TELUS COMMUNICATIONS INC.

REPLY COMMENTS for

CONSULTATION on RELEASING MILLIMETRE WAVE SPECTRUM to SUPPORT 5G

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Executive Summary

1. TELUS appreciates the opportunity to provide its reply comments.

2. TELUS strongly supports the commitment to innovation demonstrated by the Department in issuing this *Consultation on Releasing Millimetre Wave Spectrum to Support 5G* ("the Consultation"). The bands that the Department has identified in the Consultation, along with the 3500 MHz band, are the priority bands for enabling early 5G adoption and will provide spin-off benefits for digital society innovation in Canada in general. Designating these bands for flexible use provides the regulatory flexibility to allow innovators, operators and investors to pursue unbridled collaboration.

3. Few if any product categories have ever grown like mobile phones and particularly smartphones. In 2014, the number of mobile connections surpassed the number of people in the world (at 7.2B) and is currently estimated to be in excess of 8.2B[1]. There were more than 3.9B smartphones in the world by the end of 2016[2] and more than three quarters of Canadians own a smartphone[3]. The Department in the Consultation highlights that mobile data consumption is expected to grow sevenfold between 2016 and 2021.

4. Unfortunately, the entire mobile industry in Canada is operating on a mere 0.648 GHz of commercial mobile radio spectrum. The satellite industry has licensed access to more than forty times the spectrum of the mobile industry (attracting roughly one hundredth of the total annual spectrum fees.) There are currently only eight satellite earth stations in Canada in the 27.5-28.35 GHz band and none in the 37-40 GHz band. There are no satellite licensees in the 64-71 GHz band.

5. With 5G, a wealth of applications spanning a wide range of vertical industries such as healthcare, transportation, agriculture, manufacturing, automation and smart cities are

[1] *GSMA Intelligence*. https://www.gsmaintelligence.com/
[2] *Ericsson Mobility Report*, June 2017. https://www.ericsson.com/assets/local/mobility-report/documents/2017/ericsson-mobility-report-june-2017.pdf
[3] CRTC, *2017 Communications Monitoring Report*, November 2017. http://crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2017/cmr2017.pdf

anticipated to revolutionise every aspect of our lives and serve as the foundation for the global digital economy.

6. The identification of these 5G millimetre wave (mmWave) bands (in full alignment with the initial U.S. band adoption) will allow Canadians to take full advantage of the benefits provided by a North American (and potentially global) ecosystem. As such, TELUS emphasises the importance of ensuring that the technical guidelines impacting the certification and operation of infrastructure and end-user devices are harmonised with the U.S.

7. As the Department and regulators in other early adopter jurisdictions recognise, 5G regulatory planning can be advanced in parallel with WRC-19 activity while still supporting and respecting the ITU and in-process satellite / terrestrial coexistence studies. Delaying action on 5G would put Canadian innovation on the back burner and hinder the Canadian digital economy.

8. It is in this context that TELUS submits its comments, summarised as follows:

   a. Immediate and decisive regulatory action is required to allow Canada to reap early mover advantages in the new global digital economy. The steps proposed by the Department in the Consultation do not presuppose conclusions for the WRC-19 agenda items; rather, they prepare Canada to sync up with them with a running start.

   b. The proposals to designate 27.5-28.35 GHz and 37-40 GHz for terrestrial flexible (mobile and fixed) use with priority over fixed-satellite services (FSS) are critical for establishing Canada's 5G leadership. The corresponding proposed changes to the Canadian Table of Frequency Allocations (CTFA) are both appropriate and necessary in enabling flexible terrestrial use. TELUS notes that modifications to the CTFA, which are certainly influenced by ITU outcomes, are ultimately decisions made by the Department in its determination of the best spectrum management practices for Canada; these decisions ultimately reside within the Department's jurisdiction.

c. The proposal to designate an additional 7 GHz[4] of spectrum for licence exempt use to unleash Canadian innovation leveraging U.S. equipment and device economies of scale has few detractors (as TELUS had suggested would be the case in its initial comments). There is currently no use of this band and it is therefore ripe for innovation.

d. Following the U.S. band plans for the spectrum considered in the Consultation is warranted by economy of scale benefits and the necessity of border coordination, particularly as all the proposed bands in the Consultation are anticipated to utilise TDD technology requiring tight coordination at shared borders.

e. Despite FSS being secondary in the U.S. in these bands, TELUS supports the proposal to maintain co-primary allocations for fixed satellite service (FSS) / mobile service (MS) / fixed service (FS) in Canada with MS/FS having priority and a small number of FSS earth stations causing minimal constraints on 5G.

f. TELUS supports the proposal to require site-by-site coordination in the 28 GHz band and recommends triggering coordination with a PFD threshold. TELUS is confident that its proposal provides a balanced approach for Canada, taking into consideration coexistence distances, PFD contour limits and earth station geographic restrictions that ensure minimal constraints on terrestrial flexible use while minimising any technical hurdles to co-existence.

g. TELUS strongly opposes imposing any restrictions on either individual or aggregate base station emissions to address the theoretical risk of aggregate emissions interfering with satellite receivers. TELUS provides strong evidence suggesting that there is essentially no risk of aggregate terrestrial interference into space station (satellite) receivers.

h. TELUS has revisited its proposed principles for coordination in the 37.5-40 GHz band and no longer recommends the use of a PFD trigger for coordination.

i. TELUS contends that the unrestricted siting of satellite earth stations would severely hamper terrestrial investment in and utility of the 27.5-28.35 GHz and 37-40 GHz bands.

[4] Bringing the total up to 14.84 GHz

Restrictions on the geographic areas in which new FSS earth stations can be deployed are therefore justified. A made-in-Canada solution for defining geographic restrictions can ensure that minimal constraints are imposed on terrestrial 5G network deployment while allowing a small number of appropriately sited and shielded satellite earth stations to coexist. This is an area where Canada is not penalised by charting its own course and if earth stations can be sited so as not to constrain the deployment of terrestrial flexible use networks, then the pressure to restrict their number eases.

j. To take full advantage of the opportunities that 5G mmWave networks present, Canada must not be constrained by current fixed use in the 37-40 GHz band. Current first-come first-served (FCFS) licensees, who are predominantly major mobile service providers, can acquire new flexible use licences at auction and migrate any fixed links they prefer to remain in the 37-40 GHz band going forward to their newly acquired spectrum within one year of the auction ending. FCFS licensees who do not acquire licences at auction must operate on a secondary basis until displaced. The Department should find a band that it can allocate for fixed only use with fees commensurate with the restriction to fixed use and develop a fee regime that does not penalise spectral efficiency.

k. TELUS recommends that spectrum area licences currently issued on a Tier 3 basis not be renewed upon the end of their licence terms. Sites in operation under a Tier 3 spectrum area licence must be converted to site-specific radio licences and treated as described above – operating on a secondary basis until displaced, migrating to a flexible-use licence acquired at auction, or migrating to another band allocated for fixed only use.

l. In order to achieve the Department's stated objectives in the 28 GHz and 37-40 GHz bands, TELUS emphasises the importance of exclusively licensing spectrum under service areas for competitive licensing, with minimum encumbrance (aside from a handful of grandfathered satellite earth stations and, in the short term, to-be-displaced FCFS fixed service licensees). TELUS views the notion of implementing policy based on dynamic access as premature, given the nascent state of development of database driven dynamic access systems and supports reassessing the band plan for the 37-37.6 GHz frequency range down the road following U.S. developments.

m. TELUS recommends the use of 20 year licence terms as provided by the Department in all recent licensing framework proposals and decisions. Longer licence terms promote facilities-based competition and will provide licensees pursuing 5G network deployments with investment certainty, but must be coupled with aggressive build requirements to deter spectrum warehousing and speculation.

n. There is no rationale for pro-competitive measures in the licensing of the 28 GHz and 37-40 GHz bands. No competitor has any advantage in mmWave spectrum and every operator is starting anew in terms of flexible use licences or mmWave radio access network equipment. All of Canada's mobile operators deliver quad plays in their incumbent territory and have similar financial strength (normalised to the size of their operating territories). It is time for the Department to move on to the next phase (away from "market planning" and the picking of winners and losers) and start to rely on market forces to allow and ensure the efficient assignment of spectrum so that the companies that will truly lead Canada into the 5G digital future are no longer heavily penalised at auction.

9. Details behind TELUS' recommendations and comments in response to various questions raised by the Department follow in the main body of this document.

Background and Context

4-1: Business Models and Network Applications for 5G

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.

10. The deployment of 5G networks will address a variety of industry forecast use cases spanning enhanced mobile broadband, massive machine type communications, and ultra-reliable low latency communication applications. 5G networks will act as a foundation for next generation digital development of vertical industries such as healthcare, transportation, agriculture, manufacturing, automation and smart cities that require extensive facilities-based investment and help drive the highly competitive wireless marketplace. In turn, these clusters of industries (supported by a light handed regulatory environment) are expected to deliver enhanced 5G enabled services and that will have a significant multiplier effect in the Canadian economy, both in the form of private investments and contribution to GDP[5].

11. The bands the Department has identified in the Consultation will be critical in enabling the early implementation of these 5G applications in Canada. The two bands proposed for licensed use in the Consultation are at the center of 5G standardization and development. Their allocation for flexible use licensing is anticipated to benefit from the economies of scale associated with a U.S. driven ecosystem. These key bands will be instrumental in fostering early innovations provided by 5G mmWave technologies and the resulting green field business opportunities.

12. TELUS anticipates that 5G mmWave networks will enable highly disruptive applications and business models. Nevertheless, the emergence of these models is highly dependent on the regulatory environment facilitating the development, deployment and adoption of 5G technologies. Specifically, fostering early innovation will require the Department to rely on a

[5] GSMA, *The Mobile Economy 2017*.
https://www.gsmaintelligence.com/research/?file=9e927fd6896724e7b26f33f61db5b9d5&download

light handed regulatory approach with minimal intervention to encourage 5G investments and sustained growth.

13. While mmWave spectrum will deliver the richest 5G experience, its deployment will not be economic across the entire terrestrial network footprint. The initial use of mmWave spectrum will be focused in dense urban markets. In order for operators to provide a mobile 5G coverage layer, new mid-band large block TDD spectrum such as the 3.5 GHz band will be required. Ubiquitous 5G will not arrive until 3.5 GHz spectrum is liberated and reassigned as part of its fundamental reallocation to mobile service.

14. TELUS notes that nearly all respondents from the mobile industry (Bell, Rogers, SaskTel and Shaw) answer this question by describing a wide variety of innovative 5G use cases. Among these respondents, despite varying uncertainty regarding the timing and business models for the realisation of specific 5G use cases, there is a general consensus that 5G technology deployment in the mmWave bands will bring about disruptive applications with transformative impacts to Canadian society and the Canadian economy. This perspective is closely aligned to TELUS' position as described above.

15. Respondents from the satellite industry (Ciel, IntelSat, Telesat, Viasat and the BSO Coalition), as well as Xplornet[6] suggest, to varying degrees, that satellite systems will play an important role in 5G. TELUS supports the characterisation of satellite systems as complementary to the mobile network and agrees that satellites hold the potential to help serve rural and remote communities in which economic business cases for the deployment of mmWave spectrum for terrestrial access may not exist. However, TELUS does not envision satellite playing a key role in 5G within the footprint of today's existing mobile broadband networks which serve over 99%[7] of the Canadian population. The capabilities that one respondent (the BSO Coalition) describes as "meet[ing] the demands of 5G services including speeds exceeding 100 Mbps" offers good evidence for why the satellite and mobile services will likely remain

[6] Xplornet's responses to this Consultation offer an interesting balance between satellite providers and terrestrial access providers, given their unique business model of primarily service rural subscribers using both technologies
[7] CRTC, *2017 Communications Monitoring Report*. Table 5.5.15 shows 99.4% coverage for HSPA+ and 98.5% coverage for LTE.

complementary, as a peak throughput capability of 100 Mbps is something that all Canadian LTE providers offer today using the most basic[8] deployment configuration.

16. While it is possible that satellite becomes a part of a 5G "network of networks" (as described by Xplornet and ViaSat in their comments, as well as by Telesat in its own response and as input to the RABC contribution), it is not certain that this desired outcome of the satellite community will materialise in the near term. These respondents point to the 3GPP "Study on New Radio (NR) to Support Non-Terrestrial Networks"[9] as proof that satellite will become an integral part of the 3GPP 5G specification and ecosystem. TELUS contends that this item is only a study which has not yet been concluded; the degree to which satellite could become integrated into 3GPP systems and the timing of such an outcome are both highly uncertain at this time. The Phase 1 release of the 3GPP 5G technical specification will be completed at the end of this year (2017) for non-standalone implementation (anchored on LTE) and the standalone version is targeted for June 2018 upon the completion of the Release-15 specification. If satellite systems were to become a part of the 3GPP 5G standard, they would be not be included in specifications before the Release-16 standard at the earliest, targeted for completion in early 2020, and could slip well beyond that date given the workload pressure at 3GPP.

[8] A system using the 2x2 MIMO configuration with 64-QAM modulation and a 15 MHz LTE carrier has been supported since the launch of LTE (Release-8) and achieves a theoretical peak downlink throughput of 110 Mbps. TELUS' network currently supports speeds as high as 750 Mbps and is expected to support Gbps speeds in the near future.

[9] 3GPP TR 38.811 v.0.2.0, *Study on New Radio (NR) to support Non Terrestrial Networks,* June 2017. http://www.3gpp.org/ftp/Specs/archive/38_series/38.811/38811-020.zip

Canadian Approach and Timing

5-1: Flexible Use Licensing and Licence-Exempt Timing

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.

17. TELUS supports the Department's proposals to transition the 28 and 37-40 GHz bands from their current (fixed) licensing to a flexible (fixed and mobile) use licensing model. As technology standards continue to develop, industry views on 5G network architecture are converging. The 5G architecture incorporates a heterogeneous terrestrial network with an ultra-dense underlay to meet the stringent requirements of 5G services and applications, such as extremely high download throughputs in excess of 20 Gbps[10]. The anticipated density of deployment for these mmWave networks combined with the cost and difficulty of locating additional fibre runs in already developed urban environments suggests that wireless transport (i.e., "self-backhauling") and wireless fibre substitution will be an essential capability for enabling the realization of the mmWave layer of 5G networks. We further discuss the notion of self-backhauling mmWave sites in our response to Question 6-6.

18. TELUS also supports allowing licence-exempt use in the 64-71 GHz band ahead of WRC-19. While TELUS recognises that the band addressed in the Consultation overlaps with the 66-76 GHz frequency range addressed under Agenda Item 1.13 at WRC-19, we note that international mobile telecommunications (IMT) identification processes do not determine domestic policies in terms of licensing framework. TELUS also recognises that harmonization with the U.S. would be highly beneficial in enabling early innovation in 5G technologies. As such, TELUS supports the adoption of a licence-exempt approach for the 64-71 GHz frequency band. Creating a contiguous 14 GHz licence-exempt band between 57-71 GHz, by combining the

[10] Recommendation ITU-R M.2083, *IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond,* September 2015. http://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf

currently licence-exempt 57-64 GHz band with the 64-71 GHz band, will also drive development and innovation outside of the exclusively licensed spectrum regime.

