Canada Gazette Notice No. SLPB-001-17

CONSULTATION ON RELEASING MILLIMETRE WAVE SPECTRUM TO SUPPORT 5G

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COMMENTS
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1.0 INTRODUCTION

1. In accordance with the procedure set out in Innovation, Science, and Economic Development Canada (ISED or the Department) Notice No. SLPB-001-17, *Consultation on Releasing Millimetre Wave Spectrum to Support 5G*, dated 5 June 2017, we are pleased to present our views on the Department's proposed policy and technical framework for releasing the millimetre wave (mmWave) spectrum in the 28 GHz, 37-40 GHz and 64-71 GHz frequency bands to support the deployment of 5th generation (5G) wireless networks and systems.

2. Before responding to the specific questions set out in the Notice, we wish to make some general policy comments.

1.1 Requirement for additional spectrum to support 5G

3. We concur with the Department's view that Canadian consumers, businesses, and public institutions must continue to benefit from the latest wireless telecommunications services. Spectrum is a critical resource and cornerstone for wireless carriers. The release of additional spectrum as proposed in this consultation will allow service providers to substantially increase network capacity to meet traffic demands and support the rapid deployment of next-generation wireless technologies such as 5G.

4. We agree with, and support, the Department's premise that the forecasted use cases for 5G include enhanced/ultra-fast mobile broadband, massive machine-type communications, and ultra-reliable/low-latency communications. The above applications are all predicted to significantly drive usage of networks, leverage Internet of Things (IoT) growth, and facilitate deployment of new and innovative integrated verticals such as healthcare, transportation, and smart cities.

5. We are of the view that access to mmWave spectrum is vital for the development and evolution of existing networks to permit the deployment of 5G systems in Canada. The use of the wider bandwidth channels available in the mmWave spectrum will result in higher spectral utilization given that the guard bands presently used between carriers within the existing 10-20 MHz channels will effectively disappear.

6. Finally, where spectrum has already been licensed, the evolution to 5G is simply that, an evolution. 5G includes fixed and mobile applications including backhaul and connectivity to businesses. Today's existing fixed operations at 38 GHz will be vital for carriers to be able to quickly further exploit this spectrum, expanding coverage and offering new fixed and mobile services to Canadians. Limiting the use of this already licensed spectrum, or any delay in allowing carriers to fully utilize this spectrum, will place Canada at a disadvantage as the newest capabilities and services will simply not be available in Canada.

1.2 Timing of the Consultation

7. We believe that the timing of this consultation is critical, especially given that the International Telecommunication Union (ITU) is presently conducting sharing and compatibility studies on 11 frequency bands between 24.25 GHz and 86 GHz for the future development of broadband mobile services. While the ITU is not currently studying the 28 GHz band (27.5-28.35 GHz), this band is being pursued by the U.S. for domestic mobile operations to use for 5G deployment. We generally support harmonization with the various 5G frequency bands being deployed in the U.S., since a lack of harmonization would result in transitional discrepancies and severely hamper the ability of carriers to provide Canadian consumers with world class broadband access.

8. We also support making these bands available prior to the World Radio Conference 2019 (WRC-19) because this would enable service providers to begin rolling out 5G networks and introduce advanced applications and services to Canadians earlier, rather than waiting for the convening of WRC-19.

2.0 RESPONES TO QUESTIONS POSED BY ISED

Question 4-1:
Given the disruptive nature of 5G, will new business models and network applications develop that may require policy and regulatory consideration from ISED? Please describe potential new business models and network applications as well as their benefits to Canadians.

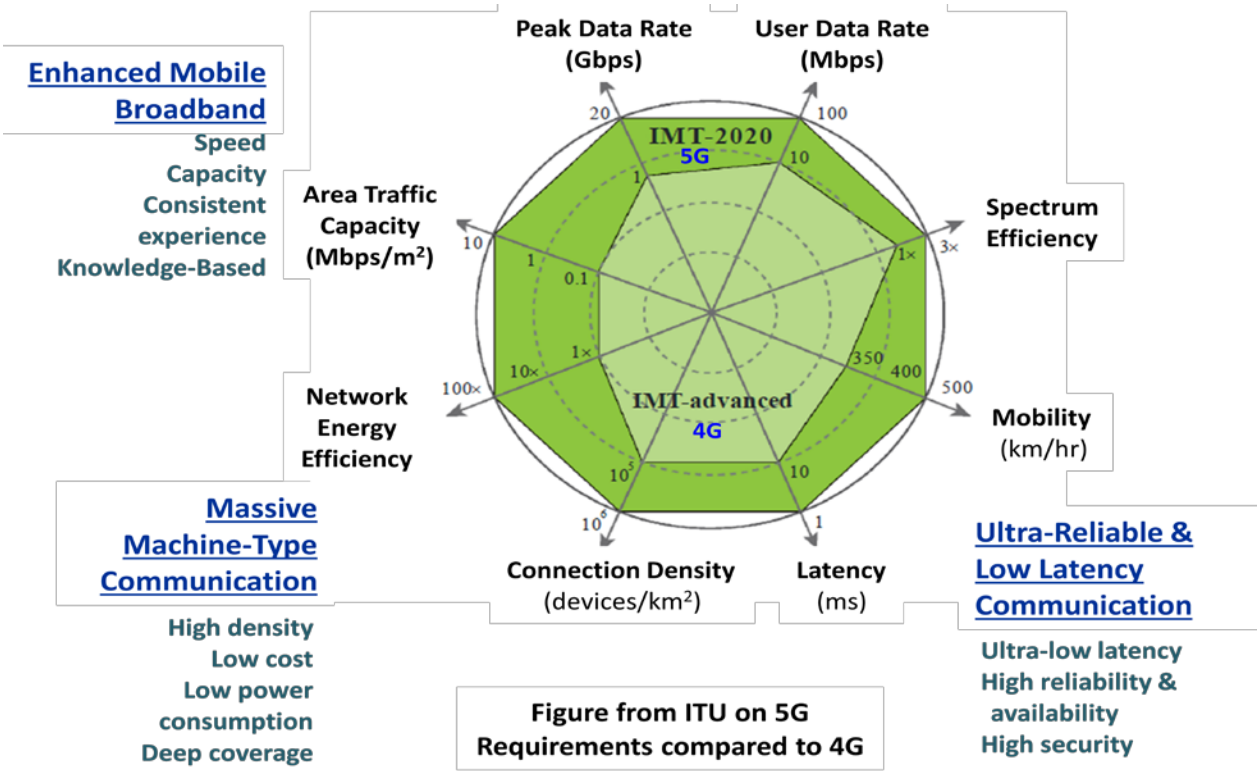
9. In the years ahead, demand for a fully mobile and connected digital society will be nothing short of transformational. Keeping pace with this transformation will require:[1]

[1] NGMN, "NGMN 5G White Paper," 17 February 2015, available at: https://www.ngmn.org/fileadmin/ngmn/content/downloads/Technical/2015/NGMN_5G_White_Paper_V1_0.pdf.

