



**TELUS COMMUNICATIONS INC.**

**Comments for**

**CONSULTATION on the SPECTRUM OUTLOOK 2018 to  
2022**

SLPB-006-17

October 2017

Spectrum Management and Telecommunications

**February 16, 2018**

## Table of Contents

<b>Executive Summary .....</b>	<b>5</b>
Allocating 3500 MHz, then mmWave spectrum is vital for Canada to lead in 5G .....	7
<b>Introduction and Summary of Recommendations.....</b>	<b>10</b>
3500 reallocation to flexible use, liberation and auction .....	10
Decisions on mmWave spectrum for 5G and auction.....	11
600 MHz auction rules and timing.....	12
800 MHz repacking .....	16
Release of additional spectrum .....	17
Innovation in licensing.....	18
<b>TELUS' Comments on Specific Questions Posed by ISED.....</b>	<b>19</b>
<b>A Principled Approach to Releasing Spectrum .....</b>	<b>19</b>
Q1: Changes to Licensing Regime to Enable Innovation .....	19
<b>Commercial Mobile Services .....</b>	<b>23</b>
Q2: Demand .....	23
Q3: New Technology Developments and Usage Trends .....	24
Q4: Measures to Address Increasing Traffic.....	27
<b>Licence-Exempt.....</b>	<b>28</b>
Q5: Demand .....	28
Q6: New Technologies and Sharing Techniques .....	31
Q7: Band Evolution and IoT .....	32
Q8: Carrier Grade / Managed Wi-Fi Service Trends .....	33
<b>Satellite.....</b>	<b>34</b>
Q9: Demand for MSS / EESS .....	34
Q10: Band-Specific Demand (C, Ku, Ka).....	34
Q11: New Technology Developments and Usage Trends .....	34
Q12: Priority Applications .....	34
<b>Backhaul .....</b>	<b>35</b>
Q13: Demand .....	35
Q14: Landscape for Backhaul – Comparison of Solutions.....	37

Q15: New Technology Developments and Usage Trends .....	38
Q16: Impact of Access Traffic on Backhaul Demand .....	38
Q17: Specific Frequency Ranges for Backhaul .....	39
Q18: Impact of In-Band Flexible Use on Backhaul.....	39
<b>Potential Bands for Future Release.....</b>	<b>40</b>
Q19: Assessment of Listed Bands.....	40
<b>3500 MHz.....</b>	<b>41</b>
3500 MHz is the critical band for enabling ubiquitous 5G.....	42
Canada’s wireless leadership at risk if we do not move quickly on 3500 MHz.....	44
Historical fixed licensing should not determine Canada’s 5G future .....	46
To move quickly, focus on existing 175 MHz in Phase 1; 400+ MHz in Phase 2 .....	46
Ensure contiguity across phased release via reassignment process .....	50
Summary of recommendations for 3500 MHz .....	51
<b>28 GHz &amp; 37-40 GHz.....</b>	<b>52</b>
<b>600 MHz.....</b>	<b>53</b>
<b>AWS-2 / PCS-H.....</b>	<b>55</b>
<b>64-71 GHz.....</b>	<b>56</b>
<b>13 GHz .....</b>	<b>56</b>
<b>32 GHz .....</b>	<b>57</b>
Q20: Services/Applications, Timing and Priority of Listed Bands.....	57
<b>800 MHz.....</b>	<b>59</b>
800 MHz has been authorised for mobile service since 1995 .....	59
Broadband use brings economic and social benefit.....	59
Repacking is feasible .....	60
U.S. paved the way and now needs Canada to align .....	61
Several key stakeholders concur.....	61
Summary of recommendations for 800 MHz .....	61
<b>mmWave bands addressed in WRC-19 Agenda Item 1.13.....</b>	<b>63</b>
24.25-27.5 GHz.....	63
32 GHz.....	64
45.5-50.2 GHz.....	65

71-76 and 81-86 GHz.....	65
<b>L-Band (1427-1518 MHz) .....</b>	<b>66</b>
<b>AWS-3 Unpaired (1695-1710 MHz) .....</b>	<b>66</b>
<b>Bands above 95 GHz.....</b>	<b>66</b>
<b>900 MHz.....</b>	<b>67</b>
Q21: Other Bands for Consideration.....	67
Q22: Application-Specific Frequency Ranges / Bands.....	68
Q23: Factors Impacting Release of Specified Bands .....	69

## Executive Summary

1. TELUS appreciates the opportunity to comment on the 2018-2022 Outlook for spectrum in Canada. Industry consultation is a welcome addition to this second Spectrum Outlook and TELUS is pleased to see that the Department is taking an integrated approach in this version (which explores all the major uses of spectrum) as opposed to simply addressing commercial mobile spectrum as in the 2013 Outlook.
2. It is important to underscore the importance of robust and purposeful industry consultation. The current Government was elected on the premise of meaningful consultation and evidence based public policy. Given the importance of 5G – the next generation wireless network, which will meet the needs of citizens and industry through advances in connectivity, latency and bandwidth – and the impact it will have on Canada and Canadian society, it is imperative to ensure our consultations result in the best possible outcome for Canada.
3. Throughout every aspect of society, access to a robust and reliable broadband network has become essential, and at the heart of this, there needs to be a spectrum policy that fosters Canadian society and Canadian innovators. Whether it be access to world class healthcare and education or a Canadian making the next great breakthrough in artificial intelligence, our broadband networks set Canada apart. As we look forward, we must make the right decisions to ensure and grow our global competitive edge.
4. By aligning the timeframe of this consultation to the objectives the Government of Canada has laid out, it becomes increasingly clear that the success of the Government's Innovation Agenda relies on the strength of our networks and Canada's ability to transition our world leading 4G networks into the next great technological advancement of 5G. Recent efforts by the Government of Canada to stimulate investment, innovation and STEM education through strategic infrastructure and social investments as well as programs like the

Innovation Superclusters Initiative<sup>1</sup> can only succeed if Canadian innovators have access to the latest technologies available.

