequency Arrangements, National Allocations and Assignments for IMT (No. APT/AWG/REP-36)*; http://www.aptsec.org/AWG-RECS-REPS.

new commercial mobile ones if they meet all of their spectrum implementation conditions of licence.

900 MHz (Section 6.3.2)

175. Rogers agrees with the Department's assessment of this band. Regarding the 896-902/935-941 MHz portion of this band, we recommend that ISED wait to see the outcome of the U.S. efforts to re-purpose the band. The proposals described in *Notice of Inquiry 17-108* are innovative and could result in the introduction of new services.[70] Failing that, ISED should consider a more comprehensive re-structuring of the 896-902/935-941 MHz portion of this band. We note that this band is aligned with 3GPP Band 8 (880-915/925-960 MHz) and therefore a Band 8 ecosystem could potentially be used in Canada.

176. Regarding the 940-960 MHz portion of the band, we note that ISED has initiated a consultation SMSE-019-17, which could result in the introduction of wireless microphones into portions of this band.[71]

L-Band (Section 6.3.3)

177. We agree with ISED's assessment of this band. However, Rogers notes that in addition to the 3GPP band standards identified in the consultation (Bands 11, 21, and 32),[72] 3GPP has developed two new 4G/LTE band standards for the L-Band: Band 75 and Band 76. It should be noted that:

- 3GPP Band 75 extends from 1432-1517 MHz; like Band 32, it is for downlink only and is intended for use in Supplementary Downlink (SDL) mode;
- 3GPP Band 76 extends from 1427-1432 MHz; like Band 32, it is for downlink only and is intended for use in SDL mode; and,
- Bands 75 and 76 were engineered to protect EESS (Earth Exploration-Satellite Service) below 1427 MHz and MSS (Mobile Satellite Service) above 1518 MHz.

178. Rogers agrees with ISED view that the L-Band should be converted to fixed or mobile use.[73] Rogers expects that the band will eventually be globally harmonized and that a global ecosystem of devices will emerge, making this band an excellent candidate for commercial mobile services in Canada. ITU Working Party 5D (WP5D) is working on updating Recommendation M.1036 to reflect L-Band

[70] FCC, *Notice of Inquiry 17-108*; https://apps.fcc.gov/edocs_public/attachmatch/FCC-17-108A1.pdf.
[71] ISED, *Consultation on the Technical, Policy and Licensing Framework for Wireless Microphones*; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11342.html.
[72] ISED, *Consultation,* para 129.
[73] ISED, *Consultation*, para 132.

identification for IMT, which is scheduled to be completed by October 2018.[74] Further, there is a discussion occurring within ITU WP5D and Working Party 4C (WP4C) regarding the upper end of this band, where the satellite operator INMARSAT is asking for protection in the form of a 5 MHz guard band (1513-1518). However, in our view, the likely outcome is a guard band of 1 to 3 MHz.

AWS-3 Unpaired (Section 6.3.4)

179. Rogers agrees with the assessment of this band. We agree that an ecosystem of Band 70 devices is likely to emerge within the next five years and that incumbent meteorological services can be adequately protected.

180. Rogers provided more in-depth comments on this band in response to the application by TerreStar Solutions for a Tier 1 licence and our position remains unchanged.[75] ISED should make AWS-3 Unpaired spectrum available as part of a 3GPP Band 70 configuration but that licences should be awarded through an open auction process.

3500 MHz (Section 6.3.5)

181. Rogers agrees with the Department's assessment of this band and recommends that ISED follow the lead of Europe, Asia, and the Americas in adopting a globally harmonized band for 5G mobile services. Further, we support ISED's decision to expand the upcoming consultation to include a review of 3400-4200 MHz.[76]

182. We note 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.[77] 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 Things)".[78] Ireland auctioned their 3.6 GHz Band (3410-3435 MHz and 3475-3800 MHz) in 2017, a band the Irish spectrum regulator, ComReg,

[74] ITU, *Recommendation M.1036*, Attachment 4.2 of Chapter 4 of ITU-R WP 5D Chairman Report (document 5D/758); https://www.itu.int/md/R15-WP5D-C-0758/en. [Note: Document access restricted to TIES users.]
[75] Rogers, *Notice of Application Received from TerreStar Solutions Inc. for a Tier 1 Spectrum Licence in the 1695–1710 MHz Frequency Band and in the PCS Block H (1910–1915 MHz/1995–2000 MHz),* Comments & Reply Comments.
[76] ISED, *Consultation*, para 142.
[77] 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.
[78] 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.

highlighted as being identified "as a primary band suitable for the introduction of 5G in Europe".[79]