- enabling user experience with a wide range of use cases and requirements;
- orders of magnitude greater capacity;
- pushing the performance envelope on throughput, latency and reliability;
- fully flexible and efficient networks in ultra-dense and multi-connectivity coverage areas; and
- sound and sustainable business models, enabled by design and empowering a broader ecosystem.

10. Figure 1 below shows the ITU's recommendations for the performance targets of 5G,[2] while the surrounding text highlights the potential requirements of the different identified service categories.

Figure 1: ITU Performance Targets



11. mmWave spectrum will play a vital role in supporting each of these service categories despite their disparate requirements. For instance, the Enhanced Mobile Broadband (eMBB) class of services require high peak rates, while ultra-reliable low latency class of services (such

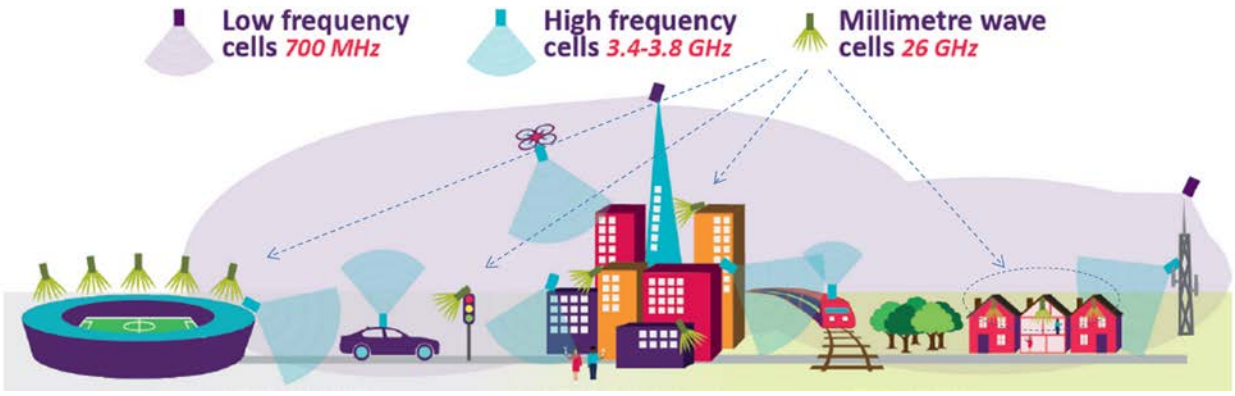
[2] ITU-R M.2083-0.

as remote operation, critical mission and public safety, vehicle-to-vehicle, Tactile Internet and Augmented Reality) require very low latency. Spectrum at frequencies above 24 GHz are well-suited to accommodate both of these requirements. With very large bandwidth, millimetre spectrum bands can meet ultra high-capacity and very low latency requirements focussed on a specific location. Integration with dense spatial reuse of spectrum and frequencies below 6 GHz will deliver a seamless mobility experience.

12. mmWave spectrum is notable for its potential to support a wide range of use cases with extreme requirements. For instance, the mmMAGIC project co-funded by the 5G Infrastructure Public Private Partnership (5G PPP) initiative of the European Commission has considered use cases for mmWave with high data rate requirements (hotspots, smart office, cloud services), high connection density (dense urban areas with distributed crowds, media on demand), and high mobility (moving hotspots such as fast trains).[3]

13. The UK communications regulator, Ofcom, published an update on 5G spectrum earlier this year (shown below) highlighting the essential role mmWave will play in fixed and mobile scenarios with extreme requirements.[4] Identifying three essential candidates for mmWave use – fixed broadband, high density/capacity small cells (hotspots), and backhaul – as shown in Figure 2, Ofcom predicted that build-out of 5G networks in mmWave bands will likely be focused on areas of high traffic demand, or to specific locations requiring services with very high capacity.

Figure 2: 5G Will Need Different Frequency Bands

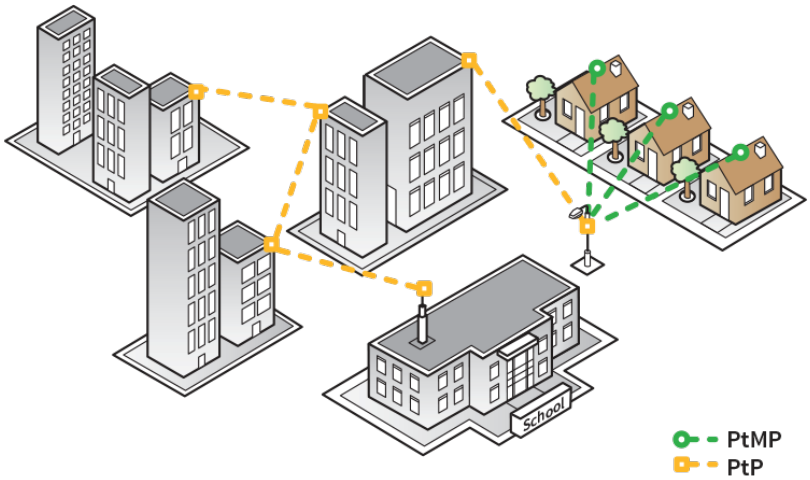


[3] mmMagic, "Use case characterization, KPIs and preferred suitable frequency ranges for future 5G systems between 6 GHz and 100 GHz," 30 November 2015, available at: https://bscw.5g-mmmagic.eu/pub/bscw.cgi/d54427/mmMAGIC_D1.1.pdf.

[4] Ofcom, *Update on 5G Spectrum in the UK,* 8 February 2017, available at: https://www.ofcom.org.uk/__data/assets/pdf_file/0021/97023/5G-update-08022017.pdf.

14. The Federal Communications Commission (FCC) also affirmed that mmWave spectrum is well suited to high-capacity fixed and mobile use cases, stating about 28 GHz and 39 GHz bands: "these bands could be suitable for deployment of high-capacity, high-throughput small cells as part of mobile broadband deployments," and at the same time proposing "rules that would provide licensees with the flexibility to conduct fixed and/or mobile operations."[5] This is shown in Figure 3.