5. In a consultation as broad as this one, the Department will have to absorb and assess input from an array of stakeholders with varying and often directly competing interests. Stepping back from it all, the Department must have one overriding priority which dwarfs all others as it will directly impact every business and every citizen in Canada. It is imperative that the Department ensure that the mobile network providers that serve 99.4% of the Canadian population have access to the spectrum they need to deliver 5G. Everything else, while potentially important in its own right, pales in comparison.
6. As the number of connected devices proliferates, data usage skyrockets and new smart living applications emerge, it is essential to expeditiously build and deliver 5G and fully realise Canada's innovative potential. The importance of this to Canada cannot be understated and the Department must ensure that the spectrum policy implemented over the coming years creates the best possible environment for 5G deployment to all Canadians.
7. The timely availability of spectrum will be crucial to deploy 5G and ensure Canadians and Canadian businesses retain their competitive advantage and continue to excel on a global stage. Specifically, the 3500 MHz spectrum band – globally seen as the most critical to early 5G deployment – will need to be available no later than 2019. To date, several G8 nations alongside other key countries have already made or are planning to make this band available for mobile use in 2018.
8. Canada's wireless networks are routinely recognised for their speeds and quality; most recently<sup>2</sup>, Canada achieved – for the second straight year – the #1 position within the G8 countries for 4G LTE speed, surpassing the United States by a factor of two and leading G8 nations by a significant margin of 17%. This was accomplished despite Canada having just 17 wireless connections per square kilometre, which is far below the EU average of 146 and

---

<sup>1</sup> TELUS was proudly the lead applicant of Canada's Digital Technology Supercluster which was chosen as one of the five winning applications on February 15, 2018. More information can be found at <https://digitalsupercluster.ca/>

<sup>2</sup> OpenSignal, *The State of LTE*, "4G Speed Comparison", published November 2017. Link: <http://opensignal.com/reports/2017/11/state-of-lte>

the U.S. average of 48. In an era of government policy centred on infrastructure investment, Canadian telecommunications operators have invested heavily in improving broadband speeds for both wireless and fixed broadband consumers and other innovative developments. Canadian operators are also making generational investments in urban and rural communities with the aim of delivering low latency terrestrial high-speed Internet to as many Canadians as possible. Since 2000, TELUS has invested \$37 billion in capital expenditures to build its networks, systems and infrastructure as part of over \$147 billion injected in the operation and development of its infrastructure.

9. As Canada moves toward 5G, it is crucial that we continue to invest in advancing Canada's mobile networks to further amplify the country's economic strength and technology leadership position. World leading 5G networks will enable Canada to meet the needs of its citizens and industries by providing the coverage, speed, capacity, reliability and ultra-low latency required for future applications such as smart cities, autonomous vehicles, innovative healthcare, emergency services, the Internet of Things (IoT) and many other complex applications being envisioned and developed by innovators across Canada. The first 5G industry standard (currently focused on LTE-supported 5G) was completed in December 2017. Full standardisation of a standalone 5G solution is expected in mid-2018.
10. For Canada to truly fulfill its innovative potential and establish itself as a global innovative hub, it must get early 5G deployment right.

#### **Allocating 3500 MHz, then mmWave spectrum is vital for Canada to lead in 5G**

11. The deployment of early 5G networks will require two kinds of spectrum: 3500 MHz and millimetre-wave (mmWave). Both are complementary; however, 3500 MHz is the most critical spectrum to fulfil the promise of 5G speed and reliability to benefit all Canadians in our digital economy. Mid-band 3500 MHz spectrum will help deliver true 5G speeds far and wide over Canada's vast urban and suburban areas and is an opportune band to penetrate inside buildings. Other G8 countries are working to make 3500 MHz spectrum available by 2018. To sustain Canada's current leadership position among these nations and enable innovation to flourish in our country, it is imperative for the Government of Canada to make 3500 MHz spectrum available as soon as possible.

12. While 5G is the next step in the evolution of the 3G and 4G wireless technology continuum, the realisation of 5G and “gigabit societies” will be transformative for individual Canadians, industries and entire economies on an unprecedented scale over previous generations of mobile technologies. The exponential leap in wireless capabilities enabled by 5G will increase productivity and convenience for businesses and citizens by powering everything from homes and vehicles to emerging applications such as the industrial IoT, industrial automation, augmented and virtual reality, predictive healthcare and robotics, as well as advances in artificial intelligence. The diffusion of 5G technologies globally will also be a fundamental contributor to economic growth and innovation. 5G will open up economic opportunities and create a virtuous cycle of innovation. By 2035, 5G is forecast to enable over \$12 trillion of global economic output<sup>3</sup>.
13. Looking ahead to the introduction of 5G networks, governments around the world – including the United States<sup>4</sup>, United Kingdom<sup>5</sup>, China<sup>6</sup>, Italy<sup>7</sup> and Germany<sup>8</sup> – are investing in building and rapidly advancing their 5G and spectrum strategies in support of improving connectivity options for citizens, industry, and communities. South Korea aims to complete the deployment of a commercial 5G network by the end of 2019 with an expected 5G penetration rate of 5% in the country by 2020<sup>9</sup>.
14. Realising the promise of 5G and successfully powering an entire ecosystem of billions of connected devices and sensors is contingent upon the availability of the most critical

---

<sup>3</sup> The 5G economy: How 5G technology will contribute to the global economy; January 2017 report based on research by Qualcomm. <https://www.qualcomm.com/media/documents/files/ihs-5g-economic-impact-study.pdf>

<sup>4</sup> *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, FCC 17-104 / GN Docket No. 17-183, published August 3, 2017. Link: [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-17-104A1\\_Rcd.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-17-104A1_Rcd.pdf)

<sup>5</sup> Next Generation Mobile Technologies: A 5G Strategy for the UK, March 2017. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/597421/07.03.17\\_5G\\_strategy\\_for\\_publication.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_for_publication.pdf)

<sup>6</sup> Business Insider: China plans to lead 5G network adoption by 2030; June 21, 2017. <http://www.businessinsider.com/china-plans-to-lead-5g-network-adoption-by-2030-2017-6>

<sup>7</sup> RCRWireless News: Italy making moves on 5G with spectrum allocation; September 25, 2017. <https://www.rcrwireless.com/20170925/5g/italy-5g-spectrum-allocation-tag23>

<sup>8</sup> Reuters: German regulator urges broadband buildout; readies 5G spectrum; December 4, 2017. <https://www.reuters.com/article/germany-telecoms/german-regulator-urges-broadband-buildout-readies-5g-spectrum-idUSL3N1O42Y7>

<sup>9</sup> RCRWireless News: South Korea to launch first commercial 5G network in 2019; May 25, 2017. <https://www.rcrwireless.com/20170525/5g/south-korea-launch-first-commercial-5g-network-2019>



building block for 5G – spectrum. To keep Canada’s networks competitive on the global stage and gain the 5G advantage among global innovators, while simultaneously supporting better social, economic and healthcare outcomes for Canadians, it will be critical to ensure the timely availability of spectrum for 5G.