183. The Department should adopt the European 3500 MHz spectrum licensing model and retain exclusive licensing within the band for Canada. Exclusively licenced spectrum bands are key inputs in current networks and will create a more certain spectral environment. This will be crucial as operators roll out 5G infrastructure and overcome any engineering challenges that would result from the unprecedented densities and innovative new uses of spectrum in 5G networks. However, ISED should move from a fixed wireless usage to a flexible use model, similar to the Department's 5G mmWave Consultation, which will allow licensees to deploy fixed terrestrial or fixed or mobile wireless access services based on network needs and market demands. The Department should also provide incumbent 3500 MHz licensees currently holding fixed service Tier 4 licences in the band with new flexible use licences for all service areas in which they meet their spectrum implementation conditions of licence as per Annex A of the *Decisions Concerning the Renewal of 2300 MHz and 3500 MHz Licences*.[80]

184. The new Canadian 3500 MHz band should be consistent with ITU actions and with ongoing standardization efforts in 3GPP, which will greatly impact the future 3500 MHz ecosystem. 3GPP has made substantial progress towards developing standards for three new 5G band standards for the 3500 MHz band:

- Band n77 will extend from 3300 MHz to 4200 MHz and is intended primarily for the Japanese market; the extremely wide bandwidth may impair the radio performance somewhat but the operators there seem willing to make this tradeoff in exchange for harmonization with the rest of the world;
- Band n78 will extend from 3300 MHz to 3800 MHz and is intended for European and American markets; and,
- Band n79 will extend from 4400 MHz to 4900 MHz and is intended for the Japanese and Chinese markets.

185. Over time, as the 3500 MHz band is 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 mmWave bands high capacity

[79] 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/.

[80] ISED, *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

5G characteristics. Fragmenting the band through small(er) bandwidth allocations will prevent Canadians from fully benefiting from 5G connectivity in the 3500 MHz band.

186. Rogers recommends that ISED make no effort to align with the U.S. Citizen Broadband Radio Service (CBRS) band. The U.S. is undertaking a very complex Licensed Shared Access (LSA) approach, in which a database manages spectrum on behalf of client licence holders, to manage the CBRS band but could limit the band's usage for 5G deployments. Notably, the LSA approach in the U.S. makes it unlikely that operators will be able to provide the wide contiguous channels in the CBRS band that makes the 3500 MHz band so well suited to 5G in Canada.

187. The U.S. and Canada spectrum environments at 3500 MHz are materially different, especially with the lack of Canadian incumbent military users in the band. As such, the three-tier licensing system, which may be necessary for the U.S. market, would add an unnecessary burden if applied to Canada.[81] Further, in *Notice of Inquiry 17-183*, the FCC is looking at the 3700-4200 MHz portion of the band to determine if there are opportunities for more intensive fixed use, for mobile broadband use, and for flexible arrangements that would allow fixed and mobile applications to co-exist.

188. Rogers notes that CITEL is developing a new 3300-3700 MHz 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 lead to a new globally harmonized band plan.[82]

5 GHz (Section 6.3.6)

189. Rogers' view is that this band is so important for many licence-exempt applications that the Department should resist any proposals that would further restrict RLAN operations, and look for opportunities to extend the band for RLAN usage, if possible. Should other services be looking to get greater access to this high demand band, ISED should ensure that, at a minimum, it will not negatively impact the current Wi-Fi/RLAN allocation.

190. Rogers supports ISED's intention to align the Canadian regulations with international regulations,[83] as this market is strongly dependent on the existence of a global ecosystem of devices. Rogers expects WRC-19 to recommend changes to

[81] FCC, *Notice of Proposed Rulemaking 17-134 – Promoting Investment in the 3550-3700 MHz Band*; https://apps.fcc.gov/edocs_public/attachmatch/FCC-17-134A1.pdf.
[82] CITEL, Minutes of Meeting XXIX, October 2017; https://www.citel.oas.org/en/Pages/PCCII/Final-Reports.aspx.
[83] ISED, *Consultation*, para 149.

this band and we encourage ISED to fully align with those changes to the extent possible.

191. Rogers anticipates the future widespread use of LTE-based radios in this band, operating in LTE-U or LTE-LAA modes. Rogers further anticipates that an unlicensed or LAA version of 5G New Radio will be developed for use in this band at some point in the future. However, 3GPP has deferred development of an unlicensed form of NR until at least Release 16, which is scheduled for completion in late 2019.

192. 3GPP is currently developing LTE-based technologies for use in the Dedicated Short Range Communications (DSRC) portion of this band (5850-5925 MHz). The LTE-based technology is often called Cellular Vehicle-to-Everything (C-V2X). C-V2X was developed as an alternative to the IEEE 802.11p-based technology. Rogers expects that the C-V2X will outperform the IEEE 802.11p-based technology that has been developed for the DSRC band. However, Rogers' view is that the DSRC band should be technology neutral to allow the market to choose best technology.