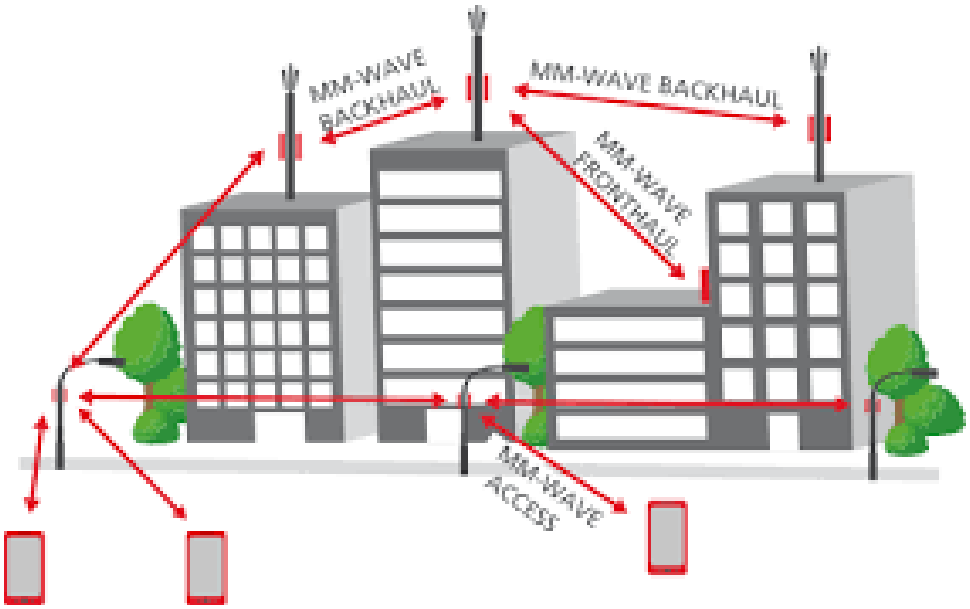
Figure 3: Gigabit to the Home



15. Furthermore, the deployment of "ultra-dense" 5G networks is anticipated to leverage mmWave communication, with advanced radio and beam-forming technologies for backhauling, offering multi-gigabit data rates with flexibility and cost/energy efficiency. Examples include a proof-of-concept for the Seoul Winter Olympics as part of the South-Korean/European project 5G Champion, and the European/Japanese project MiWEBA: Millimeter-Wave Evolution for Backhaul and Access. Figure 4 presents an overview of the MiWEBA project.

[5] FCC, *Use of Spectrum Bands above 24 GHz for Mobile Radio Services*, 22 October 2015, available at: https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-138A1.pdf.

Figure 4: Millimeter-Wave Evolution for Backhaul and Access (MiWEBA)



16. It must be noted, as stated earlier and shown in Figure 2 above, the mmWave use cases go beyond these well-recognized and targeted candidates (fixed, hot-spots/venues, and backhauling) to include a variety of mobile use cases. This will surely pave the way for a growing range of user scenarios.

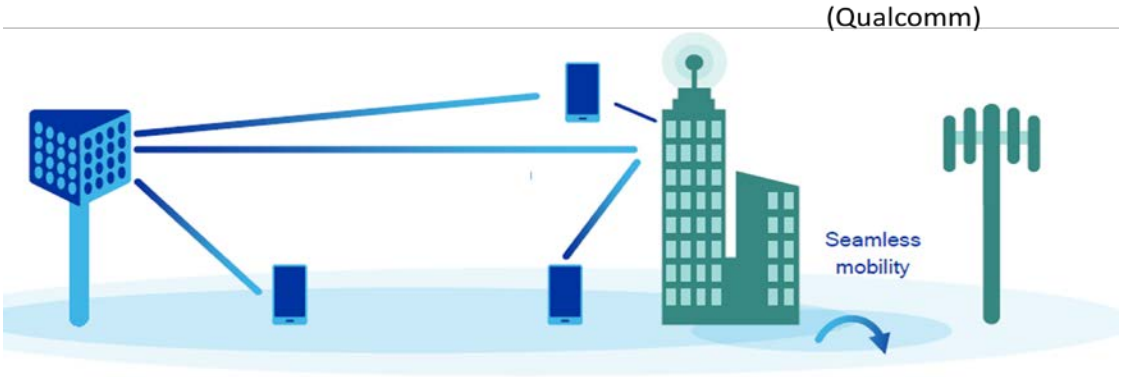
17. For example, at 5G North America (Austin, May 2017), AT&T indicated plans to team with Qualcomm and Ericsson to test mobile and fixed 5G services using the expected 5G New Radio at both 28 GHz and 39 GHz bands. Further, at a press release in February 2017, Samsung announced, along with Japanese service provider KDDI, that it had successfully completed a 5G handover trial at 28 GHz on Tokyo's metropolitan expressway amongst skyscrapers. Finally, Korea IT Times reported that the leading mobile operator SK Telecom, together with Ericsson and BMW Korea, "realized a peak rate of 3.6 Gbps for a connected vehicle travelling at a speed of 170 km/hr."[6]

18. 5G has both been enabled by, and helped spur the development of, advancements in leveraging mmWave technology for fixed/mobile applications. As illustrated in Figure 5, these advancements in the provision of robust, high-performance, and secure connectivity include

[6] Qualcomm, "White Paper: Exploring the Potential of mmWave for 5G Mobile Access," available at: https://eu-ems.com/event_images/Downloads/Qualcomm%20Whitepaper.pdf.

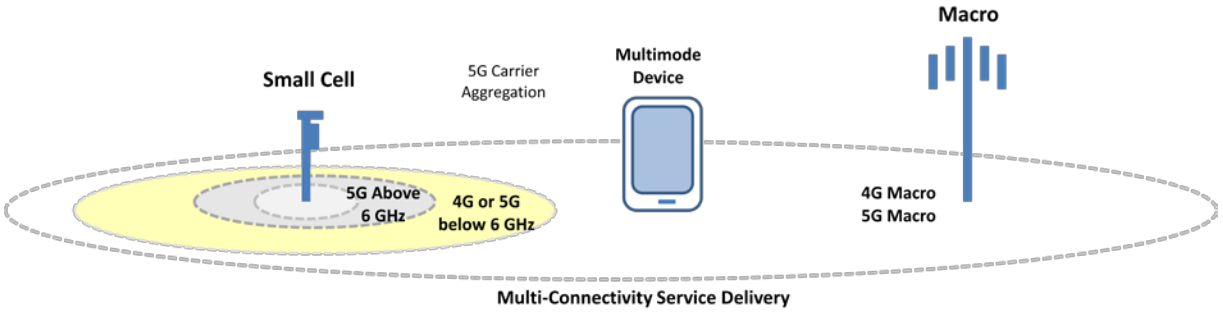
antenna design, beam-forming and intelligent beam search, interference management, dynamic selection, and tight integration with 5G and LTE at frequencies below 6 GHz.[7]

Figure 5: Advancements in System Design for mmWave Technology



19. There is broad consensus on the essential role of mmWave spectrum for 5G. This consensus is well-supported by the extensive developments achieved by the global ecosystem (including by us) in the past few years, from 5G characterization and identification of a wide range of user scenarios, to requirements, enabling technologies and spectrum, research and innovations, standardization work-plan, and testing and trials. As shown in this section, mmWave has the potential to work in a cost-effective, multi-band, multi-connectivity, high-capacity, and high-coverage environment. Leveraging the mmWave spectrum will enable services and user experience in a wide range of use cases of benefit to Canadians, offering gigabit fixed/mobile services, and gigabit data networking and transport on a variety of business models.

Figure 6: Multi-Connectivity Service Delivery



20. As the Department is well aware, 5G is not a standalone phenomenon. 5G certainly holds the promise of significant improvements in terms of latency, bandwidth and overall traffic

[7] NGMN White Paper.

characteristics resulting in Canadian consumers having access to advanced products and applications. It should be noted however, that 5G is an ongoing evolution of existing networks that carriers have been deploying throughout Canada. Figure 6 demonstrates how existing 4G LTE and WiFi connectivity will be leveraged to deploy 5G. In fact, a successful 5G network will be comprised of multiple bands (making use of existing bands/networks) and multiple connectivity 5G environments in which the mmWave spectrum is but a single component of an interconnected network.