19. Alignment with WRC outcomes is primarily driven by two objectives: to facilitate international coordination and to promote ecosystem harmonization. In the Canadian context, concerns with both coordination and ecosystem compatibility in these bands depend primarily on the U.S. Both of these objectives can be achieved in parallel with the WRC-19 process. TELUS therefore supports the designation of these bands now for flexible use, ahead of WRC-19 and in alignment with the U.S. band plans. TELUS also notes that both the 27.5-28.35 GHz and 37-40 GHz bands addressed in the Consultation are identified as priority spectrum bands for global 5G mmWave standardization efforts under multiple standards defining organizations, including 3GPP[11] and the NGMN Alliance[12]. As 3GPP will provide technical standards enabling the utilization of the bands by December 2017[13], TELUS fully supports the Department's action to designate this spectrum for 5G in a timely manner to the benefit of all Canadians.

20. While TELUS strongly supports the early release of 27.5-28.35 GHz and 37-40 GHz spectrum to establish Canada as a 5G leader, we also recognise the importance of and support the role that Canada continues to play in our participation and leadership within the ITU-R WRC-19 process to identify additional mmWave spectrum for 5G (IMT-2020). The bands addressed in the Consultation will foster early innovation while additional spectrum identified by the WRC-19 process will bring the benefits of global harmonization to sustain Canada's 5G leadership. TELUS recognises that mobile / satellite coexistence will be studied for a number of mmWave bands under Agenda Item 1.13 at WRC-19 and acknowledges that valuable outputs are expected to be produced in that process. Nonetheless, while international developments

[11] 3GPP 5G Phase 1 work defines mmWave bands in the frequency ranges 24.25-29.6 GHz, 31.8-33.4 GHz, and 37-43.5 GHz. See for example 3GPP R4-1708965, *Text Proposal for NR Band Numbering,* August 2017 and 3GPP R4-1709182, *Way Forward on 39 GHz Band Definition,* August 2017.
http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_84/Docs/R4-1708965.zip
http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_84/Docs/R4-1709182.zip

[12] The NGMN has highlighted bands below 43.5 GHz as a priority focus for mmWave release (*NGMN 5G Spectrum White Paper*, v1.0, January 2017).
https://www.ngmn.org/uploads/media/1701031_NGMN_5G_SPECTRUM_WHITE_PAPER_V1.0.pdf

[13] 3GPP RP-170741, *Way Forward on the overall 5G-NR eMBB workplan*, March 2017.
http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_75/Docs/RP-170741.zip

provide context for the development of Canadian spectrum policy, TELUS views public consultation with local stakeholders (as initiated in this Consultation) as key to determining a swift decision on domestic policy that establishes Canada's 5G leadership.

21. TELUS notes that the majority of responses to Question 5-1 support the development of a flexible-use licensing framework for the 28 GHz and 37-40 GHz bands, as well as licence exempt use of the 64-71 GHz band in advance of WRC-19. Only Cogeco (which does not operate a wireless network) and Intelsat (which is fundamentally opposed to allowing terrestrial 5G use in the 28 GHz band) suggest that the Department should wait for 3GPP standards and ITU recommendations to further develop. As noted in TELUS' reply to Question 4-1 above, the Phase 1 3GPP standard which would support the early deployment of 5G technology will be completed by the end of this year (2017). Furthermore, while the ITU will not reach its final conclusions on IMT use in its Agenda Item 1.13 bands (including the 37-40 GHz band) until WRC-19, many of the coexistence studies within the ITU's Task Group 5/1 are concluding early next year and will culminate in CPM text before the end of 2018. Both of these key standardisation activities have firm timelines for near term deliverables that would support a Department decision to take bold actions and enable 5G innovation through flexible use licensing in the 28 GHz and 37-40 GHz bands in advance of WRC-19.

28 GHz Band (27.5-28.35 GHz)

6-1: Introducing Flexible Use Licensing

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***.**

22. TELUS fully supports the introduction of flexible use licensing in the 28 GHz band.

23. TELUS supports the Department's proposed changes to the CTFA domestic footnotes and to SP 3-30 GHz and views such changes as both appropriate and necessary in order to make the 28 GHz band suitable for flexible use licensing in 5G. Specifically, TELUS agrees with the proposed change to Footnote C47A (reducing the frequency range for fixed-service only systems from 27.35-28.35 GHz to 27.35-27.5 GHz), and with the proposed addition of Footnote C47C (adding "mobile service systems" for the range 27.5-28.35 GHz). Both proposals align with the introduction of flexible use licensing in the 27.5-28.35 GHz band while maintaining status quo for the 27.35-27.5 GHz frequency range.

24. Paragraph 20 of the Consultation states that currently in the 28 GHz band, "fixed services are given priority over fixed-satellite service systems sharing this spectrum." The relative priority of these two co-primary services is managed by the limitation in Footnote C47A, which implicitly restricts FSS earth station deployments by ensuring that they "pose minimal constraints upon the deployment of fixed service systems." This footnote gives the Department the latitude to restrict the possible locations when assessing FSS earth station siting requests. TELUS supports the Department's proposal to maintain this relative priority and extend it to flexible use licences by retaining the language of "minimal constraints" when considering FSS deployment. In TELUS' view, maintaining this relative priority is critical to satisfying the Department's stated objective of "promot[ing] innovation as well as the development and adoption of 5G technology in Canada" through the release of mmWave spectrum.

25. TELUS notes that of the many satellite companies responding to the consultation, only Intelsat encourages the Department not to introduce terrestrial flexible use licensing in the 27.5-28.35

GHz band because it is not included in WRC-19 Agenda Item 1.13. However, Intelsat goes on to generally accept the introduction of flexible use licensing in the 27.5-28.35 GHz band as long as FSS retains its co-primary status; TELUS notes that this is in line with the Department's proposal.

26. The Broadband Satellite Operator coalition (BSO) and Telesat as well as ViaSat request that ISED remove the word "large" from the footnote; BSO recommends it be replaced with the words, "individually licensed". TELUS is not opposed to the Department reviewing this recommendation and refers the Department to a very similar request originating in the RABC AWS Subcommittee working group which included BSO members.

> *The RABC will be providing input to Notice No. SMSE-005-17—Proposed Revisions to the Canadian Table of Frequency Allocations. In that response the RABC intends to ask the Department to review its consistency in the use of the term "large antennas" in several CFTA domestic footnotes and whether the Department could provide more specificity around the term "large antennas" in such instances. While antenna diameter may be a factor in the creation of interference, it is not necessarily the predominant factor.*
>
> *The RABC recommends that the Department consider improving the clarity of or defining the word "large" in footnotes C47A and C47C. To make it clear that the bands are not to be considered for blanket licensing of earth stations in the 27.5-28.35 GHz band, the addition of "to be individually licensed" would be helpful.*[14]

27. In Paragraph 23 of the Consultation, the Department indicates that while "there are no Canadian spectrum utilization policies on earth stations in motion (ESIM) communicating with FSS space stations", there are terminals authorised for use in Canada for airborne and maritime applications on a no-interference / no-protection basis. Paragraph 26 of the Consultation proposes that this secondary airborne and maritime use continue to be permitted, but that the use of land-based ESIMs would be prohibited due to the high potential for interference with flexible use systems. TELUS agrees with the proposed prohibition on the use of land-based ESIMs (contrary to the recommendations from Ciel and ViaSat), and supports maintaining no-interference / no-protection operation of airborne and maritime ESIMs, as long as the volume of devices operating in such a manner remains limited. Should the usage of airborne or

[14] Paragraphs 18 and 19 of the RABC's comments.

maritime ESIMs increase substantially (such that they could pose an interference concern to the operation of flexible use systems, even under an operating status of no-interference / no-protection), TELUS would suggest that the Department further consult on the matter.

6-2: Moratorium for Fixed Service Licences

6-2
ISED is seeking comments on the moratorium for new site-specific fixed service licences as described above.

28. TELUS supports a moratorium on the issuance of new site-specific fixed service licences in the 28 GHz band as proposed in the Consultation. The imposition of such a moratorium would support the Department's stated goal of supporting 5G innovation by minimising encumbrance of the band in preparation for imminent flexible use licensing (e.g., not adding further coordination challenges beyond those associated with existing FSS earth stations). Given that FCFS licensing has been available for site-specific fixed service licences since the "New Licensing Framework"[15] was issued in December 2014 and that no licences have been issued between that time and now (September 2017), TELUS suggests that demand for the band for fixed service applications is negligible, and that a moratorium will have little to no effect on the availability of suitable bands with similar properties to be used for fixed service applications.

29. TELUS notes that this proposal was unanimously supported by respondents who addressed this question. Xplornet suggested that the moratorium should be temporary without being explicit about the timing. (Xplornet suggested it be lifted "after this process" which is not particularly clear.) TELUS recommends that any lifting of the proposed moratorium be only considered after a 28 GHz licensing framework has been published, flexible use licences have been assigned in a competitive process and any required residual auction has been completed. Only at such a future juncture, when demand for terrestrial flexible use licences has been met,

[15] *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,* Canada Gazette SLPB-006-14, December 2014. https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/decision-24-28-38-eng.pdf/$FILE/decision-24-28-38-eng.pdf

would TELUS support a lifting of the moratorium and the FCFS licensing of unassigned spectrum via licensed links or potentially grid cells.

6-3: Band Plan

6-3
ISED is seeking comments on its proposal to adopt the band plan (as shown in figure 3 above) in the 28 GHz band.

30. TELUS supports the proposal to adopt the band plan as shown in Figure 3 of the Consultation.

31. TELUS reiterates its view that harmonization with the U.S. is crucial to enabling early 5G innovation, as it permits the Canadian market to leverage economies of scale associated with equipment ecosystem development in the U.S. TELUS further reiterates that a harmonised band plan will simplify coordination efforts between terrestrial services along the Canada-U.S. border.

32. The proposed band plan also exploits the benefits of large contiguous channel bandwidths as an enabler of new 5G use cases. For example, in its "IMT-2020 Vision" recommendation[10], the ITU-R defines a target of 20 Gbps peak downlink throughput (achieved with 30 bps/Hz of peak downlink spectral efficiency) for the enhanced mobile broadband 5G use case. These targets are currently being finalised by ITU-R Working Party 5D in its "IMT-2020 Requirements" report[16], and they have also been adopted by 3GPP so that its standardisation efforts meet the requirements of 5G applications[17]. In order to address these requirements, 3GPP's 5G Phase 1 development considers carrier bandwidths of up to 400 MHz[18], with the possibility of aggregating up to 1 GHz[19]; TELUS anticipates that the total aggregated

[16] Draft new Report ITU-R M.[IMT-2020.TECH PERF REQ], *Minimum requirements related to technical performance for IMT-2020 radio interface(s)*, February 2017. https://www.itu.int/dms_pub/itu-r/md/15/sg05/c/R15-SG05-C-0040!!MSW-E.docx
[17] 3GPP TR 38.913 v14.3.0, *Study on Scenarios and Requirements for Next Generation Access Technologies*, August 2017. http://www.3gpp.org/ftp/Specs/archive/38_series/38.913/38913-e30.zip
[18] 3GPP R4-1708845, *WF on UE Mandatory Channel Bandwidth*, August 2017. http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_84/Docs/R4-1708845.zip
[19] 3GPP TR 38.802 v14.1.0, *Study on New Radio Access Technology Physical Layer Aspects*, June 2017. http://www.3gpp.org/ftp/Specs/archive/38_series/38.802/38802-e10.zip

bandwidth will increase in subsequent phases as was the case with LTE Advanced. Under the 30 bps/Hz spectral efficiency target and an assumed 80% downlink-to-uplink ratio, the proposed 425 MHz blocks would allow a licensee to achieve peak downlink throughputs of approximately 10 Gbps. In short order, aggregation of up to 1 GHz of spectrum will enable the industry to achieve the IMT-2020 target of 20 Gbps; this can be most efficiently accomplished by combining large blocks of contiguous spectrum.

33. The majority of respondents support the band plan as proposed. Microsoft suggests that the proposed block size is not required to achieve a "'5G' data rate", but TELUS would argue that Microsoft's comment is irrelevant. 5G will be broadly defined across a number of bands, with support for 5+5 MHz blocks as well as 1 GHz unpaired blocks and beyond. There is nothing technically wrong with a 400 MHz or 425 MHz block. Rogers, Shaw and TeraGo call for the band to be broken into four blocks versus the two blocks proposed by the Department in line with the FCC. TELUS encourages the Department to consider the significant amount of largely equivalent spectrum to be made available in the 37-40 GHz band and to not unnecessarily fragment the 28 GHz band. TELUS provides further comment in its reply comments to Question 9-3 later in this document.

6-4: Coordination Requirements and Triggers

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

34. TELUS reiterates its support for requiring site-by-site coordination between flexible use terrestrial stations and FSS Earth Stations (ES) approved under the geographic restriction policy detailed in our initial response to Question 6-5.

35. More specifically, given that FSS earth stations will act as potential interferers and flexible use may be the victim of interference in the case of the 28 GHz band, coordination requirements would only apply in the consideration of new applications for FSS earth station siting in proximity to existing flexible use terrestrial stations or 4G stations of flexible use licensees in the band. FSS licensees requesting earth station siting in areas of planned or likely future flexible use terrestrial station deployments would be rejected under TELUS' proposed geographic restriction policy.

36. Flexible use stations siting near existing FSS earth stations (per Annex A of the Consultation) or future approved FSS earth stations (e.g., those whose applications have been accepted by the Department at the time of new flexible use siting) could request coordination. TELUS recommends that the Department encourage FSS licensees to engage in commercially negotiated solutions for coexistence where there are established earth station operations.

37. As a precursor to facilitating coordination between flexible use terrestrial stations and FSS earth stations in the 28 GHz band, TELUS has recommended in its original filing that the Department require FSS earth station licensees to submit their technical site data as part of the approval process, including interference contours at the -77.6 dBm/m^2/MHz level, which should be published on the Department's website. Furthermore, any technical modifications to approved sites should be subject to reassessment under the geographic restriction requirements as a new application.

38. TELUS also emphasises the importance of the Department encouraging site shielding to minimise spillover emissions from FSS earth stations wherever possible. In a measurement campaign performed by Nokia Bell-Labs[20], substantial transmitter / transmit path leakage was detected, thus indicating that shielding will be necessary to ensure minimal constraints are imposed on existing and potential future flexible use terrestrial stations. Nevertheless, FSS licensees should be allowed to select their engineering solution within their desired business case to comply with the protection criteria that are set by the Department as an output of this Consultation process (i.e., a technical framework for the 27.5-28.35 GHz frequency range).

[20] D. Moongilan, W.S. Majkowski, N. Patel, M. Monahan and Q. Yu, *Measurements of Fixed Satellite Service (FSS) Earth Station Spillover Emissions to Evaluate Potential Interference Levels to Nearby 5G Systems Operating in the 28 GHz Frequency Band*, Nokia Bell-Labs, September 2016. https://www.fcc.gov/ecfs/filing/10930005008632

Application of shielding would theoretically provide FSS licensees with higher flexibility in siting their earth stations and should accordingly be strongly encouraged.

39. In this submission, TELUS provides additional justification for adopting a coordination PFD trigger value of -77.6 dBm/m^2/MHz and the corresponding coordination distances between FSS ESs and flexible use terrestrial stations.

40. Based on the a submission to the FCC from multiple filers (denoted the joint filers)[21] and a recent IEEE published study[22], the distances that ensure sufficient protection from the FSS ES emission leakage into 5G cellular base stations are summarised in Table 1. The channel models for 28 GHz cellular transmission from FSS ES to 5G BS, antenna modeling, cell sectorisation parameters, as well as other 3GPP specified evaluation parameters for Urban macro (UMa) and Rural Macro (RMa) scenarios of interest are outlined in 3GPP TR 38.901[23].