193. Rogers notes that the ITU is seriously considering support of high power operation in the 5150-5250 MHz portion of the band, which would align with ISED's decision to allow higher power and outdoor RLAN devices (HPODs) to operate in this band. Rogers commends the Department for allowing HPODs to operate in the 5150-5250 MHz band prior to WRC-19 as a positive step to make more efficient use of spectrum today for the services that Canadians are demanding.

Bands above 24 GHz (Section 6.3.8)

194. Rogers agrees with the Department's assessment of these bands. We encourage ISED to make spectrum available in these bands for fixed and mobile services, aligning with regulations in the U.S., Europe, and other regions, to the maximum extent possible.

195. 3GPP is developing standards for 5G NR technology for a number of IMT bands above 24 GHz, all of which should be completed as part of Release 15 in spring 2018. Bands under consideration include:

- Band n257, operating in the band 26500 MHz - 29500 MHz;
- Band n258, operating in the band 24250 MHz - 27500 MHz;
- Band n259, operating in the band 31800 MHz - 33400 MHz; and,
- Band n260, operating in the band 37000 MHz - 40000 MHz.

196. Rogers notes that the FCC in their 2nd Report & Order for the *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services* consultation has ordered several

changes to these bands.[84] One makes available 700 MHz of new spectrum in the 24 GHz band for 5G mobile services, 24.25-24.45 GHz (200 MHz) and 24.75-25.25 GHz (500 MHz) with Upper Microwave Flexible Use Service (UMFUS) licensing. Another makes available 1000 MHz of new spectrum in the 47 GHz band for 5G mobile services, 47.2-48.2 GHz (1000 MHz) also with UMFUS licensing.

197. As such, Rogers agrees that the 24.25-27.5 GHz is the next "band of interest" for 5G-based services due to significant international interest,[85] and we encourage ISED to consider a consultation on this band within the next five years.

198. Further, Rogers agrees that the recent allocation of the 32 GHz band for backhaul was a positive step for the industry but we again note that band usage standards have not been written yet, which may delay utilization of the band. Rogers encourages the Department to move quickly on developing the technical standards for the 32 GHz band to compensate for the loss of dedicated fixed service in the 38 GHz band.

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

a. the proposed services and/or applications for each frequency band
b. the potential timing of releasing for each frequency band
c. the priority of the release of the frequency bands

Provide supporting rationale for your responses.

199. Rogers is pleased to provide the following comments on the frequency bands in Table 7 of the Consultation, including on: the proposed services and/or applications for each band; the potential timing of releasing for each band; and, the priority of the release of the various frequency bands.

Band	**Potential Service/Application**
814-824 paired with 859-869 MHz (800 MHz)	Commercial mobile

200. This band has high potential for commercial mobile services in Canada. 3GPP has already completed standardization for Band 26 and Band 27, which would allow fairly rapid deployment of LTE-based network. However, there would need to

[84] FCC, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services* (2nd Report & Order); https://ecfsapi.fcc.gov/file/11222494324943/FCC-17-152A1.pdf.
[85] ISED. *Consultation,* para 163.

be industry consultation to assess candidate band plans and licensing arrangements. The consultation should include the entire 806-824 MHz and 851-869 MHz range, as there are public safety users in the band whose needs must be considered in any changes to the band. As such, any consultation on this band should include stakeholders in the public safety, Specialized Mobile Radio (SMR), and mobile network operator communities.

201. It has taken the U.S. more than ten years to transition the 800 MHz band. We expect that the process may take as long in Canada if major changes to the band are needed, especially to the public safety portion of the band where disruptions would be highly disruptive to these essential services and could put Canadians' safety at risk. It is possible that the transition process could be significantly shortened if Canada were to adopt a Band 27 plan. Further, there may be some dependency on the availability of a Public Safety Broadband Network (PSBN) operating in the 700 MHz band. We note that ISED has recently issued a Request for Information on a PSBN for Canada.[86]

202. This is a low priority band from Rogers' perspective, as the expected disruption to public safety and SMR users will likely be substantial.

Band	**Potential Service/Application**
896-960 MHz (900 MHz)	Commercial mobile Fixed Licence-exempt

203. Rogers sees few potential new services or applications for this band beyond those that are already in service. As noted above, we are monitoring the FCC's *Notice of Inquire 17-108* to see if a realignment of the 896-901/935-940 MHz, along with amendment of the rules, would permit the use of broadband LTE technology for advanced private Land Mobile Radio (LMR) services. We also note that ITU Working Party 5C is working towards global harmonization of wireless microphone spectrum, and we encourage ISED to align with those recommendations when available. Regarding the 940-960 MHz portion of the band, we again highlight that ISED has initiated a consultation, SMSE-019-17, which could result in the introduction of wireless microphones into portions of this band.