Question 5-1:

ISED is seeking comments on developing a flexible use licensing model for fixed and mobile services in the 28 GHz and 37-40 GHz frequency bands, and allowing licence-exempt use of the 64-71 GHz frequency band ahead of WRC-19 and before 5G technology standards are finalized.

21. We support the Department's proposed adoption of a "flexible use" licensing model for both the 28 GHz and 37-40 GHz frequency bands. This would allow licensees the freedom to decide whether to deploy fixed systems, mobile systems or a combination of fixed and mobile systems – a wise approach given the uncertainty of what the deployment of 5G will ultimately look like.

22. We also support the proposed use of the 64-71 GHz frequency band on a licence exempt basis ahead of WRC-19 and before 5G standards are finalized.

2.1 28 GHZ FREQUENCY BAND

Question 6-1:

ISED is seeking comments on the changes proposed above to introduce flexible use licensing in the 28 GHz band, including consequential changes to the CTFA domestic footnotes and the policy on this band contained in SP 3-30 GHz, Revisions to Spectrum Utilization Policies in the 3-30 GHz Frequency Range and Further Consultation.

23. We support the Department's proposed adoption of a "flexible use" licensing model which would allow licensees to decide whether to deploy fixed systems, mobile systems or a combination of fixed and mobile systems in the 28 GHz band.

24. We also support the consequential changes that will be required to the Canadian Table of Frequency Arrangements (CTFA) footnotes and the policy on the 28 GHz band to allow the use of flexible use licensing in this band.

Question 6-2:

ISED is seeking comments on the moratorium for new site-specific fixed service licences as described above.

25. We support placing a moratorium on issuing new site-specific fixed service licences in the 28 GHz band. Given the anticipated future widespread use of the band to accommodate 5G services, adoption of a moratorium is prudent at this point in time in order to ensure that the band is not encumbered and is available for the development of a flexible use licensing scheme in the band.

26. We further support the view that the Department should continue to make available developmental licenses for the early development of 5G technologies for this band.

Question 6-3:

ISED is seeking comments on its proposal to adopt the band plan (as shown in figure 3) in the 28 GHz band.

27. The proposed band plan of 2 x 425 MHz blocks is similar to the plan that has been adopted in the U.S. However, we recommend the Department wait for the release of the 3rd Generation Partnership Project (3GPP) recommendation on bandwidth size before finalizing this band plan.

28. In order to optimize this band for the deployment of 5G, it will ideally be aligned with 3GPP technical standards. It is reasonable to assume that the principal technologies developed for this band will follow this standard. While the 3GPP standard has yet to be fully defined, it is clear that Time Division Duplex (TDD) is the preferred form of duplex as Active Antenna Systems are more readily implemented. Thus, we agree with the Department's proposal for unpaired use of the spectrum.

29. We applaud ISED's attempt to maximise the channel bandwidth, which will allow for the full broadband efficiency potential of 5G to be realized. However, it is also clear that the bandwidth building blocks being considered and discussed within 3GPP may not be based on 425 MHz. In fact, thus far 400 MHz appears to be the maximum channel size under discussion, with other bandwidths variants (100, 200 MHz etc.) also under consideration.

30. We expect that the 3GPP Standards organization will reach a conclusion on bandwidth soon, and thus recommend a band plan be developed accordingly. Whatever the conclusion of 3GPP, we would recommend channeling based on the maximum building block size, with any fractional remainder (perhaps 50 MHz) packaged as single license. While this block would be less efficient than a maximized block, it would nonetheless have some utility for 5G.

31. Therefore, we recommend that the Department wait for the outcome and decision of the 3GPP standards organization prior to finalizing the actual block sizes and band plan for the 28 GHz band.

Question 6-4:

a) ISED seeks comments on its proposal to require site-by-site coordination between proposed flexible use terrestrial stations and FSS earth stations in the 28 GHz band when a pre-determined trigger threshold is exceeded.

32. We are of the view that such a requirement would be manageable, and note that there are currently eight satellite earth station locations operating across the country. Given that the existing footnote (C47A) in the Canadian Table of Frequency Allocation limits FSS implementation to "applications that will pose minimal constraints upon deployment of fixed service systems, such as a small number of large antennas for feeder links", we believe that the Department should impose limits on the placement and overall number of future FSS stations in order to minimize the impact to 5G networks.

33. We also offer the following additional points for the Department's consideration. First, the key to successful coexistence is to first determine a proper interference threshold, and if mitigation techniques exist to make coexistence reasonable. This can vary widely depending on the technology chosen by both parties. It is clear that terrestrial operators will follow 3GPP standards in the deployment of 5G, and while satellite operators have stepped up their involvement in 3GPP standards work in an effort to capitalize on ecosystem development, it remains uncertain if they will continue moving in this direction, particularly if they happen to disagree with the finding of the coexistence studies conducted by 3GPP.

34. Second, in any case 3GPP will publish a report on their coexistence studies. We believe that the Department should adopt the 3GPP requirements as we do not see any new technical considerations that would arise in a Canadian only context. While some satellite operators may cite that Canada may have unique coverage requirements given the higher northern latitudes, it

should be noted that other countries also have similar northerly (and southerly) coverage issues and these are well accounted for in the 3GPP findings. Terrestrial deployment in this band will be small cell by nature, and coverage requirements will eventually require a very large numbers of sites. To simplify coordination efforts, we suggest that the coexistence findings resulting from the outcome of the 3GPP studies be used to define geographic restrictions as suggested below.

b) If site-by-site coordination is proposed, what coordination trigger and value would be the most appropriate (e.g. PFD or distance threshold)?

35. We believe that the use of a PFD trigger mechanism to initiate the site-by-site coordination process would be appropriate. We agree with the RABC proposal that an FSS earth station that generates a PFD equal or greater than some to-be-determined threshold into a deployed or planned flexible use terrestrial station coverage area would require a detailed interference analysis. Such an approach would allow operators to identify flexible use terrestrial stations or FSS earth stations with which detailed coordination would be required, without performing time consuming and detailed calculations every time a new station is planned.

36. We are not aware of an industry-agreed trigger in the 28 GHz band and therefore agree with the proposal put forth by the RABC which proposes that the Department initiate a study to determine the appropriate PFD coordination trigger for FSS and flexible use terrestrial station operators. We believe that such a study needs to be carried out in the near-term.

c) ISED is also inviting proposals for specific technical rules on proposed flexible use stations and FSS earth stations (e.g. site shielding) that could facilitate more efficient sharing between terrestrial and earth stations.

37. We agree with the Department that band flexible use terrestrial stations in the 28 GHz may be subject to interference from the emissions of an FSS earth station. We further agree that site shielding of future earth stations may be an efficient way to limit potential interference to flexible use terrestrial stations, thus providing additional flexibility in potential earth station siting without impacting deployment of flexible use terrestrial stations.

38. We further support the RABC view that the decision to implement site shielding as a means to effect successful coordination should rest with the earth station licence applicant because in some cases it may be more cost effective for the earth station applicant to employ other means to reduce interference and successfully coordinate.