Table 1: Protection distances between FSS ESs and flexible use terrestrial stations

FSS class	Class 1	Class 2	Class 3	
			Urban macro	Rural Macro
Minimal distance between FSS ES to 5G base station (m)	50	400	3000	4000

41. Tolerable interference levels for cellular systems, including 5G, are well understood and can be characterised by base station receiver desensitisation, defined as the degradation of the minimal signal level reception point (receiver sensitivity). Numerous coexistence studies[24, 25, 26] adopt an interference protection criteria of 6 dB (I/N = -6 dB) corresponding to approximately 1 dB increase in the noise floor, i.e., 1 dB degradation in the receiver sensitivity as shown in Table 2. Table 2 also shows receiver desensitisation for different I/N protection levels, calculated as follows:

[21] FCC Proceeding IB 15-256, *Letter from AT&T, Nokia, Samsung, T-Mobile & Verizon*, FCC ID 60001739132, May 6, 2016. https://www.fcc.gov/ecfs/filing/60001739132 (Hereafter abbreviated Joint Filers, 2016)
[22] S. Kim et al., *Coexistence of 5G With the Incumbents in the 28 and 70 GHz Bands*, IEEE Journal on Selected Areas in Communications, Vol. 35, No. 6, pp. 1254-1268, June 2017.
[23] Indoor systems would have sufficiently high isolation to alleviate interference concerns
[24] *Service Recommendations to Support Technology Neutral Allocations*, WiMAX Forum, April 2007.
[25] *LTE – The UMTS Long Term Evolution, From Theory to Practice,* Wiley, first edition, 2009.
[26] ITU-R coexistence Report M.2030. http://www.itu.int/pub/R-REP-M.2030-2003

$$Receiver\ Desensitisation = 10\log_{10}\left(1 + \left(\frac{I}{N}\right)_{linear}\right), \left(\frac{I}{N}\right)_{linear} = 10^{\frac{I/N}{10}}$$

Table 2: Receiver desensitisation values corresponding to various I/N values

Interference to noise protection requirement I/N	Receiver Desensitisation
-1.3 dB	2.41 dB
- 6 dB	0.97 dB
-10 dB	0.41 dB
-12.2 dB	0.25 dB

42. Following a similar methodology to the one outlined by Intel in its submitted comments, the 5G protection requirement, defined as PFD level at the 5G receive antenna can be obtained using the following expression:

$$PFD = \frac{I}{N} + 10log10(4\pi/\lambda^2) - G + PSD_N$$

Where PFD = power flux density in dBW/m^2/Hz (or dWm/m^2/MHz as used below)

I/N = Interference to noise protection requirement in dB

λ = carrier wavelength in meters

G = 5G receiver antenna gain in dBi

PSD_N = 5G receiver noise power spectral density

43. Table 3 specifies the parameter values (adopting the conservative recommendations used by the joint filers) and the underlying formulae used to calculate the -77.6 dBm/m^2/MHz PFD limit proposed by TELUS:

Table 3: PFD calculation details

	Parameter	Value	Comment / Formula
A	I/N in dB	-6	Commonly used value
B	Frequency (GHz)	28	Target frequency
C	Wavelength (m)	0.010706874	299792458/b/1000000000, EM wave speed =299792458 m/s
D	Rx antenna gain (dBi)	16	Assumes 5G antenna is down-tilted
E	Implementation loss (dB)	3	Commonly used value
F	Rx noise figure (dB)	5	
G	Receiver noise temperature T_0 (K)	290	Room temperature
H	Boltzmann constant	1.38064852E-23	Constant
I	Receiver noise floor (dBW)	-198.98	10log10(G×H)+F
J	Rx noise power density (dBm/MHz)	-108.98	I+30 + 10log10(1000000)
	PFD (dBm/m^2/MHz)	**-77.6**	A+10log10(4π/C^2)-D+J+E

44. TELUS notes that in Intel's comments on the Consultation, Intel modelled a similar PFD calculation with more aggressive assumptions (specifically, a receive antenna gain of 29.1 dBi). Intel's model concluded in a required PFD limit of -90.3 dBm/m^2/MHz. In light of this worst-case analysis, TELUS suggests that adopting a PFD limit of -77.6 dBm/m^2/MHz represents a balanced approach with reasonable assumptions.

45. TELUS notes alternative calculation methods in the literature also produce the same PFD target. In the example shown in Table 4, the equivalent noise temperature at the receiver $T_{eq} = T_0 + T_{system} = T_0 F = T_0 10^{NF/10}$, where F is the noise factor related to noise figure NF via the equation $NF = 10\log10(F)$, which is then used to calculate the receiver noise power as $P_N = 10\log10(kT_{eq})$ and the rest of the parameters as outlined below:

Table 4: Parameters for alternative PFD calculation method

Parameter	Value
I/N in dB	-6
Frequency (GHz)	28
Wavelength (m)	0.010706874
Rx antenna gain (dBi)	16
Implementation loss (dB)	3
Rx noise figure (dB)	5
Equivalent noise temperature T_{eq}(K)	917.0605214
Boltzmann constant k	1.38064852E-23
Receiver noise power (dBW)	-198.98
Rx noise power density (dBm/MHz)	-108.98
PFD (dBm/m^2/MHz)	**-77.6**

6-5: Geographic Restrictions on FSS Earth Stations

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.
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.

46. TELUS continues to view the establishment of a policy restricting the geographic areas in which new FSS earth stations can be deployed in the 28 GHz band as essential in transitioning the band to flexible use licensing for 5G.

47. Terrestrial flexible use licensees will be the victim of interference from FSS transmit earth stations in the 28 GHz band which are sited in their proximity. As such, new FSS earth stations must be sited so as to only pose minimal constraints on the ongoing long term deployment of terrestrial 5G services. TELUS notes that once an FSS earth station siting request is approved, an interference contour would be defined that would necessitate coordination for flexible use stations deployed in its proximity.

48. The satellite industry should be encouraged to use the frequency range from 28.35-30 GHz for new earth stations that they would like to site in areas that would pose constraints on the

ongoing long term deployment of terrestrial 5G services and to apply for earth stations in the 27.5-28.35 GHz sub band only when these earth stations would impose minimal constraints on the deployment and operation of flexible use terrestrial stations. TELUS notes that if an FSS licensee desires exclusive use of a licence in the 27.5-28.35 GHz band where flexible use deployment is likely, they can opt to bid on the spectrum in a competitive process along with bidders interested in acquiring licences for flexible use terrestrial deployments in the required area or pursue subordination in a commercially negotiated agreement.

Recommended Geographic Restrictions

49. In terms of the total land mass of Canada, TELUS suggests that there are vast tracts of land where satellite earth stations would pose no constraints on the deployment and operation of terrestrial flexible use services. These areas are typically devoid of decent transport options and are only likely to be useful to satellite licensees in limited cases. Of the "small number of large antennas for feeder links" that the Department proposes be allowed in the 27.5-28.35 GHz sub band, TELUS suspects that most requests will involve siting on the fringes of urban / suburban areas where there are fibre connectivity options.

50. As such TELUS proposes a series of "filters" (in increasing geographic resolution) be defined to qualify siting requests and minimise imposed constraints on the ongoing long term deployment of terrestrial flexible use services. TELUS proposes three specific filters that any siting request would have to pass through in order to be approved. TELUS notes that it is proposing a methodology that is a marked departure from the geographic restrictions implemented by the FCC recently and which the satellite industry strongly opposed. TELUS has studied fibre access (via central office interconnects in our network) that offer potential connectivity to FSS earth station licensees. We note that ample opportunities for access remain under the following proposed geographic restriction filters.

51. The first filter that TELUS proposes is based on population density. Terrestrial flexible use services in the band will undoubtedly be deployed in the long run in all high population density areas in the country. As such, TELUS proposes that no satellite earth station siting request be approved if any area covered by its -77.6 dBm/m^2/MHz PFD contour overlaps a high density grid cell with a population density of more than 100 people per square kilometre.

52. The following two figures graphically depict an example of the proposed population density filter as applied to British Columbia, Alberta, Ontario and Quebec. In these examples, we make use of Census 2011 population data defined at the resolution of 25 km^2 hex grid cells. TELUS recognises that in May 2015, the Department transitioned[27] from hex-grid cells to square-grid cells. To the best of our knowledge, population data for the square grid based approach has not yet been made publically available. As such, we have based our analysis on the 25 km^2 hex grid. TELUS would not object to the application of square-based grid cells to achieve the population density filter, so long as the appropriate size grid is selected to reflect the geographic restrictions for FSS and protection for flexible use that we have proposed here.

53. In Figures 1 and 2, green cells indicate a population density of below 100 people per square kilometre, and red cells reflect a population density above 100 people per square kilometre. Clear exclusion zones for FSS earth stations are defined in and around areas of high population density (e.g., all major urban markets) as well as within markets which would be addressed in a second phase of mmWave deployment.

[27] *Decisions on Changes to the Definition of Competitive and User-Defined Service Areas for Spectrum Licences*, Canada Gazette DGSO-001-15, May 2015. https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/DGSO-004-15-grid-cells-decision.pdf/$file/DGSO-004-15-grid-cells-decision.pdf

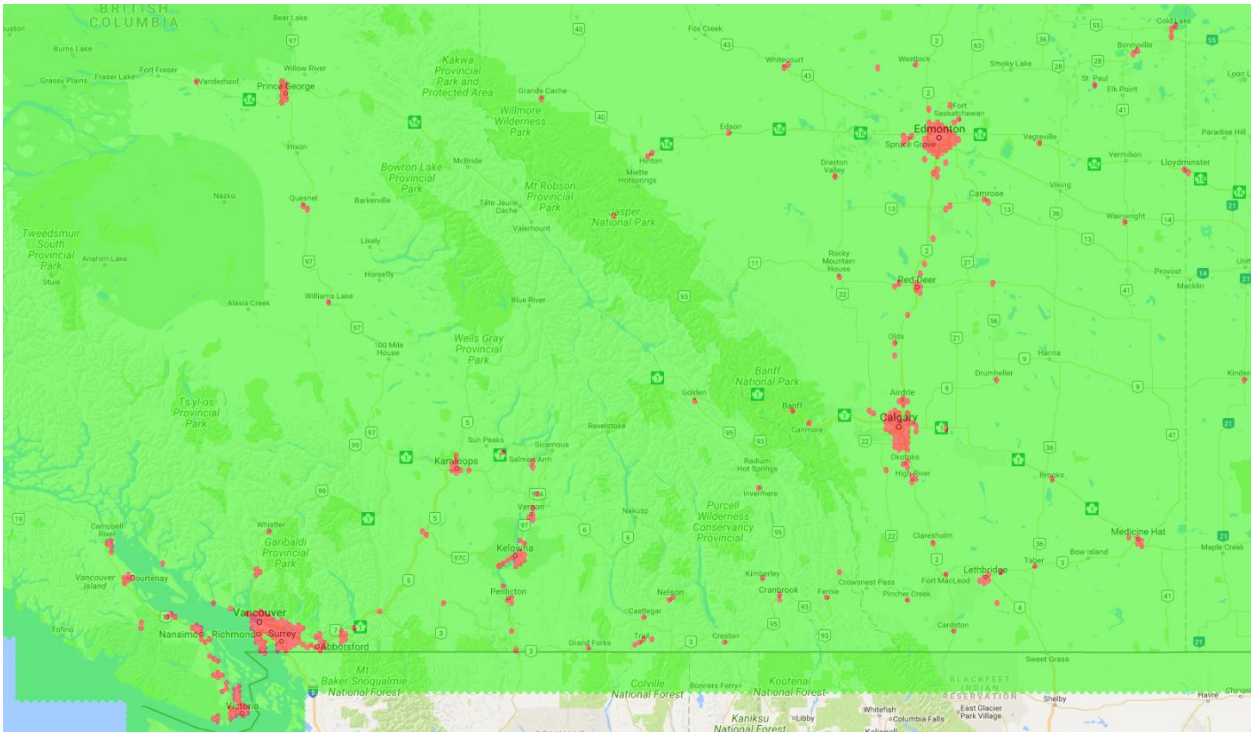

Figure 1: British Columbia and Alberta sample geography with the proposed "population density filter" applied

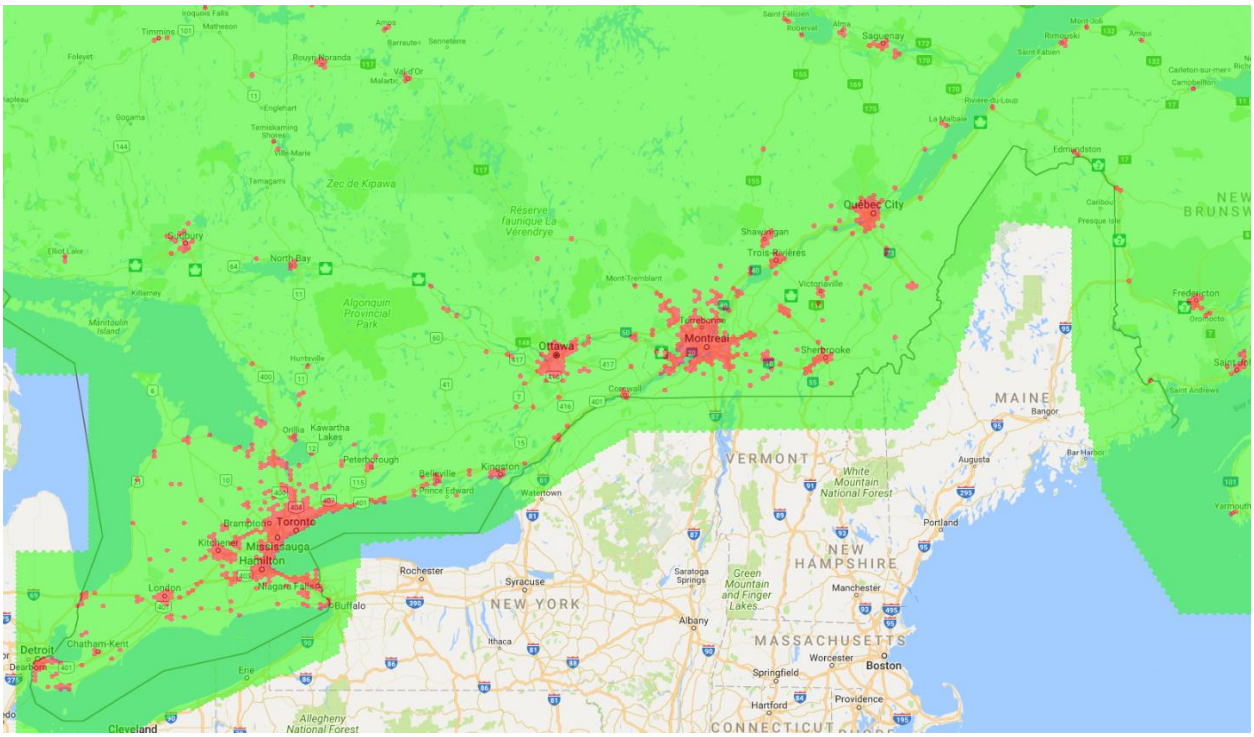

Figure 2: Ontario and Quebec sample geography with the proposed "population density filter" applied

54. The second filter that TELUS proposes is based on the state of mobile network deployment. Terrestrial 5G flexible use services in the band will generally be deployed over time wherever mobile networks have multiple bands deployed to increase capacity. As such, TELUS proposes that no satellite earth station siting request be approved if its -77.6 dBm/m^2/MHz interference contour overlaps any existing mobile network's base station with mid band or high band spectrum deployed (i.e., PCS, WCS, BRS, AWS, or any future band above 1 GHz). In contrast, siting would be allowed if the proposed FSS earth station location is near low band only stations in rural and remote areas. The following two figures graphically depict this proposal in the areas of British Columbia, Alberta, Ontario and Quebec using publicly available mobile base site data maintained by the Department in their Spectrum Management System database. In Figures 3 and 4, red circles indicate mobile sites with mid and high band spectrum deployed. TELUS notes that this second filter is similar to the first filter but demonstrates how mid-band 4G network coverage spans a broader territory than the high density populations illustrated under the first filter, reflecting the investments made by mobile network operators such as TELUS in delivering advanced broadband services to smaller communities. Further, we observe that within the predominantly "green" areas of the map (away from mid band tower deployment), the typical inter-site distance is approximately 5-10 kilometres. As referenced in Paragraph 32 of the Consultation (and supported by Table 1 above), "preliminary studies indicate that flexible-use terrestrial stations require a separation distance of between 50 meters and 400 meters for Class 1 and Class 2 FSS earth stations and up to 4 km for Class 3 FSS earth stations. Given these two observations, there appears to be ample opportunity to site a small number of FSS earth stations away from mobile network coverage.