204. For the upper part of the band (940-960 MHz), Rogers supports following the outcome of the consultation in releasing the band for wireless microphones. For the 896-901/935-940 MHz portion of the band, Rogers recommends monitoring the

[86] Public Works and Government Services Canada, *Request for Information - Public Safety Broadband Network (ISED 401700)*; https://buyandsell.gc.ca/procurement-data/tender-notice/PW-17-00802374.

outcome of the U.S. realignment and make changes to the Canadian band plan if and when appropriate. For the remainder of the band, no change is recommended.

205. This band is a low priority for Rogers.

Band	**Potential Service/Application**
1427-1518 MHz (L-Band)	Commercial mobile Fixed

206. This band holds great potential for commercial mobile services. The industry is developing this band as a Supplementary Downlink (SDL) band for IMT systems operating in nearby bands. An SDL band is used as downlink (base-to-mobile) only, and would address the great demand for downlink mobile access that operators are experiencing. As this is “mid-band” spectrum, the radio propagation characteristics are very good. 3GPP is developing standards for LTE that would allow radio carriers in this band to be aggregated with carriers in other bands to provide high speed mobile downlink services. We expect that 3GPP will develop 5G standards at some point in the future, also for SDL mode of operation.

207. In Rogers’ view, despite slow progress in the past, this band is on the way to being globally harmonized for IMT services. We note that ISED postponed a decision on this band in 2012 due to lack of global consensus but that at ITU WRC-15 there was full consensus in the Americas region and partial consensus in Europe that the band should be converted to IMT services. 3GPP standards for LTE-SDL across the entire L-Band should be completed as part of Release 15 in spring 2018, and commercial equipment available shortly thereafter.

208. Although ISED established temporary “exclusion zones” for the areas around Downsview and Mirabel airports, so as to protect Aeronautical Mobile Telemetry (AMT) operations there, this is a temporary arrangement and should be removed so as to allow unfettered development of commercial mobile services in the Downsview and Mirabel regions. Our interpretation of SRSP-101 (2015) is that this temporary arrangement was to remain in place for 2 to 5 years, ending no later than 2019. We note that the AMT industry is transitioning from L-Band to C-band operations. Given the current fractured nature of this band, Rogers would support a “stepwise” approach to reconfiguring the band. In order to maximize the utility of the band for commercial mobile services, Rogers recommends that existing users be vacated from the band in no more than 7 years.

209. This band is a high priority for Rogers due to the high demand for downlink mobile capacity, the expected early availability of commercial equipment, and the fact that the band is likely to be a globally harmonized band. We note that AMT services, as the band is currently used in the U.S., has priority over other mobile

services (including IMT) and that negotiation will likely be required between ISED and the FCC before the L-Band can be used in Canada for IMT in order to prevent cross-border interference. These negotiations should commence as early as feasible. We also note that there is incumbent EESS passive service at 1400-1427 and that these services will need to be protected, so there may be some limits on operation in the lower part of this band. EESS operators should be consulted as soon as possible and informed of these developments.

Band	**Potential Service/Application**
1695 – 1710 MHz (AWS-3 unpaired)	Commercial mobile Fixed

210. This band holds great potential for commercial mobile services in Canada. The U.S. has combined this band with the PCS-H band and part of the AWS-4 band to create a new band for commercial mobile services. 3GPP has developed standards for Band 70 specifically for this new U.S. band plan. This new band offers 15 MHz of uplink spectrum and 25 MHz of downlink spectrum. We expect that this new Band 70 will become an important part of the existing AWS ecosystem in North America, with a multitude of LTE devices and broad coverage. Canada should align the Canadian band with the U.S. in order to take advantage of this upcoming opportunity.

211. Rogers notes that ISED has recently released its decision denying the application by TerreStar for additional spectrum and the licensing of this band.[87] As per our comments submitted on TerreStar's application, Rogers supports the AWS-3 unpaired spectrum being combined with additional spectrum to create Band 70 and continue to recommend that the spectrum be licensed through a competitive process.