Question 6-5

a) ISED is seeking comments on whether there should be restrictions on the geographic areas in which new FSS earth stations can be deployed in the 28 GHz band.

39. We are of the view that given the frequencies involved and the desire to deliver broadband services to Canadians, the design range of cell edges will be restricted. Consequently, practical deployment of 5G will be restricted to urban/suburban centres, major highway corridors, rural community hotspots/gathering places, or last mile roadside fixed service. We recommend that these areas should be avoided for FSS services.

b) If geographic restrictions on FSS earth stations are proposed, ISED is inviting detailed proposals on how they could be implemented, and what areas should be targeted.

40. We agree with the RABC proposal that the Department initiate a study to determine appropriate restrictions on geographic areas in which future earth stations may be located. We believe that such a study would facilitate the successful frequency coordination of future FSS earth stations and planned or deployed flexible use terrestrial stations.

Question 6-6:

ISED is seeking comments on whether it should impose any limits on the aggregate emissions of the terrestrial services. If limits are proposed, ISED is inviting detailed proposals on why they should be implemented, and what the limits should be.

41. We are opposed to the imposition of any aggregate emission limits. In our view, aggregation limits essentially amount to a deployment limit placed on the 5G network by the Department. Given that the stated purpose of this proceeding is the widespread deployment of 5G networks for the benefit of all Canadians, we believe that 5G deployments should not be encumbered by FSS systems. While we agree that FSS systems should continue to have some access to the band, it should be on the basis that their deployments do not impede 5G deployments – especially in key areas such as urban/suburban centres, major highway corridors, and rural community hotspots/gathering places. Failure to provide this certainty for 5G deployment would require carriers to limit the number of active users through some form of network throttling and/or network coverage reduction, all of which would reduce the utility of 5G to Canadians. It should be noted, that even though satellites have co-primary status in the band, given the rapid change in wireless technology and the promise of 5G networks worldwide,

the Department must consider preference for 5G or risk falling behind the US and other world economies that have clearly signalled their "priority" towards 5G.

42. In addition, terrestrial 5G will employ Active Antenna Systems (AAS) which are designed to direct energy toward the desired receiver in an active way, and not toward a Satellite. Thus, the technology will limit any aggregate emission effect. AAS will also provide greater interference rejection than fixed gain antenna systems, and it is our hope that the satellite community will adopt AAS for this reason.

43. Finally, we are of the view that calculating the aggregation of emissions is virtually impossible. Emissions will be variable in number, power, direction, bandwidth and numerology, making calculation virtually impossible. Likewise, the determination of a suitable mitigation approach would be a severe technical challenge.

44. Given the importance of 5G to all Canadians, and the impediment to its success that such a limit could impose, we strongly recommend that the Department not place any aggregation emission limits on future terrestrial services in this band.

Question 6-7:

ISED proposes that all existing FSS earth stations and those in applications pending approval for operation would be permitted to continue to operate under the current conditions of licence as described above. Comments are sought on this proposal.

45. We support the proposal that existing FSS earth stations and those in applications that have already been submitted be excluded from the band sharing mechanisms proposed in the previous sections of the consultation and be required to operate within their current parameters and conditions of their existing licences. However, negotiated business arrangements should be used as a means to remove barriers to terrestrial deployment.

2.2 37-40 GHZ FREQUENCY BAND

Question 7-1:

ISED is seeking comments on the proposal to implement flexible use licensing in the frequency band 37-40 GHz, including the consequential changes to CTFA footnote C51, while continuing to allow for fixed-satellite service (space-to-Earth) in the band.

46. We are in agreement with the Department's proposal to expand priority in the band to fixed and mobile, from just the fixed service. Flexible use for the fixed and mobile services would follow and these services would have priority over the FSS in the band.

47. We fully support the Department's proposed adoption of a "flexible use" licensing model which would allow licensees to decide whether to deploy fixed systems, mobile systems or a combination of fixed and mobile systems in the 37-40 GHz band. We believe this is a wise approach given the uncertainty surrounding what the deployment of 5G will ultimately look like.

48. We also support and agree with the consequential changes that will be required to the Canadian Table of Frequency Arrangements (CTFA) footnote C51, while continuing to allow for fixed-satellite service (space-to-Earth) in this band.

Question 7-2:

ISED is seeking comments on whether a moratorium on the issuance of new licences under the New Licensing Framework for the 24, 28 and 38 GHz Bands and Decision on a Licence Renewal Process for the 24 and 38 GHz Bands is required at this time.

49. In the case of the 28 GHz band, we acknowledge that the implementation of a moratorium on the issuance of new licenses will have little impact to existing users since this band currently has no fixed service users.

50. However, given that the 38.4-40 GHz band is presently being used to deliver backhaul for mobile services and for enterprise wireless solutions, we agree that an immediate moratorium on the issuance of new licenses could negatively impact current and future deployment plans for incumbent licensees at this time. However, we agree that once alternative licensing processes are finalized, a moratorium should be applied.

51. Finally, we support the Department's proposal on the implementation of a moratorium for the 28 GHz band and believe that the 37-40 GHz band should be dealt with differently from the proposed treatment of the 28 GHz band. As stated above, 5G in 38 GHz is merely an evolution

of existing services. Backhaul and connectivity to business comprise the existing services, and these same services are included in the 5G. Not permitting existing licensees to continue to deploy sites and to quickly use this spectrum will disadvantage Canadians.

Question 7-3:

ISED is seeking comments on the proposal to adopt the band plan as shown in figure 7 for the frequency band 37-40 GHz.

52. We are in agreement with the Department that it is important for Canada to align with the ecosystem that develops in the U.S. As a result, we support aligning the band plan with what has or will be decided in the U.S., in order to benefit from economies of scale for equipment and provide Canadian consumers with access to world class 5G networks and services. Alignment with the U.S. band plan will also significantly simplify the coordination of fixed and mobile systems/services along the Canada-U.S. border.

53. Given that the FCC is currently in the process of developing a new band plan for the frequency range 37-37.6 GHz, we agree that it is premature for Canada to adopt a Canadian band plan at this time as it would risk undermining the benefits of equipment availability/harmonization. As a result, we support the Department's proposal to defer the development of a Canadian band plan for this frequency range.

54. We also agree that the band plan should not preclude the deployment of any type of duplexing scheme in the 37-40 GHz band.

Question 7-4:

a) ISED seeks comments on the proposal to require site-by-site coordination between proposed flexible use terrestrial stations and FSS earth stations in the frequency band 37.5-40 GHz when a pre-determined trigger threshold is exceeded.

55. As previously mentioned in our comments on the 28 GHz band under Question 6-6, we view the imposition of aggregate emission limits as a deployment limit on the 5G network. We support the Department's goal to promote the widespread deployment of 5G networks for the benefit of all Canadians, and we believe that in order to achieve that goal, 5G deployments must not be encumbered by FSS systems. While we do agree that FSS systems should continue to have some access to the band, it should be on the basis that their deployments do not impede 5G deployments – especially in key areas such as urban/suburban centres, major highway

corridors, and rural community hotspots/gathering places. Failure to provide this certainty for 5G deployment would require carriers to limit the number of active users through some form of network throttling and/or network coverage reduction, all of which would reduce the utility of 5G services and the resulting economic benefits to Canada.