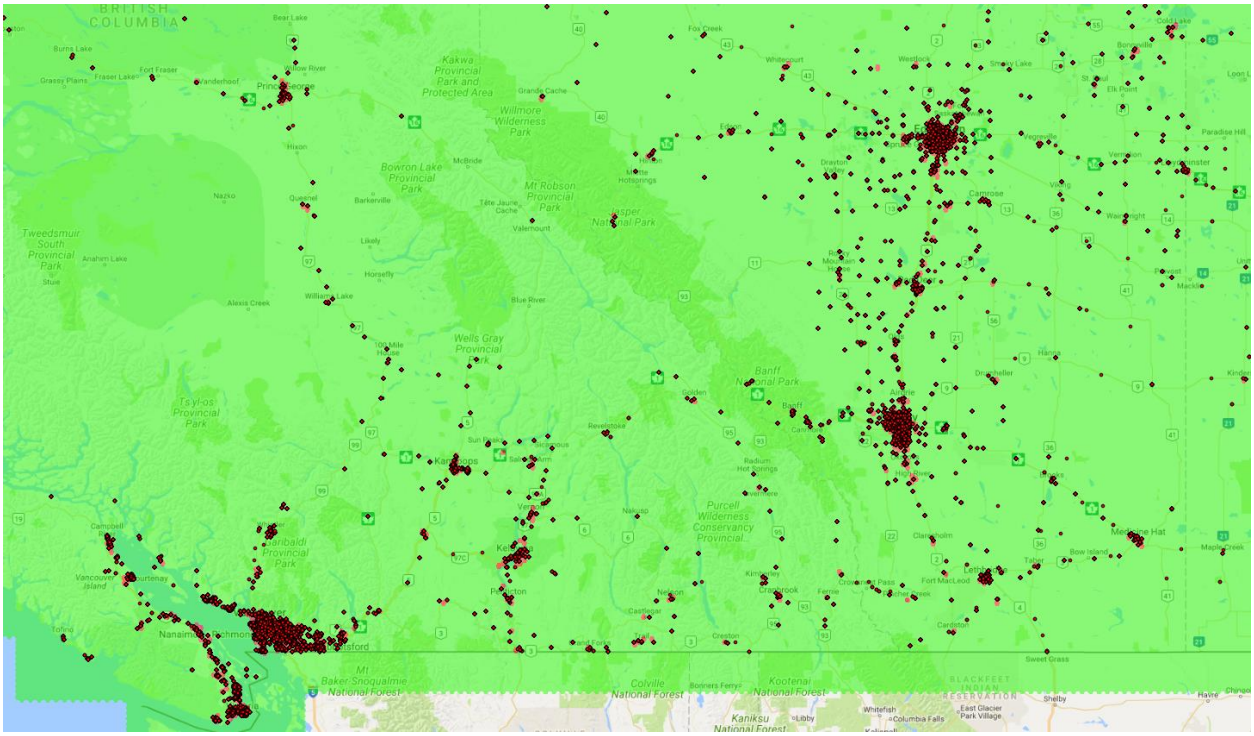

Figure 3: British Columbia and Alberta sample geography with the proposed "mobile network filter" overlaid on population density

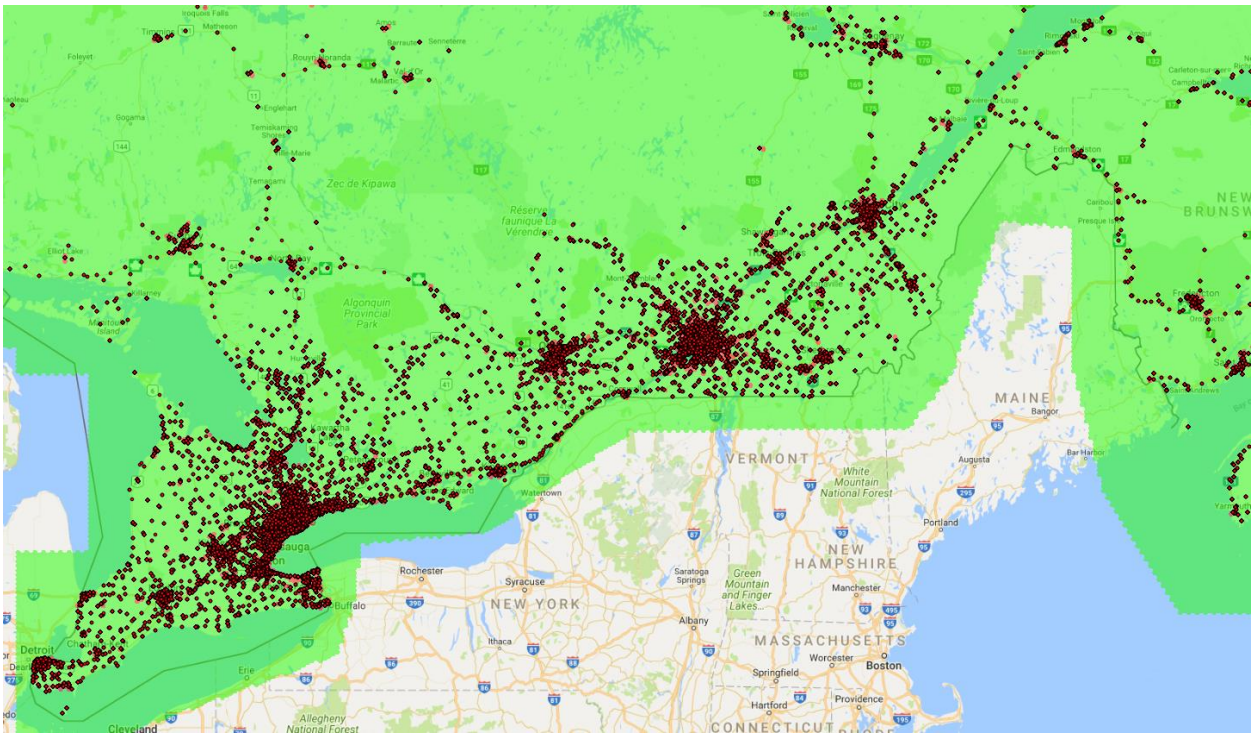

Figure 4: Ontario and Quebec sample geography with the proposed "mobile network filter" overlaid on population density

55. The third filter that TELUS proposes is based on areas with high transient populations such as transportation hubs including but not limited to railway stations, airports, and cruise ship ports, highways, mass transit routes, major event venues, and resorts, which need to be considered directly in exceptional cases (where not addressed by the first two filters). As such, TELUS proposes that no satellite earth station siting request be approved if its interference contour overlaps any areas categorised as having high transient populations as described in the list above.

56. TELUS notes that only two satellite companies (Intelsat and ViaSat) that did not participate in the RABC process oppose the implementation of geographic area restrictions. The majority of respondents (including the satellite companies who participated in the RABC process) support some form of geographic restrictions, with most recommending further study by the Department or within the RABC.

6-6: Aggregate Emissions

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.

57. TELUS does not believe that the Department should impose any limits on the aggregate emissions of the flexible use terrestrial service. Due to the propagation characteristics of mmWave frequency bands, the realization of mmWave communications for terrestrial services is dependent on the application of highly directive beamforming transmission. Even in the absence of mmWave satellite communications, minimising the wasteful transmission of energy away from users is crucial for the successful realization of terrestrial mmWave communications. As such, the vast majority of terrestrial mmWave transmissions will be pointed below the horizon, where most traffic is being served. TELUS views the case of covering indoor users in high-rise buildings using upward-facing outdoor base stations as unrealistic due to building penetration losses and the substantially higher efficiency of indoor coverage solutions.

58. The industry accepted architecture for 5G terrestrial network deployments benefits from the development of a flexible-use licensing framework to enable self-backhauling of flexible use terrestrial stations in the mmWave bands. Fibre-fed rooftop and tower sites will act as "anchors" that provide backhaul connectivity for the mmWave layer near the ground using line-of-sight or near-line-of-sight transmission under a flexible use licensing regime. Hub sites using mmWave could, in turn, provide connectivity to other nearby mmWave sites (with predominantly line-of-sight or near-line-of-sight site-to-site transmissions aligned along the horizon). Only for a limited set of hub sites pointing towards a rooftop or tower for connectivity would upward or skyward transmission occur. For this fraction of an already limited subset of sites, TELUS suggests that the probability of a transmission overshooting the rooftop or tower receive antenna in the specific direction of a satellite space receiver is extremely low if non-existent. As such, TELUS would view the application of any broad restrictions on skyward transmissions (e.g., based on elevation angle) as excessive, constraining and detrimental to the innovation and development of 5G terrestrial networks in the mmWave bands when weighed against the benefit of flexible use as an enabler for rapid deployment of ultra-dense mmWave terrestrial networks.

59. TELUS concludes that aggregate interference from flexible use terrestrial networks is unlikely to disrupt the operation of FSS geostationary or non-geostationary systems. This conclusion is supported by the Nokia led study referenced in TELUS' response to Question 6-4. The cited studies correctly point out that opposing studies conducted by the satellite industry are based on the outdated ITU-R S.1432 recommendation issued in 2000, which requires an I/N protection margin of -12.2 dB. On the other hand, satellite companies used substantially higher I/N protection margins in their recent network filings submitted to the FCC[28], in one case assuming an I/N margin of 8.45 dB which maps to an increase of over 20 dB when compared to the -12.2 dB threshold, as shown in Table 5.

[28] FCC proceeding GN Docket No. 14-177, *Notice of Ex Parte by O3b Limited*, FCC ID 60001519678, March 24, 2016 https://ecfsapi.fcc.gov/file/60001840905.pdf

Table 5: Comparison of Overall Uplink I/N for Gateway Type Links for Representative Systems

System	Location (°W. L.)	Frequency Band	Overall I/N_{up} (dB)
Viasat-2	69.9	28.1-29.1 GHz	0.2
AMC-16	85	28.4-28.6 GHz	6.96 - 0.69
Viasat 89W	89	28.1-29.1 GHz	0.2
Jupiter 1	107.3	28.35-28.6 GHz	5.7
AMC-15	105.5	28.4-28.6 GHz	**2.99 - 8.45**
Jupiter 1	107.3	28.35-28.6 GHz	5.7
Anik F2	111.1	Inc. 28.35-28.6 GHz	1.3
Viasat-1	115.1	28.1-29.1 GHz	-1.1

60. Consequently, assuming a relatively conservative protection value of I/N=-6 dB of aggregate interference (caused by cellular sectors) over the noise threshold, the maximum number of sectors within any FSS spot beam that have aggregate interference below the protection threshold for different SS classes and for different 5G terrestrial base stations' EIRP levels, as reported in a recent IEEE publication[29] and in the joint filers' submission[30] are summarised in Table 6 below:

Table 6: Analysis of Required Number of 5G Terrestrial Stations to Cause FSS Satellite Station Interference

	Typical BS EIRP = 62 dBm / 100 MHz	**Maximum BS EIRP = 74 dBm / 100 MHz**
Max # of BS sectors for Class 1 SS	36,000	36,000
Max # of BS sectors for Class 2 SS	21,600	21,600
Max # of BS sectors for Class 3 SS	40,000	12,000

61. It must be pointed out that these results do not take into account a realistic network loading which, if accounted for, would allow for the number of sectors to double or even triple compared to the values listed above. TELUS notes that recent submissions to ITU Task Group 5/1 adopt more realistic loading factors (in the context of other bands), which would result in a larger number of terrestrial station sectors being supported.

[29] S. Kim et al., June 2017.
[30] Joint Filers, May 2016.

62. In addition to the aforementioned arguments supporting the limited impact of terrestrial flexible use networks on FSS systems, TELUS emphasises that, by virtue of population count and positioning, Canada is anticipated to create an order of magnitude lower aggregate emissions than the U.S.

63. TELUS notes that both the BSO Coalition and Telesat recommend restrictions on terrestrial flexible-use transmissions, asking for elevation angle masks on EIRP emissions or other pointing restrictions. Given that terrestrial use of the 27.5-28.35 GHz band will be by licensed service providers[31] who can be required to modify their network designs if necessary, TELUS does not share this view that an EIRP or elevation angle limit would be a good insurance measure – it would be an unnecessary burden at this stage.

6-7: Grandfathering FSS Earth Stations

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.

64. TELUS recognises and understands the desire to maintain the operation of existing FSS earth stations in their existing locations and under their current operating parameters.

65. However, TELUS proposes that licensees for existing FSS earth stations must comply with several new conditions of licence to ensure they impose minimal constraints on the operation of flexible use stations.

66. Licensees of existing FSS earth stations must calculate and provide to the Department for publication their analysis of the -77.6 dBm/m^2/MHz interference contours for each of their FSS earth stations. The publication of these interference contours would advise new flexible use licensees of the areas of potential interference as they consider their deployments.

[31] Especially since all mobile industry respondents and all satellite industry respondents support a licensed regime.

67. If the calculated interference contours conflict with the geographic restriction policy proposed in our response to Question 6-5, the Department should encourage the FSS licensee to engage in commercially negotiated solutions for coexistence with flexible use licensees.

68. TELUS understands that the Department intends to categorise applications pending approval for operation as identical to existing FSS earth stations, but disagrees with this approach. Applications pending approval may have been submitted before the Consultation, but the Department still has the authority to approve or deny such applications based on their view of the higher priority of flexible use over FSS.

69. TELUS recommends that the Department postpone the issuance of final approvals for outstanding FSS earth station applications (in both the 28 GHz and 37-40 GHz bands), in order to ensure that any geographic restriction policy adopted through this consultation process can be given due consideration in the Department's decision.