212. This band is a high priority.

Band	**Potential Service/Application**
24.25-27.5 GHz	Commercial mobile Fixed Licence-exempt

213. This band holds great potential for both commercial mobile and fixed services. There is already significant progress at the ITU, in Europe, and in the U.S. on this band. The ITU is studying this band and it is likely that it will be identified as an IMT

[87] ISED, *Decision on TerreStar's Application for a Tier 1 Spectrum Licence in the 1695–1710 MHz Frequency Band and in the PCS Block H (1915–1920 MHz/ 1995–2000 MHz)*; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11370.html.

band at WRC-19. The European Union Radio Spectrum Policy Group (RSPG) has designated the band as a "pioneer band" for 5G mobile services. The U.S. has started rulemaking, in *Report & Order 17-152*, that will make the band available for flexible wireless use, meaning that licence holders may use the band for both fixed and mobile services. 3GPP is developing standards for 5G mobile technology for this band as part of Release 15, which is scheduled for completion in spring 2018.

214. In Europe, the RSPG has recommended that harmonization measures be developed before 2020, so we expect that commercial 5G services could begin by 2022. In the U.S., rulemaking is already underway, and the FCC recommends moving as quickly as possible to auction the spectrum,[88] suggesting that commercial 5G services could begin even earlier than 2022. Technical standards are already under development in 3GPP and we expect these to be completed on schedule, with commercial equipment that should be available by 2018-2019. Rogers recommends that ISED move quickly to make this band available in Canada.

215. Rogers' view is that the 27.5-28.35 GHz and 37-40 GHz bands are the highest priority mmWave bands that are currently being considered by ISED and that this band, 24.25-27.5 GHz, is the second highest priority.

Band	**Potential Service/Application**
31.8-33.4 GHz (32 GHz)	Commercial mobile Fixed

216. This band holds great potential for both commercial mobile and fixed services. In the short term, however, Rogers supports the use of this band exclusively for fixed backhaul applications. Europe already uses this band extensively for fixed links and, as a result, there is a large ecosystem of equipment available for use in this band. ISED has previously stated that, "The Department will designate the frequency band 31.8-33.4 GHz for fixed two-way point-to-point radio systems."[89] Rogers strongly supports that decision, especially considering the high demand for backhaul spectrum as detailed above. We note that RABC is in the process of developing a SRSP for this band. In the longer term, this band may emerge as a global 5G band for commercial mobile services but Rogers prefers to wait for that to develop.

217. We recommend that ISED wait for the outcome of WRC-19 prior to considering any further changes to this band.

[88] FCC, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services* (2nd Report & Order).
[89] ISED, *Backhaul Decisions*, pg 20.

218. For fixed services, this is a high priority, as more dedicated spectrum for backhaul is urgently needed. For commercial mobile services, this is a low priority band.

Band	Potential Service/Application
40-42.5 GHz	Commercial mobile Fixed Satellite

219. This band holds potential for commercial mobile, fixed, and satellite services. The band is being studied by the ITU for potential IMT applications. The FCC has declined to propose mobile use in the 40-42 GHz range, as no proponent could explain how mobile use could be made consistent with existing satellite operations.[90] However, the FCC did propose authorizing the 40.5-42.5 GHz portion of the band for flexible fixed and mobile licensing. The band is currently used for fixed services in Europe. In Canada, the band was considered as part of the 2014 Backhaul Decisions, at which time ISED committed to continue monitoring High Density FSS (HDFSS) deployments in the band.[91]

220. Rogers recommends that the Department wait for WRC-19 to conclude before considering any changes to this band.

221. This is a low priority band.

Band	Potential Service/Application
45.5-50.2 GHz	Commercial mobile Fixed Satellite

222. This band holds potential for commercial mobile, fixed, and satellite services. The United States has started rulemaking for this band with the latest rulings found in the 2nd Report & Order for the *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*.[92] In the 1st R&O, the FCC proposed licensing the entire 47 GHz band (47.2-50.2 GHz) under Part 30 UMFUS rules. In the 2nd R&O, the FCC decided to license the 47.2-48.2 GHz portion of this band with the band comprising 5 blocks of 200 MHz each. The remainder of that band (48.2-50.2 GHz) was reserved for FSS use. A significant portion of the band (45.5-47 GHz) is on the agenda for WRC-19 for IMT services (agenda item 1.13). We note that in the Consultation ISED has identified the 45.5-47 GHz band as “Potential use by future

[90] FCC, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services* (2nd Report & Order).
[91] ISED, *Backhaul Decisions*, pg 28.
[92] FCC, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services* (2nd Report & Order).

satellite networks".[93] Given all of these factors, Rogers anticipates that the band will eventually be used for some combination of mobile, fixed, and satellite services.

223. Rogers' recommendation is to wait for WRC-19 before releasing this band while monitoring industry activity in the United States.