56. It is clear that terrestrial operators will follow 3GPP standards in the deployment of 5G, and while satellite operators have stepped up their involvement in 3GPP standards work in an effort to capitalize on ecosystem development, it remains uncertain if they will continue moving in this direction, particularly if they happen to disagree with the finding of the coexistence studies conducted by 3GPP. In any case, 3GPP will publish a report on their coexistence studies, which we believe could be the basis for shared use coordination.

57. Terrestrial deployment in this band will be small cell, and coverage requirements will eventually require very large numbers of sites. To simplify coordination efforts, we suggest that the coexistence findings be used to define geographic restrictions as suggested below.

b) If site-by-site coordination is proposed, what coordination trigger and value would be the most appropriate (e.g. PFD or distance threshold)?

58. We support the RABC view that the use of a PFD trigger mechanism to initiate site-by-site coordination process would be appropriate. Such an approach would allow operators to identify flexible use terrestrial stations and FSS earth stations for which detailed coordination would be required, without performing time consuming and detailed calculations every time a new station is planned.

59. We further agree, as outlined in the response to Question 6-4(b) regarding the 28 GHz band, with the initiation of a study to determine an agreed trigger (either distance or PFD) in the 37-40 GHz band to be used by FSS and flexible use terrestrial station operators.

c) ISED is also inviting proposals for specific additional technical rules on flexible use stations and FSS earth stations (e.g. site shielding) that could facilitate more efficient sharing between terrestrial and earth stations.

60. As correctly pointed out in the Consultation document, in the 37-40 GHz band, an FSS earth station can be subject to interference from the emissions of flexible use terrestrial stations. We agree with the views expressed by the RABC that earth station site shielding could in some

cases be an efficient way to facilitate coordination and allow deployment of a future earth station. Similarly, elevation angle restrictions or other measures on new flexible use terrestrial stations could facilitate coordination with an existing FSS earth station.

Question 7-5:

a) ISED is seeking comments on whether there should be restrictions on the geographic areas in which new FSS earth stations can be deployed in the frequency band 37.5-40 GHz.

61. We believe that new FSS earth stations should be restricted to rural areas in order to minimize any potential conflicts and or restrict the deployment of terrestrial 5G services.

b) If geographic restrictions on FSS earth stations are proposed, ISED is inviting detailed proposals on how they could be implemented, and what areas should be targeted?

62. Given the high frequencies involved, and the desire to deliver broadband services, the design range of cell edges will be relatively small. Consequently, practical deployment of 5G will be restricted to urban/suburban centres, major highway corridors, rural community hotspots/gathering places, or last mile roadside fixed services. We recommend that the Department place restrictions on FSS earth stations in these areas.

Question 7-6:

It is proposed that, should SRS and/or MSS systems be deployed, flexible use licensees in the band 37.6-40 GHz may be subject to technical provisions to facilitate co-existence. Comments are sought. ISED notes that any such technical provisions would be established through a future consultation process.

63. In the consultation, the Department indicated that presently there are no existing or planned SRS or MSS operations in Canada. As a result, we are of the view that there should be no restrictions placed on the terrestrial services at this point in time.

64. As the Department is keenly interested in promoting the widespread deployment of 5G networks and making the resulting new and innovative services and applications available to Canadians, we believe that 5G deployments should not be encumbered or hampered by any future SRS or MSS deployments.

Question 7-7:

ISED is seeking comments on:

a) The options and implications for the treatment of incumbent licensees currently holding Tier 3 licences, the percentage that would apply to option 1 and supporting rationale.

65. We do not support either option presented by the Department, and respectfully proposes a third option permitting existing Tier 3 licence-holders to deploy 5G on their existing licences. The reasoning for our proposal is as follows.

66. The first option proposed by the Department suggests that licensees should give up an arbitrary percentage of their spectrum in exchange for "higher value" flexible use licences in 2024. While it may be necessary for these licensees to align in some sense to the new band plan, it is hardly a fair trade to downgrade their bandwidth in exchange for permission to operate on a flexible basis. Using these bands for mobile service is significantly more complex than for fixed service, and having ubiquitous coverage for fixed or mobile applications requires an immense number of base stations. It would be very costly for these licensees to take advantage of the "value" of their new licenses. As a result, we do not support option 1 as proposed.

67. The Department's proposed second option would offer Tier 3 licensees site-specific licences in replacement for their current licences at the end of the 2024 term. We believe that this option is not a sustainable path forward given the unique requirements of deploying 5G. As this band evolves to a 5G service offering, existing site-specific licences will impede the provision of ubiquitous coverage, which is a cornerstone of the 5G vision. For 5G to be maximized, licensees will need the ability to deploy on a site area basis. Providing site-specific licences to existing Tier 3 services will simply make the band unattractive to bidders by creating uncertainty to access, and this will minimize the value of this band for Canadian 5G services. Therefore, we also do not support option 2 as proposed.

68. We respectfully propose that the Department consider a third option for the treatment of Tier 3 incumbents: permitting 5G services to be implemented by existing licensees. These licensees would retain the same amount of spectrum as in their current licence, but they would be required to align within the band in order to avoid broad disruption of the band plan. Given that existing licences are composed of 50+50 MHz, we believe that aligning to a 200 MHz band plan would be very feasible. For instance, an existing licensee with 50+50 MHz would get access to half of the proposed 200 MHz contiguous block in the new band plan. Similarly, a

licensee with 100+100 MHz would get access to the entire 200 MHz contiguous block. Under the above scenario, the Department would still have 1 GHz of greenfield mmWave spectrum to auction – from 37.6 GHz to 38.6 GHz, and 600 MHz of recovered FCFS licensed spectrum from 38.6-38.7 GHz, 39.1-39.4 GHz and 39.8-40 GHz (see our response to 7-7 (b) below). This is in addition to 1.85 GHz of 28 GHz mmWave spectrum.

69. If there are some licensees that choose not to deploy 5G services once the changes have been implemented in the new band plan, the Department could choose to protect these systems on a grandfathered basis.

70. The core benefit to this proposal is maximizing the rapid deployment of 5G services on this band, since the Department would not have to wait until 2024 to restructure the band plan and give access to flexible use licenses. Accelerating the timeline for deploying 5G would be most consistent with the Department's goal to enable 5G services to Canadians as quickly as possible. Further, we believe that there is no evidence to suggest that existing 38 GHz deployments cannot co-exist with new 5G deployments. Indeed, existing deployments can be viewed as early 5G services, and they would easily coexist with newer 5G deployments.

71. The *Framework for Spectrum Auctions in Canada* suggests that the existing licences would not be renewed in 2024 if there is a fundamental reallocation to a new service. We assert that 5G is not a fundamental change, but a move to ubiquitous coverage and even smaller cells. This is compatible with the existing applications of building-to-building connectivity and cell site backhaul facilities.