70. TELUS notes that there was unanimous support from all respondents who answered Question 6-7 to support grandfathered operation for existing sites as of the issuance of the Consultation document. TELUS opposes the ViaSat (explicit) and Intelsat (implied) proposal to grandfather newly accepted sites and pending applications which are received before the date of issuance of a decision (and consequent enforcement of new rules) as the result of this Consultation. With the clear framework proposed by the Department in this Consultation, TELUS suggests that applicants for new satellite systems will be fully aware of the constraints that they will face in deploying new systems, in light of the proposed priority for terrestrial flexible-use and consequent restriction of posing minimal constraints on flexible use system deployment. In TELUS' view, the interval between the issuance of the Consultation and any future decision should not be viewed as an opportunity to "sneak in" a grandfathered system. TELUS views two other sets of proposals presented by mobile industry stakeholders as constructive. Bell and Rogers ask the Department to encourage commercial negotiations between FSS earth station licensees and future flexible-use terrestrial operators to resolve coexistence issues for grandfathered systems. SaskTel proposes that earth station siting requests currently pending approval be assessed in consideration of the Department's intent of posing minimal constraints on the deployment of flexible-use (fixed and mobile) systems. TELUS supports both of these

proposals. Shaw suggests a stronger requirement, asking the Department to make pending FSS earth station application approvals conditional on a requirement "to eliminate any constraints imposed upon flexible use terrestrial operations in the future". TELUS supports each of these proposals.

Frequency Band 37-40 GHz

7-1: Introducing Flexible Use Licensing

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.

71. TELUS fully supports the introduction of flexible use licensing in the 37-40 GHz band.

72. TELUS fully supports the proposed changes to the CTFA domestic footnote C51 in order to make the 37-40 GHz band suitable for flexible use licensing. Specifically, TELUS supports the addition of "mobile services" to the footnote C51 to support flexible use licensing.

73. As in our response to Question 6-1, TELUS notes that the Department is proposing to maintain support for the priority of terrestrial (formerly fixed, now flexible use) services over fixed-satellite services on the basis of sharing the frequency band on a co-primary basis. In Paragraph 48 of the Consultation, the Department upholds the principle of not constraining the deployment of terrestrial services throughout the band where satellite service also has an allocation. In TELUS' view, the proposed modified footnote gives the Department the latitude to restrict the possible locations when assessing FSS earth station siting requests. TELUS once again supports the Department maintaining this relative priority (now for flexible use over fixed-satellite service) in preserving the language of "minimal constraints" when considering FSS deployment. In TELUS' view, maintaining this relative priority is critical in order for the Department to satisfy their stated objective of promoting innovation as well as the development and adoption of 5G technology in Canada" through the release of mmWave spectrum.

74. TELUS notes that there was nearly unanimous support across respondents to this question for the implementation of flexible use licensing in the 37-40 GHz band.

75. Several respondents from the satellite industry (Intelsat, ViaSat) indicated the importance of Q-band and V-band (which include the 37.5-40 GHz frequency range) for addressing FSS downlink requirements as Ku-band and Ka-band are reportedly becoming more congested.

TELUS notes that the Department's recently issued Spectrum Outlook consultation [32] documents over 27 GHz of spectrum currently allocated for satellite usage. TELUS suggests that given the relatively low amount of spectrum allocated for mobile (and flexible-use) terrestrial applications, the intense focus being presented by the satellite industry on 37.5-40 GHz seems excessive for an undeployed band.

76. Intelsat, Viasat and Telesat (who has a pending application for an NGSO constellation in the 37.5-42.5 GHz frequency range) each suggest that the Department remove the language on "a small number of large antennas for feeder links" from both the existing and proposed modified footnote C51. TELUS opposes this suggestion and believes that particular language was introduced to ensure that FSS earth station deployments possess the technical characteristics that would ensure they pose minimal constraints to both fixed and mobile systems.

77. While TELUS appreciates the view shared by the satellite industry regarding the importance of the 37.5-40 GHz band for FSS downlink applications, TELUS notes that the 37.5-40 GHz band did not seem to be highly attractive for satellite deployment (as evidenced by the lack of FSS earth stations in operation today) before the publication of the FCC's "Spectrum Frontiers" decision. It was only in March 2017 that Telesat filed its application for a GEO (geostationary Earth orbit) satellite in the band, which was rejected and subsequently reapplied for as an NGSO cluster of 117 LEO (low earth orbit) satellites.

78. TELUS expects that satellite providers who wish to serve both Canadian and U.S. markets with systems whose beams are capable of covering the North American continent would ideally seek to find synergies between regulatory frameworks in our two countries. As such, TELUS suggests that the FCC's proposed *Memorandum Opinion and Order*[33] may be a suitable response to concerns with coexistence in the 37-40 GHz band for Canada as well. In this proposal, the FCC would maintain 4 GHz of spectrum (40-42 GHz and 48.2-50.2 GHz) as

[32] *Consultation on the Spectrum Outlook 2018 to 2022,* Canada Gazette SLPB-006-17, October 2017

[33] FCC GN 14-177, *Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order (Draft),* October 26, 2017. Circulated for tentative consideration by the FCC at its November 16, 2017 open meeting.

"core satellite bands", leaving the 37-40 GHz band and its priority for flexible-use 5G terrestrial licensing completely unencumbered.

79. Responses from the satellite industry in Question 7-1 closely resemble those made in response to Question 6-1. Telesat and ViaSat once again request that ISED remove the word "large" from the footnote; Telesat recommends it be replaced with the words, "individually licensed". TELUS is not opposed to the Department reviewing this recommendation and refers the Department to comments in Paragraphs 46 and 47 of the RABC's comments.

7-2: Moratorium on New Licences

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.

80. The status of the 38 GHz band at the time of the 2014 *Consultation on a New Licensing Framework and Licence Renewal Process for the 24, 28 and 38 GHz Bands* was clearly marked by low utilisation, limited ability for many to renew at the eight links per one million population requirement, and limited availability to multipoint equipment for advanced services (a point made by both Javelin and TeraGo in their responses). In managing the spectrum's utility, the Department clearly conveyed[34] to all that renewed licences would not have a high expectation of renewal due to the transition to site-specific licenses in the band. Additionally, the FCFS grid cell licence regime was not retained fully but transitioned to site-specific licenses for new applications or modifications to existing deployments. TELUS presumes that rational actors would account for the licence limitations in their business plans, which forms the context for TELUS' comments in response to Questions 7-2 and 7-7.

81. TELUS notes that nearly all respondents support a moratorium on the band at this time. TELUS views Shaw's self-contradictory support for a moratorium on new licences while

[34] *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*, Annex A (Conditions of Licence) states that "these licences do not have a high expectation of renewal."

simultaneously recommending an exception for the addition of new sites within its own grid cell licence areas as hypocritical; Shaw appears to be more concerned with their near term interests in the band, rather than maximising its utility for 5G. The respondents who opposed an immediate moratorium (e.g., Bell and Rogers) suggested that the moratorium take effect once the licensing process consultation is completed. Rogers qualified its proposal with the need for the Department to identify an alternate microwave band to make up for the loss of dedicated fixed service in the 38 GHz band. TELUS concurs and supports further study on suitable bands for relocation of existing FCFS links in the 38 GHz band.

82. Subject to a decision to make the ongoing operation of FCFS links secondary (and subject to displacement with notification), TELUS would not oppose a delayed moratorium as suggested by Bell and Rogers. Should the Department decide to grandfather FCFS links, the immediate imposition of a moratorium would be necessary to prevent further encumbrance of the band before it is made available for auction.

83. TELUS continues to oppose the Department's proposal to "treat the 28 GHz and 37-40 GHz bands differently with respect to moratoriums on issuing new licences" for fixed service use. While we recognise the different levels of usage in the two bands, TELUS proposes that the policy changes considered in the Consultation to introduce flexible use licensing into the two bands represent a higher use of the spectrum. The imposition of a moratorium would support the Department's stated goal of supporting 5G innovation by minimising encumbrance of the band in preparation for imminent flexible use licensing to the maximum extent possible.

84. TELUS continues to support the imposition of a moratorium on the issuance of new licences to site-specific fixed service applications in the 37-40 GHz band, including new applications, new stations being added within an existing FCFS spectrum grid cell licence area, or modifications of stations within an existing FCFS spectrum grid cell licence area (in accordance with the "New Licensing Framework"[15]).

7-3: Band Plan

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.

85. TELUS supports the Department's proposal to adopt the band plan in the 37-40 GHz frequency band as proposed in the Consultation.

86. TELUS reiterates its view that harmonization with the U.S. is crucial for enabling early 5G innovation, as it permits the Canadian market to leverage economies of scale associated with equipment ecosystem development in the U.S. TELUS further reiterates that a harmonised band plan will simplify coordination efforts between terrestrial services along the Canada-U.S. border. Large contiguous channel bandwidths will foster innovation and enable the aspirational IMT-2020 targets of 20 Gbps peak downlink throughput (as detailed in our response to Question 6-3).

87. TELUS supports the proposal to reserve the development of a band plan for the 37.0-37.6 GHz frequency range for future consultation (pending U.S. developments) to ensure Canada will reap the benefits of ecosystem harmonization.

88. TELUS acknowledges the nearly unanimous support for the proposed band plan by all respondents. Only Cogeco suggests that "the FCC is still developing the band plan for 37-40 GHz" and that Cogeco "agrees with ISED that adopting a Canadian band plan would be premature at this time." TELUS believes that Cogeco has misconstrued the Department's proposal, as TELUS noted in the previous paragraph – the proposal to reserve the development of a band plan to a later date is specifically restricted to the 37.0-37.6 GHz range (which the FCC has proposed for Federal sharing and with potentially smaller channel sizes). TELUS notes that most other respondents also support delaying a band plan for the 37.0-37.6 GHz frequency range only. TELUS notes that TeraGo links its support for the band plan to its response to Question 7-7 on the treatment of 37-40 GHz incumbents; TELUS addresses TeraGo's comments in its response to Question 7-7.

7-4: Coordination Requirements and Triggers

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

89. While TELUS initially supported site-by-site coordination between FSS ESs approved under the geographic restriction policy described in our response to Question 7-5 and flexible use terrestrial stations based on PFD thresholds in its original submission, TELUS has determined, after additional evaluation, that specific coordination based on a PFD threshold cannot be recommended at this time.

90. The conclusion is based on the lack of Canadian FSS deployments in this band along with the technical parameters highlighted in Intel's comments. Furthermore, current studies within the ITU-R Task Group 5/1 consider only the minimum distance as summarised in Table 7. The common theme of the preliminary results is coexistence feasibility between 5G and FSS under a minimal geographic separation varying between 207 m and 1 km.

91. More specifically – given that flexible use terrestrial stations will act as potential interferers and FSS earth stations may be the victim of interference in the case of the 37.5-40 GHz band, coordination requirements would only apply in the consideration for new deployments of FSS earth stations in proximity to existing flexible use terrestrial stations. FSS licensees requesting earth station siting in areas of planned or likely future flexible use terrestrial station deployments would be rejected under TELUS' proposed geographic restriction policy; flexible use terrestrial stations being deployed would be excluded from the FSS earth station licensee's protection zone (unless granted consent to operate within it).

Table 7: Summary of TG 5/1 coexistence studies covering the 37.5-40 GHz frequency band

Reporter	Short-term interference	Long-term interference	Comments
Canada		$d_{protection}$ = 276m for I/N = -6 dB and $d_{protection}$ = 520m for I/N = -12.2 dB when both BS and UE interference is accounted for.	Canada intends to conduct future sensitivity studies.
Huawei	d=0.5km for I/N = -1.3 dB.	Protection distance of $d_{protection}$ = 0.5km is sufficient under both I/N = -10 dB and I/N = -6 dB protection conditions.	Considered carriers #10 and #24 (representing Europe). Significant isolation margins have been found (> 20 dB).
Brazil		$d_{protection}$ = 207 m from the cluster edge, the I/N = -10 dB was not exceeded in any situation in the simulation.	Considered carriers #6 and #15.
China	D=0.4km for I/N=-1.3 dB	I/N=-10 dB for carriers #06 and #23, and I/N=-12.2 dB for carriers #20 and #21 provide significant margin for $d_{protection}$ = 400m and higher.	Considered carriers #06, #20, #21 and #23. Two deployment scenarios considered (option 1 and option 2).
GSMA		$d_{protection}$ = 1km, probability of I/N exceeding -10 and/or -6 dB is very small, less than 0.001.	Considered carriers #06 and #26,
USA		Interference levels are within the I/N=-10 dB for a considered system, where the ES is d = 1.1 km from the center of the 5G deployment ($d_{protection}$ is smaller than this distance).	The IMT/5G system is deployed in a 1 km^2 area located near Englewood, CO (39.55N, 104.9 W). Base station locations and pointing directions are randomly assigned. User equipment locations are also random and point toward the base station within an angular range. The FSS receive earth station is located approximately 1.1 km directly north of the centre of the IMT deployment area and points towards the transmit space station.

92. As a precursor to facilitating coordination between flexible use terrestrial stations and FSS earth stations in the 37-40 GHz band, TELUS recommends the Department require FSS earth station licensees to submit their technical site data as part of the approval process, including

specifications for their requested protection zones, and publish this data and any associated maps on the Department's website. Furthermore, any proposed modifications to approved protection zones should be subject to reassessment under the geographic restriction requirements as a new application.

93. TELUS supports site shielding to maximise protection for the FSS earth stations and to facilitate more efficient sharing where FSS may want to be closer to an urban centre. TELUS does not recommend mandating shielding; rather, FSS licensees should be allowed to determine the best engineering solution to meet their business needs (e.g., making use of shielding if an FSS licensee wishes to site closer to the border of a restricted geographic area).

7-5: Geographic Restrictions on FSS Earth Stations

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.
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?

94. TELUS maintains the view that establishing a policy restricting the geographic areas in which new FSS earth stations can be deployed in the 37.5-40 GHz band is an essential step in transitioning the band to flexible use licensing for 5G.

95. Future satellite licensees may be the victim of interference from terrestrial flexible use licensees, who are proposed as priority in the band, if sited in proximity to flexible use terrestrial stations. Geographic restrictions should be applied to FSS earth station siting to ensure that their presence does not constrain 5G deployment in areas where, in the long term, 5G is likely to be deployed. TELUS notes that once an FSS earth station siting request is approved, a protection zone would be defined for requiring coordination from flexible use stations in its proximity.

96. TELUS also remains of the opinion that the satellite industry should be encouraged to use frequencies outside of the 37.5-40 GHz range for new earth stations that they would like to site

in areas that would be subject to interference from the ongoing long term deployment of terrestrial 5G services and to apply for earth stations in the 37.5-40 GHz sub band only when these earth stations can be sited away from existing and planned terrestrial mobile network deployments.

97. TELUS once again notes that if an FSS licensee desires exclusive use of a licence in the 37.5-40 GHz band where flexible use deployment is likely, they can opt to bid on the spectrum in a competitive process along with bidders interested in acquiring licences for flexible use terrestrial deployments in the required area or pursue subordination in a commercially negotiated agreement.

Recommended Geographic Restrictions

98. TELUS recommends that the same three geographic restriction filters (as detailed in our response to Question 6-5) apply in qualifying FSS earth station sites in the 37.5-40 GHz range. TELUS supports the notion that outside the restricted areas that FSS should be allowed to define a protection zone for their earth stations.

99. In contrast to the 28 GHz band, where the interference contour associated with an FSS earth station is a measurable quantity, the notion of a "protection zone" for the 37.5-40 GHz band is subject to the specific requirements of each FSS earth station. As such, TELUS proposes a set of guidelines for the definition of protection zones in the 37.5-40 GHz band:

    a. Applications for earth stations in the 37.5-40 GHz band must define a protection zone, specifying the area in which the earth station will require protection from transmissions of terrestrial flexible use licensees.

    b. The earth station applicant shall demonstrate in its application, using reasonable engineering methods, that the requested protection zone is the minimum area necessary to protect its proposed earth station from terrestrial flexible use transmissions.

    c. The protection zone may not overlap areas defined as exclusions under the geographic restriction filters described in our response to Question 6-5.