224. This is a low priority band.

Band	**Potential Service/Application**
50.4-52.6 GHz (51 GHz)	Commercial mobile Fixed Satellite

225. This band also holds potential for commercial mobile, fixed, and satellite services. The U.S. has started rulemaking for this band with a number of proposals in the 1st R&O 16-89 for bands above 24 GHz.[94] The FCC proposed licensing the band for fixed and mobile services using Part 30 UMFUS licensing. The proposed band plan would include 2000 MHz of spectrum in a variety of configurations (10x200 MHz, 5x400 MHz, and 4x500 MHz). We note that parts of the band will be discussed at WRC-19 for both IMT and satellite services.

226. Rogers recommended to wait for WRC-19 before releasing this band while also monitoring industry activity in the U.S.

227. This is a low priority band.

Band	**Potential Service/Application**
71-76 GHz	Fixed Commercial mobile Licence-exempt

228. Rogers' view is that for a number of reasons this band is best suited for licensed, fixed services. The band is currently designated for fixed services in all 3 ITU regions and has high potential for wireless backhaul for 5G networks in urban areas. We do not believe that the 71-76 GHz band should be licence-exempt because all or part of the 54-71 GHz band will be licence-exempt, which should satisfy demand for spectrum of that type. We support the decisions made in SP-70 GHz that designated this band for fixed services and note that ISED has recently published SRSP-371.0, which should spur increased availability of commercial

[93] ISED, *Consultation*, Table 3.
[94] FCC, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services* (1st Report & Order); https://ecfsapi.fcc.gov/file/0714115429654/FCC-16-89A1.pdf.

equipment. Equipment manufacturers are already producing equipment for backhaul in this band.

229. In Rogers' view, the band would be a poor choice for commercial mobile services due to poor propagation characteristics and other problems. This is consistent with recent FCC *Report & Order 17-152* on the 70/80 GHz bands (71-76 GHz and 81-86 GHz), wherein the FCC considered but declined to authorize mobile use in these bands. To justify this decision, FCC stated:

> There is broad support in the record for focusing on and enhancing the existing rules for fixed use of the band, while there is little consensus among the proponents of mobile use as to how to coexist with fixed links. Under the existing licensing mechanism, these bands can play an important role in 5G development by facilitating backhaul and other fixed uses. It is important not only to protect existing links but also to provide an opportunity for future growth of fixed service in these bands as demand for backhaul and other related services increases.[95]

230. Although the FCC is open to solutions, Rogers believes that these challenges will make it impractical to use the band for mobile services within the next five years in Canada. As such, Rogers proposes no change to this band for the next five years.

231. This is a low priority band.

Band	**Potential Service/Application**
81-86 GHz	Fixed Commercial mobile Licence-exempt

232. Similarly to 71-76 GHz, Rogers' view is that the 81-86 GHz band is best suited for licensed, fixed services. The band is currently designated for fixed services in all 3 ITU regions and has high potential for wireless backhaul for 5G networks in urban areas. We do not believe that the 81-86 GHz band should be licence-exempt because all or part of the 54-71 GHz band will be licence-exempt, which should satisfy demand for spectrum of that type. We support the decisions made in SP-70 GHz that designated this band for fixed services and note that ISED has recently published SRSP-371.0, which should spur increased availability of commercial equipment. Equipment manufacturers are also already producing equipment for backhaul in this band.

233. In Rogers' view, the band would be a poor choice for commercial mobile services due to poor propagation characteristics and other problems. As noted above, this is

[95] FCC, *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services* (2nd Report & Order), para 200.

consistent with the recent FCC *Report & Order 17-152* on the 70/80 GHz bands (71-76 GHz and 81-86 GHz), wherein FCC considered but declined to authorize mobile use in these bands.

234. Again, Rogers' view is that the identified challenges will make it impractical to use the band for mobile services within the next five years in Canada. Rogers therefore proposes no change to this band for the next five years.

235. This is a low priority band.

Band	**Potential Service/Application**
Bands above 95 GHz	Licence-exempt Fixed

236. There are currently studies underway in Europe on the 130-174.8 GHz D-band, so there is some potential in this range prior to 2022, most likely for licensed, fixed services. The ITU, under WRC-19 Agenda Item 1.15, is also studying a fixed service allocation in the 275-450 GHz range but in this case we do not believe that suitable technologies will be available prior to 2022. Nonetheless, Rogers supports study of these bands for future use as fixed services.

237. Rogers believes that equipment suitable for operation in the D-band is likely by 2022 and so ISED should consider allocating spectrum and developing standards for this band in Canada.

238. Rogers views the D-band as high priority in bands above 95 GHz.

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

239. Rogers generally supports the potential frequency bands for release between 2018 and 2022 as proposed by the Department in Table 7 of the Consultation. Rogers has identified four (4) additional bands that should be considered for release by ISED in the next five years, including:

- 5.925-6.425 GHz;
- 6.425-7.125 GHz;
- 1525-1559 MHz paired with 1626.5-1660.5 MHz and 1670-1680 MHz; and,
- 1610.5-1626.5 MHz paired with 2483.5-2500 MHz.