72. Moreover, the *Framework for Spectrum Auctions in Canada* states:

> Licences issued via auction will have terms of up to 20 years, based on the specific spectrum being offered. Where spectrum use is not anticipated to change, longer terms (e.g. 20 years) would be offered. As a condition of licence, licences will have a high expectation of renewal, unless a breach of licence condition has occurred, a fundamental reallocation of spectrum to a new service is required or an overriding policy need arises. [8]

[8] *Framework for Spectrum Auctions in Canada, March 2011*, section 3.5.

73. The above statement from the Department clearly indicates that a fundamental reallocation must be triggered and agreed to at the ITU. We believe this statement was intended to address situations where the new allocation is fundamentally (technically) incompatible with the old allocation. We believe that this is not the case with the 38 GHz band and deployment of 5G services. Again, existing 38 GHz deployments are within the scope of what 5G services will entail.

74. For the above reasons, we respectfully suggest that rather than waiting for the existing licences to expire in 2024 and conduct an auction for the entire 38 GHz band, a better approach would be to allow existing licensees the option to provide earlier 5G services (with a firm commitment to accommodate changes and deploy 5G services from the new band plan) and for the Department to auction the remaining 1 GHz of greenfield spectrum.

75. Should the Department decide not to proceed with our proposed third option, as outlined above, we recommend that option 1 be the preferred approach as it clearly recognizes the deployments that licensees have made in good faith and with real investment.

b) The options and implications for the treatment of incumbent licensees currently holding FCFS licences and supporting rationale.

76. With respect to FCFS licences, we generally support the Department's proposed option 2. We note that these licences are not wide area licences. The fact that we have deployed the spectrum in good faith should be taken into consideration as the Department makes changes to the band.

77. We are of the view that existing stations should be afforded protection and that any auction that may occur could be done over the top of these licensees. It may also be possible that all such licensees may be provided protection by having them shift to a single block within the new band plan.

2.3 64-71 GHZ FREQUENCY BAND FOR LICENCE-EXEMPT OPERATIONS

Question 8-1:
ISED is seeking comments on its proposal to designate the band 64-71 GHz for licence-exempt operations on a no-protection, no-interference basis.

78. We agree with the Department's view that, as there are presently no operations in the 64-71 GHz frequency range, designating this band for licence-exempt (LE) operation will have no impact on any incumbent services. We also note that in the U.S., the FCC has authorized LE operation in the 64-71 GHz, adopting the same technical standards as in the adjacent frequency band of 57-64 GHz. Canada has already harmonized with the U.S. on technical rules for the operation of LE devices in the 57-64 GHz band.

79. We agree that it is important to harmonize spectrum use with the U.S., particularly where consumer devices are concerned, and we therefore support the Department's proposal to designate the band 64-71 GHz for licence-exempt operations on a no-protection, no-interference basis.

2.4 GENERAL SPECTRUM ACCESS CONSIDERATIONS

Question 9-1:
ISED is seeking comments on:
a) Whether flexible use access in these bands should be exclusively licenced or licence-exempt.

80. We are of the view that a licensed spectrum environment promotes the innovative development of networks and services in ways that deliver the best quality, reliability, and variety of service to Canadians. While there may be a place for some unlicensed spectrum for experimentation and low end service offerings, experience with 4G networks has shown us that interference is the main constraint to network development. Thus, license exempt spectrum cannot possibly deliver the high level products and services that Canadians expect of their operators. Both the 28 GHz and 37-40 GHz bands should be licensed as these hold the greatest potential for the development of flexible fixed, mobile or dynamic fixed and mobile services. Further, licensed spectrum facilitates coordination among users and incumbents with differing services and adjacent operating areas.

b) If a licencing approach is proposed, which types of licences (radio licences, spectrum licences with user-defined licence areas, spectrum licences with service areas for competitive licensing, or others) are expected to best lend themselves to licensing flexible use in the 28 GHz and 37-40 GHz frequency bands in order to support a variety of 5G technologies, applications and business cases?

81. With respect to which licensing approach should be used, we would support the use of a spectrum licence with appropriate service areas for competitive licensing. In our view, the use of spectrum licences with predefined geographic service areas are considerably more practical than licensing on a site by site basis. Further, we are of the opinion that these service areas should be of significant size to in order to minimise boundary coordination requirements. Boundary coordination could also be minimised by some post auction alignment of spectrum among the licensees.

c) Whether a licence-exempt dynamic access using data base should be implemented in all, or portions of the 28 GHz, 37-40 GHz, particularly in the band 37-37.6 GHz.

82. In the 28 GHz and 37-40 GHz bands, we are of the view that license exempt dynamic access using a data base is generally not appropriate. We believe that coordination among incumbents may be more efficiently accomplished within the flexible licensing-coordination process. This planned arrangement also ensures that services can be reliably delivered to users. However, we recognise that administration of licensing-coordination operations may be assisted through the use of an appropriate data base among the group of spectrum licensees operating in the various bands. We note that where the concept of license exempt databases has been proposed, there is a joint proposal to implement an extensive monitoring network. We question the practicality of this, particularly for mmWave communications.

Question 9-2:

If an exclusive licensing approach is implemented, preliminary comments are sought on the benefits and risks related to longer licence terms for these frequency bands.

83. We support long licence terms, i.e., terms of at least 20 years, since they are the most effective way to encourage investment, innovation, and widespread deployment. As ISED noted, "licence terms in excess of 10 years […] create greater incentive to invest in the telecommunications industry and for the industry itself to further invest in the development of network infrastructure, technologies and innovation."[9] The certainty of longer terms will have a

[9] Notice No. 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*, paragraph 21.

particular positive impact on deployment rates in rural communities, where developing the network infrastructure requires heavy investments. ISED's commitment to encouraging infrastructure development through longer license terms is a key reason that Canada's wireless networks are world class.

Question 9-3:

If an exclusive licensing approach is proposed, ISED is seeking preliminary comments on possible measures that could support competition in light of the current conditions in the Canadian wireless service market and anticipated development and deployment of 5G services if flexible use licensing is developed through a spectrum licensing model.

84. It is inevitable that with the growth of connected devices, "big data", mobile applications and cloud services, new and innovative products and services will at some point interact with Canada's communications networks. Without access to world-class wireless networks, Canada will be at a significant disadvantage. Canada's future prosperity depends on having access to 21st century network infrastructure. World-class wireless networks provide the critical foundation that supports a thriving digital, information and knowledge economy.

85. In order to deploy new 5G networks in a timely manner, wireless providers will require large contiguous bands of spectrum across different frequency bands. As noted in a report prepared by Nokia:

> 5G radio is likely to use several bands from 400 MHz to 100 GHz. … The lower frequency bands being made available for 5G have good penetration characteristics that provide coverage to support applications with high mobility and reliability. Efficiently using sub-6 GHz spectrum will require different carrier bandwidths and flexible spectrum aggregation techniques. … For 3-6 GHz spectrum, support for high contiguous carrier bandwidths of more than 100 MHz will be especially relevant. The higher frequencies have several bands available to provide huge capacity and throughput.[10]

86. Thus, for Canada to realize the full benefits of 5G technology, carriers require access to larger bands of spectrum. Spectrum set-asides and/or tight spectrum caps prevent larger spectrum allocations from being available to network operators, and as a result, there is a risk that Canada will not realize the full potential of new 5G network technology.