Terrestrial flexible use licensees who wish to locate new facilities within the protection zone must receive consent from the earth station licensee prior to operation.

100. TELUS notes that only two satellite companies (Intelsat and ViaSat) that did not participate in the RABC process oppose the implementation of geographic area restrictions. The majority of respondents (including the satellite companies who participated in the RABC process) support some form of geographic restrictions, with most recommending further study by the Department or within the RABC.

7-6: Technical Provisions for SRS and/or MSS

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.

101. TELUS recognises that given the co-primary allocation for the SRS service in the 37-38 GHz band, supporting coexistence for future deployments would require the development of similar technical provisions to facilitate coexistence as those which have been considered in the Consultation for FSS.

102. Given the nature of the SRS service as described in the Consultation (i.e., space-to-earth communications, presumably to an earth station), TELUS suggests that a similar framework as the one we have proposed for coordination with and geographic restrictions on the siting of FSS earth stations (in our responses to Questions 7-4 and 7-5, respectively) should be considered.

103. On the other hand, TELUS does not consider the potential use of MSS downlink operation in the 39.5-40.5 GHz frequency range in the same way. In TELUS' view, broad deployment of MSS would introduce high levels of interference to flexible use terrestrial systems when their service areas overlap. Should the Government of Canada consider the deployment of MSS services within the 39.5-40 GHz frequency range in the future, TELUS would strongly

encourage the Department to consider limiting its application to rural and remote areas, with MSS supplementing the coverage of flexible use terrestrial systems rather than overlapping with them, particularly in areas with high density flexible use terrestrial deployments.

104. Should emerging applications for SRS or MSS deployment be considered in the future, TELUS recommends that the Department should seek stakeholder input via public consultation to address coexistence mechanisms. Examples of the mechanisms include coordination triggers and geographic restrictions, and should take into account the state of deployment of flexible use systems at that time.

7-7: Treatment of Incumbent Licensees

7-7
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.
B. the options and implications for the treatment of incumbent licensees currently holding FCFS licences and supporting rationale.

105. Throughout its comments, TELUS has agreed with the Department's proposed changes for both the 27.5-28.35 GHz and 37-40 GHz bands to introduce flexible use licensing to support 5G mmWave deployments. In TELUS' view, the Department's proposals clearly characterise 5G flexible use as a higher use of the terrestrial spectrum than legacy fixed-only services, which are relatively inefficient services that can be better supported by other bands.

Tier 3 Licensees

106. TELUS notes that as of the date of this submission, TeraGo (the largest Tier 3 licence holder in the band) does not have any fixed links registered within its spectrum licence areas, according to the records in the Department's Spectrum Management System database and only 180 fixed links registered in the FCSA database[35]. TeraGo appears to fail to meet the eight links per one million population deployment requirement in several of its Tier 3 licence areas[36].

[35] Frequency Coordination System Association database (November 6, 2017) records
[36] Specifically, Kingston (3-20-CDEF/G/J), Barrie (3-26-G/H), Niagara (3-29-CDEF/I/J), Windsor (3-32-I/J), Red Deer (3-48-CDEF/I), Okanagan (3-51-CDEF/I/J), and Victoria (3-53-H)

TELUS requests that the Department take into consideration whether TeraGo has simply not filed their site information, or whether it is no longer in compliance with the deployment requirement that acted as a condition for their licence renewals. TELUS observes the same situation for two other licensees in the band (ABC Allen and I-Netlink).

107. TELUS continues to support the Department's proposed "Option 2" for the treatment of Tier 3 licensees. Should any sites exist in operation at the end of the licence term (but before the displacement deadline as proposed below), they should be issued site-specific radio licences and treated like other FCFS licensees as proposed in our response below. The implication of this "Option 2" recommendation is that there should be a full termination of legacy Tier 3 licences at the end of their term. Treatment of the Tier 3 licences in such a fashion would maximise the available spectrum for a flexible-use licensing process in the 37-40 GHz band, allowing new flexible use licences to be auctioned within the existing Tier 3 licence areas with certainty about their availability upon expiry of the existing licences. Such certainty is necessary to provide bidders with a clear timeline for the realization of their investment in the spectrum blocks which are currently encumbered by Tier 3 licensing. By committing to a clear timeline for a full recall of the spectrum (accompanied by the allocation of alternate bands for the relocation of legacy point-to-point microwave systems), the Department will ensure the availability of multiple large, contiguous and unencumbered blocks of spectrum in the 37-40 GHz band that will enable the provision of innovative 5G capabilities for all interested parties (including so motivated band incumbents).

108. Should the Department not adopt TELUS' recommendation for the "Option 2" treatment of existing Tier 3 licensees, TELUS would propose some recommendations for appropriate measures for flexible use conversion. TELUS agrees with the Department's statement, "flexible use licences would be expected to be much more valuable and in demand than fixed," which suggests that the amount of spectrum should be significantly reduced in any fundamental reallocation to flexible (i.e., mobile) use. As such, TELUS proposes that if converting existing spectrum licences to flexible use (rather than converting sites to radio licences at the end of licence term as TELUS recommends), 25% of each licensee's aggregate spectrum holdings in each Tier 3 licence area could be retained. In order to ensure that both clawed back and retained spectrum is usable[18] for 5G, a potential conversion should be in increments of 50 MHz;

as an exception to the 25% rule, the three licensees each holding a single 100 MHz spectrum licence in a given Tier 3 licence area could be granted a 50 MHz flexible use licence (i.e., a 50% conversion would apply only to these three licences). The converted flexible use licences should be assigned as a single contiguous Tier 3 unpaired licence to each licensee to maximise the contiguity and efficiency of the band and the value to the licensee. Further, TELUS suggests that such licences, if issued through a flexible-use conversion, should not be made available at the end of the licensees' terms; rather, licensees should be required to participate in an assignment round as part of a competitive licensing process in order to maximise the contiguity of spectrum assigned in the band for both the converted and new licensees. Licensees issued converted flexible use spectrum would be given a one year displacement period following completion of the auction of 37-40 GHz licences to transition out of their existing spectrum assignments.

109. TELUS notes that responses to Question 7-7 came almost exclusively from terrestrial service operators (both fixed and mobile) who are the likely bidders in the flexible-use terrestrial licensing process which will follow in the two bands addressed in the Consultation.

110. In its response, Shaw supports the "Option 2" treatment of licensees at the end of their licence terms in alignment with TELUS' proposal. While TELUS questions the extent to which TeraGo given its limited scale could exploit Shaw's claimed "unfair advantage in the race to deploy 5G networks", TELUS agrees with the core principle expressed by Shaw; i.e., that licensees holding legacy fixed spectrum licences should not be granted a 5G spectrum windfall simply by virtue of the fact that the fixed licences they hold are in a band which sometime later happens to end up on a path to being globally identified for mobile (and consequently, flexible) use to support 5G terrestrial deployments.

111. In contrast to TELUS' position above, several other respondents to this question (BCBA, Bell, Rogers, SaskTel and TeraGo) support the Department's proposed "Option 1", suggesting that existing Tier 3 licensees should be granted flexible-use spectrum area licences at the end of their 10-year terms, despite the Department's decision on the band in 2014 to transition to site-

specific licensing without a high expectation of renewal[37]. Each of these respondents proposes its own views on an appropriate amount of spectrum to be retained upon conversion to a flexible-use licence. In TELUS' view, all of these proposals provide an unjustified windfall to legacy licensees, with most respondents suggesting a full (100%) flexible use conversion and only SaskTel and Rogers suggesting a reduced amount (60% and 66%, respectively), and would grant them an unfair 5G head start advantage as described in the previous paragraph. Each of these respondents attempts to justify its proposals for retention on the basis of a hypothetical principle of acknowledging historical investments. TELUS has not been able to find this principle in the SPFC or the FSAC and notes that there is a long history of legacy services being relocated out of a band in order to facilitate a fundamental reallocation such as with the PCS band, the AWS-1 band, the 700 MHz band and the 600 MHz band.

112. TeraGo provides its comments as the only significant fixed-only licence holder in the band. TeraGo, whose Tier 3 spectrum holdings in the 37-40 GHz band represent the large majority (25 out of 28) of licences currently issued, effectively argues for retaining all[38] of its spectrum through the flexible-use conversion process. TeraGo additionally makes a brash and unsubstantiated claim that "[existing] licensees are generally the operators that will be best equipped and most likely to succeed in implementing a 5G business strategy." On the contrary, the existing licensee serving a small niche client base operates the legacy network which is likely to impede the implementation of 5G networks where it is deployed. All the legacy point-to-point microwave deployment in the band is both (i) based on paired spectrum with a 700 MHz duplex gap that cannot be retuned to 200 MHz TDD blocks and (ii) even if it were, none of it delivers anything more than 150 Mbps peak so it is of very little use for 5G. As such, all legacy point-to-point microwave deployment represents an encumbrance on 5G and any new deployments to support 5G need to be modern, higher speed equipment based on advanced TDD technologies. TeraGo's claims of being "best equipped" to succeed in 5G seem to be its

[37] *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*, Annex A (Conditions of Licence) states that "these licences do not have a high expectation of renewal."

[38] TeraGo would only lose a single 100 MHz licence in Victoria, BC under its proposal for flexible-use conversion will full retention.

storyline for seeking profit from a windfall conversion of fixed-licence spectrum that for three years now has had no expectation of renewal.

113. TELUS notes that Bell, Rogers, SaskTel and Xplornet offer their comments as non-stakeholders in the band. While TELUS accepts SaskTel's concise proposal as being consistent with its previous BRS windfall, TELUS suspects that Rogers, Bell and Xplornet are being strategic in using this 5G mmWave consultation as a platform to pre-lobby the upcoming consultation on the 3500 MHz band, which will undoubtedly include similar questions on the amount of spectrum that should be granted under a flexible-use conversion of their existing fixed-only licences. In that process, just as in this Consultation, Rogers and Bell are seeking a massive mobile windfall based on a limited and fungible investment in minimal builds to ensure their licence renewals and secure their conversion.

114. Rogers calls for a one-third reduction in converted holdings (rounded down to the nearest 200 MHz block), suggesting that it views a treatment consistent with the windfall conversion that licensees in the 2500 MHz band received as appropriate and as they also recommend for a 3500 MHz windfall conversion. However, Rogers fails to provide justification for this level of retention of converted spectrum. Rogers' proposal to grant converted spectrum to existing licensees conflicts with its recognition that "the shift of the 38 GHz band from simple fixed service usage to use as a pioneer 5G band will be a fundamental reallocation of the spectrum", which Rogers acknowledges as the reason the Department in 2014 nullified the "high expectation of renewal" that is otherwise provided to licensees under the Department's *Framework for Spectrum Auctions in Canada* (FSAC).

115. Bell proposes that existing Tier 3 licensees retain the same amount of spectrum as in their current licence, but that they be granted permission to deploy 5G services within their licence areas. Bell's suggestion that existing licensees could continue operations within a "realigned" band plan (where paired spectrum would be converted into portions of the proposed contiguous 200 MHz blocks) neglects to address the fact that equipment serving point-to-point links in the 37-40 GHz band today is incapable of being retuned within a single 200 MHz block, as it is designed for use with a 700 MHz duplex gap. As such, TELUS questions Bell's suggestion of

how such systems could be grandfathered and further doubts the ability of these systems to coexist with newer 5G deployments.

116. The relationship of Bell's arguments to a 3500 MHz pre-lobby become blatantly obvious in Paragraphs 70-73 of its reply. Bell first argues that "existing deployments can be viewed as early 5G services" – an absurd proposition, in TELUS' view, when one considers that many of the legacy point-to-point microwave deployments in the band use technology deployed with bandwidths as low as 10 MHz.

117. Bell additionally argues (in sharp contrast to Rogers' comments as described above) that the transition to flexible-use licensing does not represent a fundamental reallocation. Bell further suggests that the determination of what does constitute a fundamental change ultimately resides with decisions and actions taken at the ITU. TELUS strongly opposes Bell's view. While decisions reached on allocations at the ITU certainly do influence Canada's spectrum management policy, the Department holds the full jurisdictional right to determine domestic allocations and consequently, domestic spectrum policy. Licensees holding legacy fixed-only spectrum licences should not be granted a 5G spectrum windfall simply by virtue of the fact that the fixed-only licences they hold are in a band which sometime later happens to end up on a path to being globally identified for mobile (and consequently, flexible) use to support 5G terrestrial deployments. While TELUS notes and strongly supports the proposed flexible use concept, it is clear that the de facto change involved (the fundamental reallocation) is to add on "and mobile service systems" as a co-primary service with priority over FSS. TELUS believes Bell is playing with words and is searching when it contends that the FSAC language, "unless a fundamental reallocation to a new service is required" must be interpreted to have the meaning that a fundamental reallocation only occurs when it is dictated to Canada by a UN Special Agency. A fundamental reallocation of the band is necessary to add "mobile service systems" as a co-primary service with priority. The reallocation fundamentally changes the value of the band. In other words, in proposing to change the licensing framework for the 37-40 GHz band from fixed to flexible-use and in modifying the Canadian Table of Frequency Allocations (CTFA) to introduce the same priority for mobile service over FSS as already exists for the fixed service, the Department is clearly redefining the purpose of the band (hence, a fundamental reallocation).

FCFS Licensees

118. In the case of FCFS licensees, TELUS highlights the Department's observation from the Consultation – that the vast majority of FCFS licences are held by major mobile operators. In TELUS' view, these mobile operators are the intended primary users of new flexible use terrestrial licences for 5G. TELUS continues to support the Department's "Option 2" proposal: to allow FCFS licensees (whose sites were either originally licensed on a grid cell or site-specific basis or for sites converted from Tier 3 licences at the end of the licence term, as described in TELUS' response to Question 7-7A above) to continue operating only on a secondary basis to flexible use licences until displaced.

119. TELUS notes that Rogers, despite having the largest number of FCFS links deployed[39], has the foresight to support the proposal that FCFS licensees continue operating only on a secondary basis while working towards a modernization of their network. TELUS, who also has FCFS links deployed, shares Rogers' concern that the grandfathering of FCFS links would "severely limit deployment of 5G", especially in the major urban areas. TELUS believes that if the Department was to grandfather existing licensees without mandatory displacement, there would likely be insufficient unencumbered mmWave spectrum made available through a competitive licensing process to enable innovative 5G capabilities for all interested parties. Such large-scale encumbrances would drastically reduce the efficacy of the band in helping to realise Canada's 5G leadership.

120. In its initial submission, TELUS recommended that the conclusion of the auction of 37-40 GHz licences should act as the one year notice of displacement for site licensees in all 61 urban[40] service areas. Further, TELUS accepted the Department's proposal for the continued secondary (no-interference/no-protection) operation of sites deployed under FCFS licences in rural service areas only and supported the proposed one year notification period for displacement of such rural sites upon request of a flexible use licensee.

[39] 2,868 licensed links representing 54% of the links in the band, according to the Department's Spectrum Management System Authorization Data Extract (October 2017).
[40] Urban service areas refers to the 61 of 172 Tier 4 service areas containing a population centre of 30,000 or more.