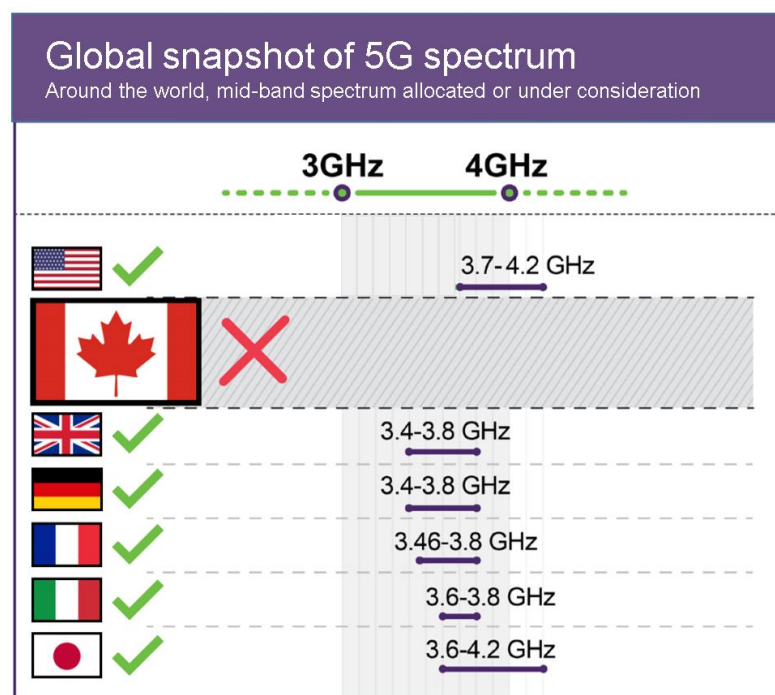
15. These countries’ faster timelines for making 3500 MHz spectrum available for 5G networks leaves Canada at risk of falling behind. If that happens, it will hamper our industry and our competitive advantage among the G8 and other highly industrialised nations. 3500 MHz spectrum will need to be available in Canada no later than 2019 to enable Canadian operators to deploy our country’s first 5G mobile networks alongside other leading nations. It is vital for the Canadian Government to make 3500 MHz spectrum available for 5G as soon as possible to enable Canadian innovation to flourish, further strengthen the economy and sustain our global leadership position.

## Introduction and Summary of Recommendations

### 3500 reallocation to flexible use, liberation and auction

16. As TELUS awaits decisions on both the 600 MHz licensing framework and on releasing mmWave spectrum to support 5G, TELUS has become concerned about the lack of forward movement on the 3500 MHz band file in light of the urgency of releasing spectrum in Canada to support 5G.

Figure 1: Mid-Band Spectrum Allocation or Targets for Countries Globally as per Qualcomm<sup>10</sup>



17. As TELUS details in its response to Question 19, Canada is in prime position to immediately embark on the process of releasing flexible use 3500 MHz for Canadian operators in two or more phases, starting with 175 MHz of spectrum issued as flexible use licences by mid-2019 as Phase 1. To realise this expedited timeline, the Department must consult on a Phase 1 band plan, clawback, and licensing framework to enable the auction of the first tranche – the existing 175 MHz FWA band (3475-3650 MHz). Existing operations of rural WISPs

<sup>10</sup> Qualcomm, *Spectrum for 4G and 5G*, published December 2017.

Link: <https://www.qualcomm.com/media/documents/files/spectrum-for-4g-and-5g.pdf>

will not constrain near term 5G rollouts and should be permitted to continue operating as-is until the application of the final transition policy.

18. TELUS believes that ISED should aspire to release more than 400 MHz of flexible use spectrum through Phases 1 and 2 of what we would describe as a Canadian mid band transition. This recommendation is based on a target block size of 100 MHz (the largest contiguous bandwidth currently supported by the 3GPP 5G New Radio specification for bands below 6 GHz)<sup>11</sup> and Canada's four operators per region. Where this presumably contiguous 400+ MHz of spectrum should fall in the overall 3GPP band n77 (3300 – 4200 MHz) would be based on the various issues to overcome in displacing or coexisting with incumbent licensees in the name of the larger Canadian agenda for 5G. Given the urgency of releasing 3500 MHz spectrum to support 5G, TELUS recommends that these issues be addressed in Phase 2 of the 3500 MHz transition and that a 175 MHz Phase 1 transition take place immediately, only dealing with the in-band transition issues. TELUS recommends that Phase 1 flexible use licences be issued in the assignment stage of the Phase 1 3500 MHz auction; TELUS further recommends that the specific frequency assignments be temporary in nature and subject to reassignment in a Phase 2 auction to guarantee contiguity across these two phases. This proposal will ensure an efficient outcome of the initial two-phased release of 3500 MHz spectrum, treating licensing as end to end across 400+ MHz of spectrum in the band and not as the collating of two independent assignment processes. Finally, TELUS recommends that the Department consider a Phase 3 release of spectrum, ideally addressing the entire 3400-4200 MHz band.