Band	Potential Service/Application
5.925-6.425 GHz	Satellite Fixed Licence-exempt Commercial mobile

240. The 5.925-6.425 GHz band includes 500 MHz of unpaired spectrum

241. This band is the subject of a public consultation in the U.S., as per *FCC Notice of Inquiry 17-183 Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*. In that consultation, the FCC observes that the band is heavily used for satellite services and for fixed services. The FCC is seeking comments from industry on the feasibility of using the band for flexible wireless broadband use. The consultation specifically seeks comments on the potential to use this band as an extension of the existing Unlicensed National Information Infrastructure (U-NII) bands, which extends from 5150-5925 MHz. The inquiry also seeks comments on the suitability of the band for licensed broadband use.

242. The European Commission is also studying the extension of the WAS/RLAN band up to 6425 MHz, as per ECC Work Item 57. This study is expected to conclude in early 2018. This band also appears on the WRC-19 under agenda item 9.1.3, Fixed Satellite Services.

243. Any changes to this band would have to consider incumbent satellite and fixed link users in Canada, so a broad industry consultation with all stakeholders would be essential. Rogers proposes that the Department consider changes to this band when the FCC Inquiry, ECC Study, and WRC-19 outcomes are available, likely in 2020.

Band	Potential Service/Application
6.425-7.125 GHz	Satellite Fixed Licence-exempt Commercial mobile

244. The 6.425-7.125 GHz band includes 700 MHz of unpaired spectrum. This band is the subject of a public consultation in the U.S., also as part of *FCC Notice of Inquiry 17-183 Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz.* The inquiry notes the current use of the band for satellite, fixed, and mobile services. The U.S. consultation seeks industry comment on the potential for more intensive fixed use or flexible use.

245. Any changes to this band would have to consider incumbent satellite, fixed, and mobile users in Canada, so a broad industry consultation with all stakeholders

would be essential. Rogers proposes that ISED consider changes to this band when the FCC consultation decision is available, likely in 2020.

Band	Potential Service/Application
1525-1559 MHz paired with 1626.5-1660.5 MHz and 1670-1680 MHz	Satellite Commercial mobile

246. This band consists of 1525-1559 MHz paired with 1626.5-1660.5 MHz for a total of 68 MHz of spectrum. The band, excluding 1670-1680 MHz, is currently licensed in Canada for Mobile Satellite Service (MSS) with an Ancillary Terrestrial Component.

247. The U.S. licence holder is Ligado Networks, formerly known as LightSquared. Ligado is currently seeking permission from the FCC to modify the terms of the licence. Ligado petitioned the FCC in December 2015 with an omnibus proposal. The FCC issued a Public Notice (DA 16-442) in April 2016 seeking comments on Ligado's proposal but has yet to render a decision.[96]

248. The spectrum is challenging because it is adjacent to Radio Navigation Satellite Service (RNSS) spectrum at 1559-1610 MHz. RNSS spectrum is widely used for Global Positioning Service (GPS). GPS operation is highly susceptible to interference and GPS stakeholders have vigorously opposed Ligado's efforts to use the spectrum for commercial mobile services.

249. The Ligado proposal seeks to protect GPS receivers while also allowing use of the spectrum for MSS and terrestrial commercial mobile services. This proposal also includes combining the 1670-1675 MHz and 1675-1680 MHz bands with the existing Ligado spectrum. The 1670-1675 MHz portion was partially auctioned in Canada in 2008 and was part of two 2017 consultations, *SLPB-002-17: Consultation on a Licence Renewal Process for Advanced Wireless Services and other Spectrum* and *SLPB-003-17: Consultation on a Licensing Framework for Residual Spectrum Licences in the 700 MHz, 2500 MHz, 2300 MHz, PCS and 1670-1675 MHz Bands.* The 1675-1680 MHz portion is used for meteorological services. The FCC sought to clear the record on the 1670-1680 MHz band with Public Notice DA 16-443.[97]

[96] FCC, *DA 16-442: Comment Sought on Ligado's Modification Applications*; https://apps.fcc.gov/edocs_public/attachmatch/DA-16-442A1.pdf.
[97] FCC, *DA 16-443 Comment Sought to Update the Record on Ligado's Request that the Commission initiate a Rulemaking to Allocate the 1675-1680 MHz Band for Terrestrial Mobile Use shared with Federal Use*; https://apps.fcc.gov/edocs_public/attachmatch/DA-16-443A1.pdf.