121. TELUS notes that Rogers proposes a similar treatment of FCFS licensees, but only proposes that sustained (secondary) operation be explicitly prevented within the six largest urban areas (a reduced scope when contrasted to TELUS' proposed 61 "urban" Tier-4 service areas). In TELUS' view, Rogers' proposal would offer the majority of existing licensees (i.e., the major mobile operators who are likely to acquire flexible use licences in the auction of 37-40 GHz spectrum) sufficient time to transition their existing fixed systems into their newly issued licences while creating the opportunity for early 5G deployments in Canada's largest markets, but would neglect to address the top markets in smaller regions where regional providers may wish to deploy early 5G networks.

122. TELUS further notes Rogers' proposal to provide all markets beyond the six largest urban areas (and additional areas identified for early 5G deployment) with an extended (two-year) notification period, thereby allowing incumbent FCFS users to continue operating until 5G systems are deployed in their specific areas. TELUS does not oppose this more relaxed notification period for any rural markets.

123. Shaw suggests that it has invested significantly since its 2016 acquisition of Wind Mobile including "significant capital expenditures on a large fixed wireless broadband network that backhauls voice and data traffic for over one million customers." TELUS notes that the typical link in Shaw's "upgraded" backhaul network supports a throughput of approximately 200 Mbps[41] – a capability that TELUS suggests is insufficient[42] for sustaining the "new and innovative services" from which Shaw implies resources will be diverted if they have to spend time and money in relocating out of the band[43]. TELUS emphasises that in the context of supporting 5G innovation, there is no good justification for grandfathering existing FCFS link licences. As noted in Paragraph 112 of these reply comments, the legacy radios' paired use of the band cannot be accommodated within the proposed 38 GHz band plan (with 200 MHz unpaired blocks); the duplex gap restriction would mean encumbering multiple flexible use

[41] Frequency Coordination System Association database record of modulation rates and bandwidth to calculate throughput (November 6, 2017)

[42] The legacy nature of the radios deployed by Shaw and others make them infeasible for supporting modern capabilities such as carrier aggregation and higher order (4x4) MIMO.

[43] TELUS estimates that the relocation of legacy point-to-point microwave radios for Shaw would be well below $10M (a minute fraction of Shaw's total network investment) and would come with the benefit of modernising their fixed wireless backhaul network to support 5G.

licences and delaying investment in innovative services across a vast portion of the band for the sake of maintaining inefficient legacy operations. Despite the impairment that sustained operation would create, Shaw demands that their under-dimensioned legacy point-to-point microwave network be allowed to remain in operation for ten years before transitioning out to support more advanced capabilities – a request that seems to be at odds with Shaw's claimed commitment to "create a compelling next-generation connectivity experience that will drive 5G and all of its anticipated positive effects on our economy and society."

124. TELUS supports the adoption of a more rational approach (as suggested by Rogers and partially alluded to by TeraGo) where licensees may seek to modernise their short microwave links by relocating to a larger and unencumbered alternate band. TeraGo advises that the 18 GHz and 23 GHz bands may be suitable alternatives, and Rogers suggests considering both the 31.8-33.4 GHz and 40.5-43.5 GHz bands in its response[44]. TELUS suggests that the E-band (71-76 / 81-86 GHz), for which the radio standard SRSP-371.0 was recently published may be another suitable alternative. Each of these bands merits further review amongst other fixed service / backhaul options by the stakeholders. TELUS contends that relocation to another band would have no incremental cost beyond what would be required anyway for relocation within the new band plan for 37-40 GHz.

125. TELUS notes that respondents that recommend grandfathering FCFS operations with protection (e.g., Shaw, TeraGo and Bell) speculate regarding the anticipated capabilities of 5G technology to mitigate interference, thereby enabling seamless sharing and coordination around legacy licensees. While Bell and TeraGo provide no rationale, Shaw attempts to justify its supposition by citing the FCC's *Spectrum Frontiers Report and Order*, which states that "the propagation characteristics of the 37-37.6 GHz band might help minimise the complexity in coordinating shared use of that band." TELUS suggests that this statement was made only in the context of the FCC's consideration of a database-driven approach for Federal / commercial sharing and that it should not be generalised to apply to the entire band – especially

[44] TELUS notes that the 31.8-33.4 GHz and 40.5-43.5 GHz bands are not without their own complexities. Both are included in WRC-19's Agenda Item 1.13 study identifying potential candidate mmWave bands for IMT-2020 (5G), and the latter is included in the 40-42 GHz range currently being considered by the FCC as a "core satellite band" as discussed in Paragraph 78 of this submission.

with almost unanimous opposition to the use of a dynamic access / database driven approach for licensing in the band.

126. TELUS finds some of the comments made by respondents who are not stakeholders in the band (Bell, SaskTel and Xplornet) yet requesting protection for existing operations confusing. These respondents suggest that the investment in infrastructure supported by FCFS radio licences somehow justifies their ongoing annual renewals, despite there being no high expectation of renewal for non-auctioned spectrum. These requests from these respondents for sustained protection of FCFS operations (despite the impairment that this may cause to a band being repurposed for 5G flexible use) seems to be at odds the Department's stated objective of maximising the "social and economic benefit derived from the use of the radio frequency spectrum of the mmWave bands." Finally, TELUS finds Bell's comments made in Paragraphs 76 and 77 of its submission confusing. First, Bell refers to "the fact that we have deployed the spectrum in good faith", yet the Department's Spectrum Management System database does not indicate that Bell has any links licensed. Bell also states its general support for the Department's proposed "Option 2" (for operation of sites licensed under FCFS on a secondary basis), but immediately follows by suggesting that deployment be taken into consideration and that "existing stations should be afforded protection and that any auction that may occur could be done over the top of these licensees." TELUS views this inconsistency as further evidence of Bell's internal struggle between expressing an authentic view regarding the appropriate treatment of legacy operations that would impair this critical 5G band versus its desire to create a precedent for its intended windfall conversion in the 3500 MHz band.

Frequency Band 64-71 GHz for Licence-Exempt Use

8-1: Designating 64-71 GHz for Licence-Exempt Operations

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.

127. TELUS supports the designation of the 64-71 GHz band for licence-exempt operations and notes that the majority of other respondents support such a designation as well. While TELUS recognises that the band addressed in the Consultation overlaps with the 66-76 GHz frequency range addressed under Agenda Item 1.13 at WRC-19, we note that IMT identification processes do not determine domestic policies in terms of licensing framework. TELUS also recognises that harmonization with the U.S. would be highly beneficial in enabling early innovation provided by 5G technologies, as the U.S. ecosystem will enable a broad application set for the benefit of Canadians. As such, TELUS supports the adoption of a licence-exempt approach for the 64-71 GHz frequency band. Creating a contiguous 14 GHz licence-exempt band between 57-71 GHz, by combining the currently licence-exempt 57-64 GHz band with the 64-71 GHz band, will also drive development and innovation outside of the exclusively licensed spectrum regime. General Spectrum Access Considerations for Terrestrial Services in the 28 GHz and 37-40 GHz Frequency Bands

General Spectrum Access Considerations for Terrestrial Services in the 28 GHz and 37-40 GHz Bands

9-1: Licensing Approach

9-1
A. Whether flexible use access in these bands should be exclusively licenced or licence-exempt.
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?
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.

Exclusively Licensed vs. Licence-exempt

128. In TELUS' view, flexible use deployments (which require a high degree of coordination between fixed and mobile services) are only feasible with an exclusive licence under one licensee per block.

129. Respondents from the service provider communities (both satellite and terrestrial) who answer this question offer unanimous support for exclusively licensed spectrum. Terrestrial service providers (from both the mobile and fixed access communities) recognise the certainty and flexibility in network planning that arises from exclusive licensing; respondents from the satellite industry view exclusive licensing as necessary to ensure the implementation of siting restrictions and feasibility of coordination between FSS earth stations and flexible-use terrestrial stations. TELUS agrees with both of these perspectives.

Type of Licence

130. TELUS recommends issuing spectrum licences using service areas for competitive licensing. Given the ultra-dense deployment of sites anticipated for 5G mmWave networks, a licensing approach based on radio licences would be inappropriate due to the heavy administrative burden associated with coordination. Given that the demand for mmWave spectrum in the 28 GHz and 37-40 GHz bands is expected to be high, TELUS views the use of service areas for

competitive licensing in an auction process as the only practical approach to assign the spectrum.

131. TELUS notes that most respondents who are terrestrial spectrum users (e.g., mobile and fixed wireless providers) support the adoption of Tier 4 service areas for competitive licensing. TeraGo suggests that Tier 3 licence areas be used, likely to create alignment with its existing licences as discussed in Question 7-7.

132. SaskTel provides a unique proposal with regards to this question on licensing type and suggests that while urban licences would be expected to sell in a competitive auction process, licences in rural Tier 4 areas would be expected to have "almost no demand." As a result, SaskTel proposes that all "rural" spectrum (i.e., in service areas which do not include an urban population centre) be made into FCFS spectrum with user-defined service areas based on grid cells following an auction. TELUS notes that the use of FCFS mechanisms for spectrum with low or no demand would be consistent with the Department's *Framework for Spectrum Auctions in Canada* (FSAC); however, TELUS suggests that a determination of "almost no demand" for rural spectrum can only be concluded when auctioned spectrum remains unsold despite being broadly available. As such, TELUS would not oppose SaskTel's proposal, as long as the spectrum determined to have excess supply was not restricted from bids by competitive measures such as set-asides or aggregation limits. If that were the case, TELUS would suggest (as in recent consultations and decisions) that having a residual auction for any unsold spectrum would be appropriate before opening up any of the bands to FCFS licensing based on user-defined service areas using grid cells.

133. TELUS notes that the BCBA asks for similar treatment as SaskTel for "rural" licence areas, which BCBA defines as populations below 500,000. TELUS strongly disagrees with BCBA's classification and notes that of the 61 "urban" Tier 4 service containing population centres of 30,000 or more, only 10 have populations above 500,000. In TELUS' view, there are many service areas with populations in the 50,000-500,000 range which are well suited for mmWave deployment.

Shared Access via Databases

134. TELUS opposes the implementation of licence-exempt dynamic access using databases in the 28 GHz or the 37.6-40 GHz frequency ranges. Creating a unique Canadian licence-exempt dynamic access solution in either the 28 GHz or 37.6-40 GHz frequency ranges would introduce unnecessary costs and fracture the ecosystems, significantly delaying investment in 5G. TELUS notes that with 14 GHz of contiguous mmWave spectrum proposed to be allocated for licence-exempt use following this Consultation, there is ample opportunity for innovators to innovate and for the Department to experiment with dynamic shared access in the 57-71 GHz frequency range.

135. TELUS notes that the U.S. may develop a dynamic access system in the 37-37.6 GHz band to address their sharing requirements with federal incumbent users, but that Canada has no such requirement. In our response to Question 7-3, TELUS supports the proposal to reserve the development of a band plan for the 37.0-37.6 GHz frequency range for future consultation (pending U.S. developments) to ensure that Canada will reap the benefits of ecosystem harmonization. In this light, it is premature to conclude on whether a database driven dynamic access approach would be appropriate for Canada for the 37.0-37.6 GHz portion of the band.

136. TELUS notes that with few exceptions, respondents to this Consultation are strongly opposed to the use of licence-exempt dynamic access methods within the exclusively licensed bands (28 GHz and 37-40 GHz). Most respondents also noted that even though the FCC may consider dynamic access methods using databases for the 37.0-37.6 GHz frequency range, that proposed mechanism is intended to solve a problem of band sharing between federal users and prospective flexible-use terrestrial applications. Many respondents noted that Canada has no such concern, and suggest that introducing that type of complexity would be detrimental to realising 5G innovation in the near term (preferring instead to add 600 MHz of additional exclusively licensed spectrum to the band).

9-2: Licence Term

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.

137. TELUS supports the use of 20 year licence terms as provided by the Department in all recent licensing framework proposals and decisions. Longer licence terms promote facilities-based competition and will provide licensees pursuing 5G network deployments with investment certainty at the time of initial deployment and through the networks' evolution.

138. TELUS recognises that with longer licence terms comes the risk of spectrum warehousing and speculation. As such, TELUS recommends that the Department must define aggressive build requirements to ensure that the limited spectrum resources are put to good use for the benefit of Canadians. The Department should account for the physical characteristics of mmWave frequency bands and the various deployment scenarios under flexible use licensing in determining the build requirements for these bands. The Department should give careful consideration to finding deployment requirements which are not excessively onerous (given the unique propagation characteristics of the mmWave bands compared to all other commercial mobile spectrum available today), but ones which are sufficiently stringent to act as a deterrent for speculators and ensure that the spectrum is put to use.

139. Given the availability of 14 GHz of contiguous mmWave spectrum proposed to be allocated for licence-exempt use in the 57-71 GHz frequency range following this consultation process, there is ample opportunity for innovators to innovate. There is no risk of harm to innovation through long licence terms in the exclusively licensed 28 and 37-40 GHz bands.

140. TELUS notes that nearly all respondents supported the use of long licence terms that create an environment of certainty around the substantial investment that will be required for 5G network deployments; as such, respondents from the mobile industry broadly support the use of 20 year licences as the term that has been used in all recent licensing framework decisions. Several respondents from the vendor community (Nokia, Intel) propose 10 year licence terms – likely for the sake of alignment with their U.S. filings (where the FCC adopted 10-year licence terms with a high expectation of renewal).

141. TeraGo suggests that 10-year licence terms offer sufficient certainty to incentivise investment while mitigating the risk of "locking in" a band for a specific use for an extended term. Furthermore, TeraGo encourages the Department to adopt 10-year licence terms to create consistent treatment between new flexible-use terrestrial licences and TeraGo's proposal for grandfathered Tier 3 licences (for which they are seeking a 100% windfall conversion and presumably subsequent renewals). TELUS opposes this proposal from TeraGo, and notes that the intent to apply 10-year renewal terms was originally proposed to by the Department in the licensing framework set out before the in 1999 auction of 24 and 38 GHz spectrum[45]. TELUS notes once again that all recent licensing processes (since the 700 MHz spectrum auction in 2014) have made use of 20-year licence terms, making it the de-facto new standard for licence term length.

9-3: Preliminary Comments on Measures Supporting Competition

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.

142. TELUS recommends and expects that the Department will decide on an exclusive licensing approach as the best framework to foster the significant investment required to deploy 5G mmWave networks in Canada. TELUS recommends, as do Bell, Rogers and SaskTel, that the Department implement an open and competitive auction process in assigning these spectrum bands to maximise spectrum utilisation by relying on market forces. TELUS does not believe that an open and competitive auction process attracts speculators that aim to opportunistically profit by merely acquiring spectrum with an intention only to sell the spectrum at a higher price rather than to deploy (with the result being spectrum remaining fallow in Canada), as open auctions create efficient outcomes that reflect market value. TELUS suggests that any concerns about spectrum speculation could be further mitigated through the careful selection of appropriate deployment requirements, which TELUS believes will be a critical issue in the

[45] *Final Policy and Licensing Procedures for the Auction of the 24 and 38 GHz Frequency Bands*

follow-up licensing framework consultations. The Department should give careful consideration to finding deployment requirements which are not excessively onerous (given the unique propagation characteristics of the mmWave bands compared to all other commercial mobile spectrum available today), but ones which are sufficiently stringent to act as a deterrent for speculators and ensure that the spectrum is put to use.

143. The 5G mmWave network business opportunity is completely green field and all interested parties are starting from scratch in terms of flexible use mmWave spectrum in Canada, meaning that there are no parties that can be characterised as incumbents. The additional investment (beyond spectrum) in new 5G networks carries equal market risk for all participants. TELUS recommends that the Department consider a light handed regulatory approach in the auction and conditions of licence to attract bidders that can make the necessary and sustained capital investments in substantive networks and that will not warehouse and/or solicit additional subsidies and privileges before commercialising valuable 5G mmWave spectrum to serve Canadians.