### **Decisions on mmWave spectrum for 5G and auction**

19. mmWave releases are a close second to 3500 MHz in terms of urgency for 5G. The 28 GHz and 37-40 GHz bands have been proposed for flexible use in line with the U.S. and a decision and a licensing framework consultation are expected in the near future. However, 5G mmWave technology will take longer to develop and deploy than 3500 MHz technology. 5G in 3500 MHz will leverage the RF designs for existing technologies and

---

<sup>11</sup> 3GPP TS 38.101-1 V15.0.0, *NR User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone*, published December 2017. Link: [http://www.3gpp.org/ftp/Specs/archive/38\\_series/38.101-1/38101-1-f00.zip](http://www.3gpp.org/ftp/Specs/archive/38_series/38.101-1/38101-1-f00.zip)

possesses physical properties which support the use of similar cell site spacing as in existing mobile bands. Further, 5G deployments in the 3500 MHz band will complement 5G mmWave deployments by delivering a mobility experience that mmWave systems will be unable to provide on their own.

20. mmWave deployments will deliver the richest localised 5G experiences, while 3500 MHz will be the band that delivers a rich 5G experience with ubiquitous coverage through the use of ultra-wide bandwidths and massive MIMO technology. For these three reasons – technology maturity, ubiquity of coverage and mobility support – the Department must prioritise the release of 3500 MHz spectrum ahead of all other bands, while ensuring that 28 GHz and 37-40 GHz follow quickly.
21. It is vital to avoid fragmentation of 5G spectrum. 5G standards set the initial channel size of up to 100 MHz for sub-6 GHz bands and up to 400 MHz for mmWave to meet IMT-2020 5G requirements<sup>12</sup>. The Department must prioritise the allocation of large contiguous spectrum blocks and must also consider innovative ways to assign the specific frequencies to achieve the most efficient use of the band by the industry as a whole.
22. To ensure that the 37-40 GHz band is able to be effectively used for 5G, legacy fixed licensees must be relocated or operate on a no interference / no protection basis once flexible use licences have been issued. Similarly, geographic restrictions on satellite earth station siting in the 28 & 37-40 GHz bands must be defined as in the proposed Footnotes C47C and C51 for inclusion in the Canadian Table of Frequency Allocations (CTFA) requiring FSS applications to “*pose minimal constraints upon the deployment of fixed and mobile service systems*”.

### **600 MHz auction rules and timing**

23. 600 MHz spectrum will, in the medium term, provide the critical ubiquitous low latency urban / rural overlay for 5G. However, because of its limited available bandwidths, its large wavelengths which do not easily support massive MIMO and its FDD configuration which

---

<sup>12</sup> Report ITU-R M.2410-0: Minimum requirements related to technical performance for IMT-2020 radio interface(s), published November 2017. Link: <https://www.itu.int/pub/R-REP-M.2410-2017>

does not enable efficient beamforming, 600 MHz spectrum on its own will not deliver the 5G enhanced mobile broadband (eMBB) experience. The 600 MHz band will be key in enabling 5G massive machine type communications (mMTC) and ultra-reliable low-latency communications (URLLC) while remaining a critical band for rural and urban mobile broadband coverage.

24. TELUS is confident that with the robust consultation process and the evidence put on the record that ISED must conclude that a blanket 43% set aside is not justifiable given the distribution of low band holdings among the set-aside-ineligible operators. As examples, TELUS provides two simple tables.
25. Table 1 is a comparison of low band spectrum holdings (in MHz), averaged nationally for the set-aside-ineligible operators and the regional operators (grouped). It shows that the proposed rules grossly overprovision regional operators on average with low band spectrum while exacerbating TELUS' disproportionately under provisioned state with respect to low band as a function of TELUS' history as the original new entrant<sup>13</sup>. The proposed auction design is very problematic and needs to be changed.

---

<sup>13</sup>Paragraph 53 of TELUS' *Reply Comments to the Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band*, submitted November 2017. Link: [https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SLPB-005-17-reply-comments-Telus.pdf/\\$file/SLPB-005-17-reply-comments-Telus.pdf](https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SLPB-005-17-reply-comments-Telus.pdf/$file/SLPB-005-17-reply-comments-Telus.pdf)

**Table 1: Low band holdings and utilisation**

	<b>Low band MHz on average nationally before open auction of 600 MHz</b>	<b>Subscribers (M) to serve nationally (as of 3Q17<sup>14</sup>)</b>	<b>Share of low band spectrum</b>	<b>Share of mobile subscribers</b>	<b>Low band utilisation<sup>15</sup> ratio (i.e., load / stress factor)</b>
Rogers	48	10.6	32%	34%	66
Regionals (with 30 MHz set aside)	40	2.9	28%	9%	22
Bell	33	9.0	23%	29%	80
TELUS	26	8.8	17%	28%	103

26. Table 2 is an example of how dysfunctional the proposed rules are as they pertain to the two regional challengers in Canada's largest market, Southern Ontario. It shows that Shaw and TELUS are both challenger brands in the Southern Ontario retail market, with no wireline products and the exact same low band spectrum. However, with the proposed 600 MHz auction rules, Shaw would automatically enter the open auction with four times as much low band spectrum as TELUS when it bids against TELUS, Rogers and Bell for the remaining 40 MHz of unrestricted 600 MHz spectrum in Southern Ontario. At this juncture, TELUS' low band spectrum would be over twelve times more loaded than Shaw's.

<sup>14</sup> [https://www.cwta.ca/wp-content/uploads/2017/12/Sub-Stats-2017-Quarter-3-EN\\_2017.12.04.pdf](https://www.cwta.ca/wp-content/uploads/2017/12/Sub-Stats-2017-Quarter-3-EN_2017.12.04.pdf)

<sup>15</sup> Low band spectrum utilisation is defined as the number of subscribers per 10,000 low band MHz-pops, i.e., the number of subscribers to support per unit of low band spectrum. The relative values, not the absolute values, are important.