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[10] Nokia Networks, "5G Masterplan – Five Keys to Create the New Communications Era," page 7, available at: https://pages.nokia.com/5g-master-planTY.html.

87. As noted above, 5G is not a standalone phenomenon. 5G is an ongoing evolution of existing networks that carriers have been deploying throughout Canada. In fact, a successful 5G network will be comprised of multiple bands (making use of existing bands/networks) and multiple connectivity 5G environments in which the mmWave spectrum is but a single component of an interconnected network.

88. Canada's wireless market is highly competitive, characterized by intense rivalry across price and other dimensions, and resulting in world class quality networks, high rates of usage, and great value for consumers. The most advanced wireless networks are rolled-out to Canadians in both urban and rural areas; our LTE network covers 99% of the population and our world-leading LTE-Advanced network covers approximately 87%.

89. As a result, the Department needs to support a market-based approach to spectrum allocation as indicated in the *Spectrum Policy Framework for Canada's* enabling guidelines (a) and (d) which state that market forces should be relied upon to the maximum extent feasible, and regulatory measures, where required, should be minimally intrusive, efficient and effective, respectively.[11] Market forces, in short, will ensure that those willing and able to put the spectrum to its best use will bid for and acquire it. A market based approach to spectrum allocations will also ensure that the government garners the highest possible value for the spectrum it administers on behalf of Canadians.

90. Moreover, an efficient allocation of spectrum cannot be achieved if spectrum set-asides are implemented as part of an auction process. Previous set-aside policies have resulted in increasing the costs to the wireless industry by hundreds of millions of dollars by artificially reducing supply and creating arbitrage opportunities. Furthermore, spectrum set-asides can delay the allocation of valuable spectrum. After originally going unsold, the set-aside spectrum in the areas of Manitoba, Saskatchewan and the North in the first AWS-3 auction had to be put up for auction again without the set-aside restriction.

91. Consider the AWS-1 spectrum auction. New entrant bidders were able to bid on both set-aside spectrum and non-set-aside spectrum, which allowed them to minimize their own costs of acquiring spectrum while inflating others' costs. There were a number of circumstances where a new entrant bid on non-set-aside spectrum even though equivalent set-aside spectrum

[11] Industry Canada, *Spectrum Policy Framework for Canada*, June 2007, available at http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08776.html#s44.

was available at a much lower price. As a result, the price for set-aside spectrum ended up being far lower than the price for equivalent non-set-aside spectrum.

92. In the AWS-3 auction WIND Mobile (now Shaw), QMI and Eastlink all won significant blocks of spectrum covering most of the country for a combined total of less than $100 million or about $0.11/MHz-Pop. In contrast, incumbents paid over $3/MHz-Pop for comparable spectrum – about 28 times as much. Canaccord Genuity put the result into perspective:

> The national incumbents paid $3.00 per MHz PoP versus $0.11 for the new entrants, implying a new entrant subsidy of $2.7 billion. Videotron received an estimated subsidy of $860 million, even though it is controlled by a Quebec separatist, and WIND an estimated $1.58 billion, even though it is owned by North American private equity/hedge funds. With no eligible operating new entrants in the Prairies, the 30 MHz set-aside went unallocated, and MTS and SaskTel received no incremental spectrum.[12]

93. As investment firm Macquarie Capital Markets concluded, the spectrum subsidies have provided Shaw (previously Wind Mobile) and QMI with a cost advantage over the incumbents.[13] This outcome was the direct result of an auction framework that employed set-asides which limited the eligible bidders and shielded the eventual winners from a fully competitive auction.

94. The corporate beneficiaries of these policies certainly do not need taxpayer-funded subsidies. QMI's market capitalization is almost $6 billion while Shaw's is more than double that amount – almost $14 billion.[14] Since these corporations became wireless service providers their market value has soared. In Shaw's case, its market capitalization has increased by more than $2 billion in only two years, while QMI, which first won its subsidized spectrum in 2008, has seen its market capitalization increase by about $2.5 billion.[15]

95. In other situations, the original spectrum licensees were able to generate significant private returns at the expense of the Government and Canadian tax payers. For example, Public Mobile was acquired by Telus for close to five times the original spectrum cost, and Shaw purchased WIND Mobile for $1.6 billion or almost six times the amount paid by private equity

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12 Canaccord Genuity, *Government gives wireless new entrants another huge subsidy*, 9 March 2015.
13 Macquarie Capital Markets Canada Ltd., *Carrier ROIC, why it matters more now*, 6 January 2016, page 2.
14 As of 22 August 2017.
15 Shaw purchased WIND Mobile in March 2016. Shaw's market capitalization increased from about $11.5 billion at the end of 2015 to $13.7 billion as of 22 August 2017. QMI first won auctioned spectrum in 2008. QMI's market capitalization increased from about $2.4 billion at the end of 2007 to more than $5.8 billion as of 22 August 2017.

firms originally purchased WIND Mobile for from VimpelCom.[16] These are illustrations of the unintended consequences and perverse outcomes of intrusive regulations.

96. Licence transfers and divisions are a key element of a well functioning market since they allow the market to allocate spectrum to its highest value use. As a result, we support the *Spectrum Policy Framework for Canada* has the objective of "facilitating secondary markets for spectrum authorizations,"[17] and in doing so, should rely on market forces to the maximum extent feasible:

> In developing these revised guidelines, the Department recognizes, as do many other administrations, the importance of relying on market forces in spectrum management, to the maximum extent feasible. This includes aspects such as the removal of barriers to secondary markets for spectrum authorizations.[18]

97. Intrusive regulation stifles innovation and investment, with the negative impacts having a potentially greater effect in digital, information and knowledge-based economies. In order to further innovation and investment, government policy should work towards a regulatory environment that adheres to light touch regulation; only intervenes in cases where there is a clear market failure and regulation can remedy the situation; and ensures that regulation is symmetrically applied to all industry participants. Canada currently has a world-class wireless industry with competition between well financed companies. Asymmetric government spectrum policies are not required.

3.0 CONCLUSION

98. Access to the mmWave spectrum is crucial to the deployment of 5G in Canada. Leveraging this spectrum band will enable services and user experience in a wide range of use cases to the benefit of Canadians, and we commend the Department for launching this forward-thinking consultation. As discussed above, we support the Department's proposal to make the 28 GHz and 37-40 GHz frequency bands available for flexible-use licences, as well as make the 64-71 GHz frequency band available for licence-exempt use ahead of WRC-19. We also support the RABC's recommendation that the Department initiate a study in the near term to determine the appropriate coordination trigger for situations of interference between stations.

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16 Montreal Economic Institute, *The State of Competition in Canada's Telecommunications Industry – 2016*, pages 21 to 23.
17 Ibid., page 9.
18 Ibid., page 8.

99. Moreover, the Department needs to support a market-based approach to spectrum allocation and not implement any measures that might inhibit network operators from acquiring the large bands of spectrum needed for 5G deployment.

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