250. Rogers recommends that ISED monitor the outcome of the Ligado undertaking in the U.S. If Ligado is successful in modifying the terms of their licence, ISED should consider making the spectrum available for terrestrial commercial mobile services in Canada.

Band	**Potential Service/Application**
1610.5-1626.5 MHz paired with 2483.5-2500 MHz	Satellite Commercial mobile

251. This band consists of 1610.5-1626.5 MHz paired with 2483.5-2500 MHz for a total of 32.5 MHz of spectrum. The band is currently licensed for Mobile Satellite Service (MSS) with an Ancillary Terrestrial Component (ATC).

252. The U.S. licence holder is GlobalStar, who sought and received changes to their licence conditions from the FCC in *Report & Order 16-181*.[98] These changes permit the use of terrestrial low power broadband operations in the 2483.5-2495 MHz portion of the band. The FCC also committed to reviewing in a separate proceeding GlobalStar's petition to allow the use of high power systems in both the S-Band and L-Band parts of this band.

253. Rogers recommends that ISED monitor developments in this band, specifically, any further FCC actions and GlobalStar's efforts to offer to commercial mobile services in the 2483.5-2495 MHz portion of the band.

Q22: Are there specific frequency ranges/spectrum bands that should be made available for specific applications?

254. Rogers believes that the Department should make spectrum available as rapidly as possible using a technologically-neutral approach while ensuring reasonable protection of incumbent services to enable greater spectrum utilization and allow Canadian consumers to benefit from wireless innovations.

255. The additional licensed, flexible use spectrum the Department is proposing to make available in the *Consultation on Releasing Millimetre Wave Spectrum to Support 5G* will be beneficial. However, it must again be noted that the Department is proposing in that consultation to designate 7 GHz of spectrum as licence-exempt, compared to the proposal to open less than 4 GHz of exclusively licensed

[98] FCC, *R&O 16-181 Terrestrial Use of the 2473-2495 MHz Band for Low-Power Mobile Broadband Networks; Amendments to Rules for the Ancillary Terrestrial Component of Mobile Satellite Service Systems*; https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-181A1.pdf.

flexible use spectrum – and that licensed spectrum must be shared between terrestrial and satellite users. While terrestrial operators will also be able to make use of licence-exempt spectrum in their networks, exclusively licensed spectrum bands will continue to be a key input for ensuring service providers can offer a high quality of service.

256. ISED can enable new 5G and other connectivity technologies by developing flexible use licensing model for fixed and mobile services in a range of spectrum bands to help bring Canada to the forefront of digital development and adoption through the creation and strengthening of world-leading wireless infrastructure. This Consultation is an important part of ensuring additional low, mid, high, microwave and mmWave band spectrum (both paired and unpaired) is made available for operators to continue expanding 5G coverage and capabilities. A flexible use licensing model for spectrum bands will allow new technology and innovations to evolve without overly prescriptive requirements, while meeting a variety of different needs and use-cases.

257. The 32 GHz band should be made available only for fixed backhaul services, as per the Backhaul Decisions. This will compensate for the expected loss of 25 GHz, 28 GHz, and 38 GHz spectrum bands, all of which appear likely to be used for commercial mobile services. The 32 GHz band is needed as alternative to fibre backhaul and may be the only band suitable for backhaul between 23 GHz and 60/70 GHz.

258. The 5850-5925 MHz band should be made available for licence-exempt services, as soon as practical. Wi-Fi, LTE-U, LTE-LAA, and other licence-exempt technologies can help facilities-based network operators deliver services that are popular with Canadians and it is likely that the existing licence-exempt 5 GHz bands will be congested soon. If WRC-19 is able to identify new rules that permit the sharing of the band with other users, Canada should adopt these new rules at the earliest opportunity.

Q23: Are there any factors that would impact the potential release of these frequency bands between 2018 and 2022?

259. For the 32 GHz band, the key factors are:

- the expected loss of 25 GHz, 28 GHz, and 38 GHz bands for fixed backhaul services, due to licensing for commercial mobile services;
- the completion of 3GPP standards for 5G technology in the 28 GHz and 37-40 GHz bands in Release 15 (early 2018); and,

- the rapid uptake of 5G services, which would increase demand for backhaul in this band.

260. For the 5850-5925 MHz band, the key factors are:

- a decision at WRC-19 to identify new rules allowing licence-exempt use of this band and sharing of the band with other users;
- the ongoing, increase in demand for licence-exempt Wi-Fi services
- availability in the marketplace of LTE-U and LAA devices suitable for use in the band; and,
- the U.S. allowing the use of the band for Wi-Fi, LTE-U, and LTE-LAA devices, which could result in a number of “grey market” devices appearing in Canada.

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