**Table 2: Example: Southern Ontario Regional Challenger Low Band Comparison**

Southern Ontario					
	Competitor type	Current Low Band	Low Band Post Set - aside	Subscribers (M) <sup>16</sup>	Low band utilisation ratio post set-aside (i.e., load / stress factor) <sup>15</sup>
Shaw	Regional challenger (no bundling)	10 MHz (700U)	40 MHz	0.8	14
TELUS	Regional challenger (no bundling)	10 MHz (700U)	10 MHz	2.4	174

27. TELUS has detailed in its submissions to the *Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band* (SLPB-005-17) how a smaller set aside and/or particularly the use of a low band spectrum cap would diminish the material adverse impact to TELUS in particular via the proposed 600 MHz auction rules which are short-sighted.
28. TELUS is also strongly opposed to a large direct set aside of rural 600 MHz spectrum to the regional challengers who are urban / suburban focused and have limited wireline and wireless network facilities in rural and remote markets. TELUS recommends the splitting of each of the 14 Tier-2 licence areas into a rural and an urban sub licence and removing the set aside provision in the rural portion of each licence area (i.e., in the 111 of 172 Tier 4 service areas without a population centre over 30,000).
29. TELUS has supported the proposals by Rogers in the *Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band* (SLPB-005-17) to bid on specific frequency assignments in an innovative new way to optimise the outcome for

<sup>16</sup> TELUS estimates primarily extrapolated from the CRTC's Communications Monitoring Report 2017: <http://crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2017/index.htm>

operators and by extension all Canadians. TELUS believes that these principles should be applied to the upcoming frequency assignment processes in all bands as we discuss in response to Question 1.

30. As important as 600 MHz spectrum is to Canada, it is not associated with Canada's early entry into 5G. The band in the U.S. and Canada is going through a coordinated transition plan and while some markets in Canada will be clear in 2020 or 2021, the transition is not scheduled to end, all going well, until January 2022. TELUS recommends that Department resources be focused on the auctioning of 3500 MHz and mmWave spectrum ahead of 600 MHz spectrum. If the Department auctions one band before the next Federal election in the fall of 2019, it should be the 3500 MHz band.

### **800 MHz repacking**

31. Another priority band for TELUS in particular is the 3GPP Band 26 portion of the 800 MHz band. Canada needs to modernise the 800 MHz band by dividing it into a 3GPP Band 26 (mobile broadband) portion and a Public Safety / legacy narrowband portion to align with the U.S. band plan. This involves a relocation of narrowband users but supports their sustained operation while increasing the efficiency of the band's use overall. A repacking is needed to allow Sprint to use its mobile broadband spectrum within<sup>17</sup> 100 km along the U.S - Canada border. If both the U.S and Canada were to use all or most of the 3GPP Band 26 portion of the 800 MHz band for mobile broadband, not only would Canada reap the efficiency gains associated with moving to the latest air interface protocols, but the massive 140 km wide cross border sharing zones required for high power narrowband land mobile radio would no longer be needed for the broadband portion of the band<sup>18</sup>, resulting in a further doubling of the efficiency of the spectrum covering roughly 80% of the Canadian population.

---

<sup>17</sup> Despite holding licences for up to 7+7 MHz in much of the Canada-U.S. border region, TELUS understands that Sprint continues to be constrained by narrowband operations in Canada Primary spectrum, particularly due to protection requirements for ongoing Public Safety operations in 821-824 / 866-869 MHz.

<sup>18</sup> Similar to other commercial mobile (broadband) bands which operate with relatively low power spectral density and require lower signal to noise plus interference ratio (as compared to narrowband, which may require 20 dB of SINR), a mutually agreeable PFD limit could be applied for coordination which would enable deployment right up to the border.



## Release of additional spectrum

32. Beyond the bands listed above, TELUS makes its recommendations in response to Questions 19 and 20 on the priority of release of additional spectrum for commercial mobile and flexible use applications. A summary of these priorities and TELUS' rationale is listed below in Table 3.

**Table 3: TELUS' recommendations for the release of additional commercial mobile and/or flexible use spectrum**

Band	Priority of Release	Rationale
<b>3500 MHz</b>	Very High	Critical for ubiquitous urban/suburban 5G
<b>28 GHz &amp; 37/38 GHz</b>	Very High	Key for hotspot / campus 5G; complementary to 3500 MHz
<b>600 MHz</b>	High	Key for rural 5G, but the OTA TV transition will delay access for launch, release in 2020+
<b>800 MHz (Band 26)</b>	High	Ready to use ecosystem with devices already in market / More efficient air interface / Elimination of sharing zone impairments / Required to resolve border issues for Sprint
<b>24.25-27.5 GHz</b>	High	WRC-19 band with possible IMT identification Europe pioneer band, FCC designated for terrestrial flexible use
<b>45.5-50.2 GHz</b>	High	WRC-19 band with possible IMT identification 47.2-48.2 designated for terrestrial flexible use in U.S.
<b>L-Band 1427-1518 MHz</b>	Medium-High	Developing ecosystems in EU + Asia for LTE/NR. Promising potential for mid-band TDD spectrum
<b>32 GHz 31.8-33.4 GHz</b>	Medium-High	WRC-19 band with possible IMT identification U.S. deferred a decision but regional support almost everywhere else
<b>AWS-2 (PCS H-Block)</b>	Medium	3GPP standards support deployment on its own or in combination with AWS-3 unpaired uplink
<b>AWS-3 unpaired</b>	Medium	Supported by 3GPP Band 70 standard in combination with PCS H-Block
<b>40-42.5 GHz</b>	Medium	WRC-19 band with possible IMT identification Core satellite in U.S. but regional support almost everywhere else
<b>42.5-43.5 GHz</b>	Medium	WRC-19 band with possible IMT identification (Overlooked in Outlook Consultation?)
<b>51 GHz 50.4-52.6 GHz</b>	Medium	WRC-19 band with possible IMT identification
<b>71-76 GHz</b>	Medium	WRC-19 band with possible IMT identification
<b>81-86 GHz</b>	Medium	WRC-19 band with possible IMT identification

33. With respect to Licence Exempt (LE) spectrum, TELUS notes that mobile offload is not a matter of choice for mobile operators, it is a matter of necessity despite LE spectrum only

offering best-effort service which cannot match the quality of service delivered over exclusively licensed spectrum. While both licensed and LE spectrum serve a purpose in supporting Canadian wireless connectivity, TELUS notes a disparity highlighting the urgency of allocating more licensed commercial mobile spectrum (with 0.648 GHz allocated to date as compared to ~8 GHz of spectrum allocated to LE). Canada is not in a position to create major LE ecosystems on its own; therefore, TELUS supports the adoption of LE regulations that leverage ecosystem developments in other jurisdictions.