144. TELUS has engaged world class economists to assess the need for competitive measures in the wireless marketplace in Canada, and they have unequivocally concluded that no competitive measures are warranted. The mobile industry in Canada is robustly competitive[46] and there is no evidence of market power[47].

> *The Canadian marketplace for wireless service is competitive. Facilities-based nationwide and regional providers compete for subscribers in a saturated market by employing the latest technology and offering ubiquitous nationwide coverage, thus yielding some of the world's highest long-term evolution (LTE) penetration rates. There is no evidence of market power, and ISED must weigh the 2014 claim by the Competition Bureau against the vast contemporaneous evidence demonstrating the opposite. Additionally, set-asides restrict spectrum supply to non-eligible providers and open these bidders up to fake bidding (instances where eligible providers drive up the spectrum costs for non-eligible bidders). Thus, set-asides are not simply superfluous but seriously harmful.*

[46] C.M. Dippon, NERA Economic Consulting. *Expert Report of Christian M. Dippon, PhD Re: Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band,* October 2017 (Hereafter abbreviated Dippon 2017-10). Attached to TELUS' submitted comments in response to the 600 MHz Consultation.
[47] Eisenach, J.A., *Expert Report of Jeffrey A. Eisenach, Ph.D. in Reconsideration of Telecom Decision 2017-56 Regarding Final Terms and Conditions for Wholesale Mobile Wireless Roaming Service* (CRTC 2017-259). September 8, 2017.

145. Given the significant number of blocks of mmWave spectrum available in these bands, any party with a serious interest and a strong business case will be able to acquire spectrum in these bands. An open and competitive auction would ensure that fair market prices are paid for all spectrum across the country without the unintended market distortions[48] or subsidies that serve to enrich the shareholders of family controlled companies.

146. Regional provider Shaw calls once again for privileged and subsidised access to spectrum (mmWave this time) via the continued application of asymmetrical competitive measures (a set-aside). After receiving privileged and subsidised access to spectrum for the last decade it is not surprising that Shaw would continue to hold out its hand. The Department must move on to the next phase (away from "market planning" and the picking of winners and losers) and start to rely on market forces to allow and ensure the efficient assignment of spectrum.

147. Shaw notes that "in the 28 GHz band, if the Department adopts the proposal to have two blocks of 425 MHz each, there would be a maximum of two licensees for that band, and without intervention, one entity could acquire both blocks and monopolise the band." Shaw proposes a band plan using four 212.5 MHz blocks, seemingly recommending competitive measures to ensure a market-planned outcome of four operators in the band. TELUS encourages the Department to consider the significant amount of largely equivalent spectrum to be made available in the 37-40 GHz band and to not unnecessarily fragment the 28 GHz band. An operator may choose to concentrate its buying power in one band or the other versus acquiring a smaller amount of spectrum in each band (and end up better off, having avoided the cost of deploying two distinct radios).

148. In its comments, regional wireless provider (but Quebec cable conglomerate) Videotron pleads its case as a purported new wireless entrant, calling for the government to assist new entrants to gain equitable access to necessary frequencies to fight against the three incumbent providers. However, its comments are betrayed by its actions which include foreclosing the Quebec market to any other new entrants in the last four auctions and foreclosing Bell from unrestricted spectrum in part of Quebec in the AWS-1 auction. Additionally, Videotron has highlighted to

[48] C.M. Dippon, NERA Economic Consulting. *Regulatory Policy Goals and Spectrum Auction Design: Lessons from the Canadian AWS Auction*, March 2009 and Dippon 2017-10.

its investors the profit it made on flipping spectrum it bought outside of Quebec, further subsidising its Quebec and Eastern Ontario spectrum acquisitions. With a $16B market cap and a record of bidding strongly against entrants and incumbents alike, Videotron clearly does not deserve continued privileged and subsidised access to spectrum. In fact, Videotron is vocal in its contempt for asymmetrical rules in its other business lines as evidenced by Quebecor Inc. president and CEO Pierre-Karl Péladeau in his press release and as quoted in the Globe & Mail regarding the TV content business:

> *"We are dismayed by the Minister's repudiation of Canadian companies, which invest heavily …, make a major contribution to our economy and are actively involved in their communities… the Minister is endorsing a two-tier system… that is blatantly unjust."*[49]
> *"Everybody should be treated the same way … Why would you have exceptions? … we're subsidizing them. That's quite a weird business model."*[50]

149. In its response to Question 9-3, Videotron brings this inconsistency to its Consultation response, as it claims that [translated] "the three major incumbents' stranglehold on commercial mobile spectrum still persists", and that "the new entrants will not be able to leverage their current spectrum holdings in order to tackle the challenge of 5G. To do this, they need access to an adequate amount of low and high frequencies." Videotron makes this claims despite having received privileged and subsidised access to spectrum that, in their core market of Quebec, is roughly equal to Bell's spectrum holdings and approximately 70% of Rogers' or TELUS' spectrum holdings, despite serving only 40-45%[51] of the subscriber base of the national providers within the region. TELUS suggests that this notion is not unique to Videotron; all operators, both national and regional, will require access to sufficient new low-band and mid-band 5G spectrum to complement the new mmWave spectrum – especially in the 3.5 GHz band, as described in Paragraph 13 of TELUS' response above.

150. All of Canada's mobile operators are well capitalised, deliver quad plays in their incumbent territory, have similar net debt to EBITDA ratios (i.e., have similarly levered balance sheets)

[49] Quebecor press release September 28, 2017
http://www.quebecor.com/en/comm/canada%E2%80%99s-cultural-policy-quebecor-criticizes-preferential-treatment-us-giants
[50] Globe and Mail article, September 26, 2017
https://beta.theglobeandmail.com/report-on-business/canada-should-stop-subsidizing-us-internet-giants-peladeau-says/article36405743
[51] TELUS estimate based on subscriber counts from investor reports

and drive roughly the same normalised operating cashflow (EBITDA per pop in their operating territory) – see Table 8 below. In this context and given that all operators will be entering 5G mmWave network business as a green field market, the Department should move away from their past policy that guaranteed regional providers heavily subsidised spectrum (sometimes much larger than a fourth share) in each band.

Table 8 – Operating cashflow per pop in-territory and balance sheet strength

	EBITDA (TTM 2nd Qtr 2017) ($M)	EBITDA %	Net Debt / EBITDA	Pops (M)	Average Auction Cost 2008-2015 ($ / MHz-pop)
TELUS	4,098	31.6%	3.2x	33.5	1.32
Bell	8,318	37.5%	2.7x	33.5	1.27
Rogers	5,144	36.9%	3.3x	33.5	2.59
Quebecor	1,447	35.5%	3.0x[52]	9.1	0.82
Shaw	2,095	40.0%	2.6x	21.3	0.61
Eastlink	N/A	N/A	N/A	3.1	0.21

151. Over the past ten years, the Department has effectively[53] set aside 25% of the nation's mobile broadband capacity for regional providers, in turn forcing over 90% of Canadian mobile subscribers to ride on only 75% of the nation's mobile spectrum. TELUS notes that set asides distort auctions by creating false scarcity and hence higher prices for set-aside ineligible bidders and consequently their subscribers. Set asides also provide gaming opportunities for

[52] Excludes debt raised to buy back shares from CDP Capital in 2012 and 2015. Inclusive of that debt, Quebecor's Net Debt / EBITDA ratio is 4.0x.

[53] The Department has set aside 25% of the country's spectrum for well capitalised, family-controlled businesses via direct set-asides and via band caps which effectively set aside spectrum.

set-aside eligible bidders. Set asides have repeatedly proven to distort post-market outcomes[54] and result in the inefficient utilisation of spectrum[55].

Table 9: Privileged and subsidised access to spectrum in Canada (National MHz attributed using 2016 population)

		Year	Band	Rogers	Bell	TELUS	Shaw/Wind[56]	Videotron	Eastlink	SaskTel
1	Grant	1985	850	25	16	6.4				0.8
2	Grant	1995	PCS	10[57]	7	2.5[58]				0.3
3	Clawback	2001	PCS	5	6	-5				
4	Set-aside	2008	AWS-1	0[59]			17	7	3	
5	Windfall	2011	BRS	49	49					2.0
6	Cap	2014	700							
7	Set aside	2015	AWS-3				16	9	3	
8	Cap	2015	BRS							
9	[Set-aside]	TBA	600				[18]	[9]	[1]	[1]
10	Windfall	TBA	3500	TBA	TBA					
11	**Total**	**National MHz**		**89**	**78**	**4**	**51**	**25**	**7**	**4**
12		**In-territory MHz**		**89**	**78**	**4**	**83**	**85**	**90**	**130**

152. Table 9 shows privileged and subsidised access to spectrum by band by operator. Within each band it shows the quantity of national MHz (for comparability) that each major mobile provider has had privileged and/or subsidised access to. The table highlights how TELUS' lineage as the original new entrant and the only still standing company to ever create new competition in the history of the Canadian mobile industry, without being provided lucrative incentives and subsidies to do so, has yet to receive balancing treatment from the Department.

153. Line (1) in the table shows the size of the original 850 grants in terms of national MHz. Line (2) similarly shows the 1995 PCS grants. The beneficiaries of these grants have paid $3.5B in spectrum fees over the lifespan of these licences (over $8.5B in terms of 2017 dollars)[60]. The

[54] Dippon 2009
[55] AWS-1, 700 MHz, AWS-3 and BRS spectrum which has been set aside for regional providers all remains grossly underutilised, especially outside of top urban centres.
[56] Although Shaw's acquisition of Wind was a secondary-market transaction, it was a privileged transaction
[57] Rogers acquired Microcell in 2004, including 30 MHz of granted PCS spectrum
[58] TELUS acquired Clearnet in 2000, including 30 MHz of granted PCS spectrum of which 20 MHz was clawed back in TELUS' ILEC territories.
[59] Rogers acquired 20 MHz of AWS-1 set aside spectrum in most of Canada's top markets from Mobilicity, Wind and Shaw via a series of orchestrated transactions as well as from Videotron.
[60] Mark Goldberg, *Two Sides of Every Coin*, http://mhgoldberg.com/blog/?p=1157

table clearly illustrates the scale of the benefit Rogers received in comparison to other providers.

154. Note that Rogers and TELUS bought PCS spectrum previously granted in 1995 from Microcell and Clearnet but paid for this spectrum in open secondary market transactions and as such, this PCS spectrum is not included in the table just as none of the recent secondary market transactions are included.

155. Line (3) shows the effect of the only clawback of mobile spectrum[61] in Canadian history related to the 20 MHz of PCS that was clawed back from TELUS when TELUS acquired Clearnet in 2000. In January 2001, the Department turned around and auctioned this spectrum creating 60 MHz of supply in regions where TELUS had been stripped of 20 MHz in BC, Alberta and Eastern Quebec. TELUS could not bid to buy it back due to the cap in place. Bell and Rogers could only buy a subset of the available six blocks (due to the cap) but were able to acquire it at 16 cents per MHz-pop (just over the reserve price) while TELUS, Rogers and Bell spent close to $4 per MHz-pop fighting over four blocks in Southern Ontario. Speculator W2N Inc. was able to acquire the remaining spectrum clawed back from TELUS in BC and Alberta at 16 cents per MHz-pop (just over the reserve price).

156. Line (4) shows the quantity of national MHz that the AWS-1 entrants were able to acquire with privileged access and a taxpayer subsidy.

157. Line (5) shows the quantity of national MHz of mobile 2500 MHz spectrum that Bell and Rogers received as part of a windfall associated with the fundamental reallocation of fixed service MCS and MDS licences to mobile service.

158. Line (7) shows the quantity of national MHz of AWS-3 spectrum that the operating entrants were able to acquire with privileged access and a taxpayer subsidy. This "auction" (which was for all intents and purposes was a grant, since the rules ensured that there was no competitive

[61] Note: There was a clawback of fixed 2500 MHz band spectrum but this was related to a mobile conversion windfall which saw billions of dollars in value transferred from the Canadian taxpayer to Rogers and Bell. There will be another clawback of fixed 3500 MHz band spectrum in the future, but again this relates to a mobile conversion windfall which will see billions of dollars in value transferred from the Canadian taxpayer to Rogers, Bell and to a much lesser extent Xplornet.

bidding for the set-aside except in one service area), saw the operating entrants pay on average 11 cents per MHz-pop while national providers paid $3 per MHz-pop (almost 30x more.) It is worth noting that the price the operating entrants got away with is essentially equivalent to 70% off a free grant of spectrum. A cost-free grant of spectrum attracting standard annual mobile spectrum licence fees would have cost the operating entrants over time, almost three times what they paid at auction. Once again taxpayers were forced to give up the general revenues while the benefits accrued to family controlled businesses.

159. Whatever one thinks of the highly interventionist approach taken by the Department over the last decade when it comes to spectrum auctions, there is no denying that the current market structure is sustainable and highly competitive. There is no rational justification for continued intervention.

160. Should the Department deem competitive measures in some form to be necessary, TELUS would only support a large non-band-specific aggregation limit for the mmWave spectrum addressed in the Consultation that is one-size-fits-all – that is, one which is applied evenly to all bidders. By making an aggregation limit non-band-specific, the Department would enable bidders to pick both the appropriate band and the amount of spectrum required to deliver a variety of 5G mmWave services according to their business needs. In contrast, a band-specific aggregation limit could introduce spectrum portfolio fragmentation and network deployment inefficiencies which would impose additional costs on licensees as a result (e.g., requiring two radios for their mmWave deployments). By making an aggregation limit one-size-fits-all, the Department eliminates the risk of an overconcentration of spectrum without picking winners and losers in this greenfield opportunity.

161. If the Department chooses to introduce an aggregation limit for mmWave spectrum, it must account for the large bandwidth and contiguity requirements for 5G mmWave applications (e.g., the 20 Gbps peak downlink targets for IMT-2020 referenced in our response to Question 6-3).

162. TELUS notes that the FCC has defined a 1250 MHz aggregation limit across these same bands in the U.S., where four or more players compete in each market. TELUS views this aggregation limit as reasonable for the Canadian market, assuming that all of the spectrum

addressed in the Consultation is made available and is unencumbered, except potentially in the very short term.

163. Rogers' response continues to attack TELUS and Bell in the context of its views on the associated entity and collusion rules. Rogers also suggests that there needs to be a focus not only on the differences between national vs. regional providers, but also between the three national providers. TELUS finds this statement odd, coming from the national provider with the most spectrum in every mainstream mobile band, the lowest utilisation and highest spare capacity of all the national providers and potentially negotiated subordinate access to the lightly loaded cableco regional provider spectrum. TELUS notes that this Consultation offers only a preliminary call for comments on "measures to support competition" and so chooses to not further engage Rogers at this stage on its misrepresentation of the facts. TELUS instead refers the reader to Paragraphs 167–173 of its 600 MHz licensing framework reply comments for its detailed rebuttal.

164. In conclusion, TELUS proposes that the Department implement an open and competitive auction or, if deemed necessary, apply minimally restrictive competitive measures (via a non-band-specific aggregation limit) to the mmWave spectrum addressed in the Consultation. The Department must avoid creating artificial limitations on the competitive marketplace that subsidise well-capitalised regional players at the expense of Canadian taxpayers. Rather, the Department should implement policy that relies on market forces to promote Canadian investment and facilities-based competition in 5G mmWave network deployments.

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