### **Innovation in licensing**

34. TELUS has provided in its response to Question 1 how innovation in the licensing process can be exploited to: (i) accelerate the release process to address the backlog of bands, (ii) streamline the frequency assignment process to get better outcomes, (iii) provide reliable access to data to better manage service co-existence, (iv) incent facilities based competition through the rationalisation of overlapping roaming COLs and (v) improve in the long term the efficient use of FDD spectrum in Canada.
35. The detail behind TELUS' recommendations and TELUS' comments in response to various questions raised by the Department follow in the main body of this document.

## TELUS' Comments on Specific Questions Posed by ISED

### A Principled Approach to Releasing Spectrum

#### Q1: Changes to Licensing Regime to Enable Innovation

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

36. TELUS would like to see the Department ensure that it consider, with the help of industry, the following opportunities for commercial mobile licensing innovation.

#### **Pace of spectrum release**

37. The pace of change of technology development continues to accelerate, driving new demands for services that in turn require new spectrum releases. With some exceptions, the cadence of Canada's public consultation process and spectrum release plan has historically worked well; however, with the pace at which these spectrum releases are required rapidly accelerating, the Department should consider ways to fast track their processes for spectrum release (while balancing against the need for adequate stakeholder consultation).
38. One area where TELUS recommends that the Department review as a solution to increase the pace of spectrum releases is the auction process. The Department has at least two bands from the 2013 Spectrum Outlook which must be auctioned (3500 MHz, 600 MHz), and there are two mmWave bands to auction (28 GHz, 37-40 GHz). The Department need not auction each and every band via its own auction. Multi-band auction(s) would speed up the time to release all these bands that are in heavy demand. TELUS notes that the Department has auctioned residual spectrum on a multi-band basis as well as the joint auction of FWA and WCS spectrum in 2004, 2005 and 2009.

## **Frequency assignment innovation**

39. Self-contiguity has been a part of every licensing framework released in the past 10 years but almost every major carrier is in some form of network sharing arrangement<sup>19</sup>. Frequency assignments and the ability to express one's preference for one's spectral neighbours for future optionality is not an insignificant factor in Canada's objective to reap the most effective use of its scarce spectrum. This subject is on the record as part of the 600 MHz licensing framework consultation and TELUS trusts that the Department will succeed in delivering auction functionality and processes that solve the noted issues in frequency assignment. The same issues will arise in future spectrum auctions and need to be addressed.
40. New 3GPP bands span wide ranges and equipment and devices are coming to support these wide bands. A phased release of a spectrum band does not have to constrain the efficient end to end assignment of frequencies. A frequency assignment innovation that TELUS recommends the Department implement relates to TELUS' proposal to give all carriers an opportunity to acquire 3500 MHz spectrum by mid-2019 and work to find 400+ MHz of contiguous spectrum, enabling four 100 MHz blocks as part of a Phase 2 process. In this case TELUS would recommend the Department issue temporary frequency assignments through Phase 1 and then conduct a full reassignment of Phase 1 and 2 spectrum in the Phase 2 auction.

## **Service coexistence**

41. As the RABC has noted in its submission, with the trend of looking to share bands between services gaining traction, there is likely to be an increased need to coordinate with other operators. There is a completeness issue with the ISED database whereby some operators are delinquent in registering site data, or where the submitted data is incomplete or inaccurate. A complete data set is needed to efficiently manage coordination issues; TELUS recommends that the Department review the site registration process to ensure the accuracy and timeliness of data submissions as well as the integrity of the database overall.

---

<sup>19</sup> Including Bell, Rogers, SaskTel, TELUS and Videotron

42. TELUS notes that beyond the accuracy and validity of site registration data comes the challenge of scale. As the number of licensed bands increases and mmWave deployments drive further network densification, the number of spectrum licences and sites registered in ISEDs database will grow accordingly. Even with today's relatively limited data set, TELUS regularly encounters challenges with accessing data in the Spectrum Management System (SMS), either due to timeouts for large queries or caps on the size of output data sets. TELUS recommends that the Department reassess the scalability of its existing systems to accommodate the order of magnitude growth for site data and spectrum licences that it anticipates within the Outlook timeframe.

### **Roaming**

43. The current mandatory roaming condition of licence (COL) needs to be reconsidered in totality, with a view to potential abolishment. The benefits of competitive market forces can only be obtained when licensees have their fullest incentives to invest in their own networks. This in turn spurs the spread of the innovative new technologies and applications that ISED seeks. Mandatory roaming counteracts all of these benefits by allowing licensees to delay or defer investment in their own wireless networks and instead, rely on the coverage of others. Wireless licensees should act to deploy their spectrum and networks across their licensed areas, rather than picking and choosing those areas for which they will build versus those where they will roam.
44. Furthermore, the underlying policy of mandated roaming is to give “new” competitors a helping-hand as they develop the financial capability to construct their own networks. There is simply no basis for this type of rationale. The major competitors are represented by the major regional cable companies, all with the financial wherewithal to build their own networks. In addition, they have all been providing wireless services for many years, so they no longer need the benefit of mandated roaming as they build their network coverage. Instead, should they desire the ability to roam, licensees should negotiate those arrangements commercially.

45. As a result, TELUS has asked for a general review and reconsideration of the mandatory roaming COL in totality. In its recent decision on AWS-1 spectrum licence renewals<sup>20</sup>, ISED noted it “may consult in the future to review this condition of licence in the context of all commercial mobile bands.” It indicated that there might be concerns about potential impacts on competition and infrastructure deployment, as well as continued relevance of mandatory roaming. TELUS supports ISED’s acknowledgment of the need for a review of mandatory roaming. TELUS asks that any future review take into account the overarching policy that demands spectrum be put to use and the fact that the CRTC has imposed tariffed roaming, thereby rendering the mandatory COL as potentially redundant and unnecessary.

### **Legacy commercial mobile band rationalisation**

46. In the section above on frequency assignment innovation, TELUS recommends that the Department consider new mechanisms for the assignment of auctioned spectrum to maximise the contiguity of spectrum holdings within a band – including in the case of multi-phased auctions (as TELUS proposes for 3500 MHz). TELUS notes three cases where multi-phased releases have led to non-contiguous spectrum holdings (e.g., the BRS, PCS, and AWS-1/AWS-3 auction processes). These all lead to a less efficient use of spectrum and in most cases, this lack of contiguity leads to additional deployment costs.
47. Beyond the Outlook forecast period, it is likely that the industry will start to plan the refarming of traditional commercial mobile FDD (paired) spectrum for 5G. Subject to future global ecosystem developments, some bands may be suitable for refarming to TDD, which, as described in TELUS’ response to Question 3 will enable the greatest gains from massive MIMO and beamforming technologies. If the mobile industry were to indicate broad support for such a change in band plan, this refarming might also offer an opportunity for the rationalisation of spectrum contiguity within bands.
48. At an appropriate future juncture, if band rationalisation cannot be fully effected in the secondary market, TELUS suggests that the Department may want to consult on how it

---

<sup>20</sup> *Spectrum Licence Renewal Process for Advanced Wireless Services (AWS-1) and Other Spectrum in the 2 GHz Range*, para. 62., Canada Gazette SLPB-001-18, published February 2018. Link: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11367.html>

might best facilitate a process by which non-contiguous spectrum assignments could be rationalised.

## Commercial Mobile Services

### Q2: Demand

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

49. TELUS agrees with the assessment of demand for commercial mobile services in the next few years presented in the Consultation. As noted by the Department in referencing the industry standard Cisco and Ericsson studies, much of the recent historical growth in mobile data consumption can be attributed to the migration from feature phones to “smart devices” and the bandwidth-intensive applications that accompany them. This trend is expected to continue in the coming years as users continue to adopt increasingly bandwidth-intensive usage patterns (i.e., expanded use of streaming video and music services) and also with users making simultaneous connections across multiple devices (e.g., adding tablets, phablets and wearables to smartphone plans).
50. Each of the aforementioned industry forecasts agrees that the expected growth in mobile data over the next 5 years will be exponential in nature; they vary only in the particular growth factor that they predict. However, none of these forecasts is able to capture the drastic step change in data consumption that can accompany the introduction of a transformative technology. But this type of explosive growth is exactly what happened to the mobile industry in 2007, when the introduction of Apple’s iPhone created unprecedented mobile demand (followed shortly thereafter by the “app revolution” one year later with the launch of the App Store).
51. Today, technical standards for 5G mobile and the radio equipment they will enable are both under development. The deployment of this emerging 5G technology will enable applications spanning enhanced mobile broadband (eMBB), massive machine type

communications (mMTC) and ultra-reliable low-latency communication (URLLC) use cases, each of which will pose different technical challenges and creating different demands on the 5G network and the spectrum used to deploy it.

52. TELUS envisions 5G networks acting as a foundation for the next generation digital development of vertical industries such as healthcare, transportation, agriculture, manufacturing, automation and smart cities. Just as the capacity challenges of the mobile data revolution were unexpectedly sparked by the introduction of the iPhone, the emergence of 5G technology will introduce new applications requiring capabilities far beyond what today's 4G LTE and LTE-Advanced mobile networks can provide. It is for this reason that the Department must proactively plan to address demand beyond the forecasts provided by Cisco's VNI study and the like by allocating spectrum for all 5G use cases (i.e., across the 600 MHz, 3500 MHz and mmWave bands) to ensure that commercial mobile 5G networks are able to address the demand created by unforeseen applications that will accompany Canada's 5G future.

### **Q3: New Technology Developments and Usage Trends**

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

53. TELUS is assessing several new technology developments that will help address the challenging use cases posed by 5G: wider TDD channel bandwidths combined with massive MIMO antennas (to address the capacity challenges of eMBB); a new 5G air interface (to address the latency and reliability challenges of URLLC); new advances in narrowband IoT technology (to address the scale challenges of mMTC); and new duplexing techniques to adapt spectrum utilisation to traffic patterns. While each of the technologies described in this section are expected to help address traffic pressures and spectrum demand for commercial mobile services, it is important to recognise that the efficiencies that they enable are linear step changes; in contrast and as described in Question 2, the anticipated increases in demand are exponential.



54. Mobile data rates can be expressed as a product of the channel bandwidth and the spectral efficiency of a deployed technology. Therefore, to address the traffic pressure, both parameters need to be increased, and 5G technology is promising to address both. Channel bandwidths will significantly increase with the initial allocation of mmWave bands along with the completion of a multi-phased expansion of the 3500 MHz band. On the other hand, improved radio technology is necessary to enable wider bands and, more importantly, spectral efficiency.
55. One of the key technologies being introduced in the next generation of cellular technologies is massive MIMO (multiple input multiple output) technology. This technology, in the form of Full Dimension MIMO (FD-MIMO) has already been introduced in 4G LTE technology via different 3GPP releases (Rel-13 supports up to 16 antennas, Rel-14 supports up to 32 antennas) and combines beamforming and multi-user MIMO (MU-MIMO) for increased data rates. However, it is 5G technology being introduced in Rel-15 that will unleash the full potential of massive MIMO gains because the system has been designed to operate with this technology from day one inherent in 5G-NR radios anticipated in 2019. For example, in addition to having a larger number of transmit and receive elements (beyond 64), massive MIMO technology in 5G will support beamforming for control channels as well as for the data channels (in contrast to 4G LTE, where only the data channel can benefit from beamforming and MU-MIMO gains).
56. The preponderance of bands supporting wider bandwidths (e.g., 3500 MHz and mmWave spectrum) operate in Time-Division Duplex (TDD) mode, which also contributes to increased spectral efficiency. Namely, massive MIMO gains are highest when the basestation “knows” the downlink channel, and since both uplink and downlink operate on the same frequency in TDD mode, by measuring the uplink channel, the basestation can easily determine the downlink channel parameters. Therefore, TDD mode eliminates the need for excessive uplink signalling and improves the accuracy of beamforming when compared to FDD mode. Combining the benefit of TDD mode with massive MIMO is

expected to create significant improvements of up to 3x in average spectral efficiency<sup>21</sup> while increasing downlink coverage.

57. Another technology trend that will enable much higher connection density for massive Machine Type Communication (mMTC) use cases is the development of standards which support much longer battery life (10 years or beyond) and significantly increased coverage (20 dB beyond LTE). A preliminary 3GPP study has shown that connection densities of 1,000,000 connections per km<sup>2</sup> can be achieved easily with today's technologies using less than 2 MHz<sup>22</sup> of spectrum with NB-IoT technology, and using around 3.6 MHz of spectrum using LTE-M technology.
58. The evolution of each of these technologies described above has been taking place over the past few years, but each is expected to reach its full potential (i.e., without legacy technology issues because the features will be incorporated from day one) in achieving significant gains with the introduction of 5G in the 2019/2020 timeframe.
59. Beyond this initial 5G timeframe, 3GPP<sup>23</sup> has studied new duplexing mechanisms that are expected to enhance spectral efficiency and adapt spectrum utilisation to traffic patterns. Flexible duplex allows different transmission directions in FDD mode in either part of a spectrum pairing (using time division multiplexing to prevent self-interference). Introducing duplexing flexibility may provide better performance compared to static downlink/uplink resource partitioning in various deployment scenarios. The main motivation to study flexible duplex comes from the asymmetric downlink and uplink traffic ratios, which vary depending on the type of service as well as over time. Dynamic TDD introduces a similar capability for TDD mode, allowing the uplink and downlink partitioning to dynamically change.

---

<sup>21</sup> A. Ghosh, *Massive MIMO for the New Radio – Overview and Performance*, presented June 2017. Link: <http://www.5gsummit.org/hawaii/docs/slides/Amitava-Ghosh.pdf>

<sup>22</sup> Ericsson, *On 5G mMTC requirement fulfilment, NB-IoT and eMTC connection density*, published April 2017. Link: [http://www.3gpp.org/ftp/TSG\\_RAN/WG1\\_RL1/TSGR1\\_88/Docs/R1-1703865.zip](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_88/Docs/R1-1703865.zip)

<sup>23</sup> 3GPP TR 38.802 V14.2.0, *Study on New Radio Access Technology Physical Layer Aspects*, published September 2017. Link: [http://www.3gpp.org/ftp/Specs/archive/38\\_series/38.802/38802-e20.zip](http://www.3gpp.org/ftp/Specs/archive/38_series/38.802/38802-e20.zip)

#### Q4: Measures to Address Increasing Traffic

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

60. In 2012, TELUS embarked on a path to begin fundamentally changing its network architecture to include small cell densification, advanced traffic management, and to leverage licence-exempt spectrum. Each of these changes was introduced to the network in TELUS' effort to improve capacity in response to increasing traffic and to deliver the best mobile user experience to its subscribers. Since 2012, TELUS has acquired more spectrum to fuel its growth while continuing to find innovative ways of leveraging 'best-effort' unlicensed spectrum.
61. TELUS has also added key features such as carrier aggregation, 4x4 MIMO, 256 QAM, uplink Coordinated Multipoint Transmission (UL-CoMP), a centralised RAN architecture, and advanced load balancing to improve the spectral efficiency of its network. TELUS continually invests in its network to optimise performance; this sustained investment has translated to meaningful spectral efficiency increases since the launch of Release 8 LTE in 2012.
62. The largest pioneering investment in network design that TELUS has undertaken has been the introduction of small cell infrastructure. Since starting in 2015, the number of small cells deployed in TELUS' network has grown exponentially. Traditional macro cell additions still remain a necessary tool to support TELUS' coverage layer; however, over time, macro additions have become a less effective tool for adding capacity. The targeted investment by TELUS in small cells has been instrumental in addressing today's capacity challenges.
63. TELUS has leveraged most of its meaningful options in its effort to address the exponential growth in traffic since it launched LTE in 2012. Despite TELUS' sustained investment in new technologies and new infrastructure, such approaches will not be enough to support the coming growth of mobile data in our ever-growing digital economy.

64. Looking forward, the Canadian mobile industry faces two prominent challenges in the 2018-2022 Outlook timeframe: the forecasted exponential growth of mobile data consumption and the defined requirements for 5G performance<sup>24</sup> (i.e., 100 Mbps of ubiquitous downlink service in dense urban areas). There are a multitude of options available to operators to grow capacity. However, TELUS contends that to build a world-class 5G network, the best way forward is to invest in small cell infrastructure with new radio technologies utilising ultra-wide TDD bands.
65. For future investment in capacity to be economical, indoor and outdoor small cell densification needs to be efficient. Unlike macro site deployment, it can be highly challenging to deploy more than one radio per small cell site. In order to enable Canada's network providers to maximise the benefit of their small cell deployments, TELUS recommends that the Department create licensing frameworks for 3500 MHz and mmWave bands that enable large contiguous bandwidths while avoiding the forced fragmentation of assignments across bands. By designing spectrum policy in this way, the Department will support the deployment of capacity dense radios that can conform to space and power restrictions when siting new poles or street furniture real-estate for small cells, in turn enabling the rollout of 5G service.

## **Licence-Exempt**

### **Q5: Demand**

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

66. In the following, TELUS presents its views on the expected growth in licence-exempt demand from the perspective of a service provider with both wireline and wireless customers.

---

<sup>24</sup> Report ITU-R M.2410-0: Minimum requirements related to technical performance for IMT-2020 radio interface(s), Section 4.3. Published November 2017. Link: <https://www.itu.int/pub/R-REP-M.2410-2017>

67. From the earliest days of wireless access as an endpoint for wired Internet to the now explosive growth in smartphone-driven wireless mobile broadband Internet, the demand for wireless devices as the preferred medium for connectivity is expected to continue to grow significantly. Consumer-grade wired access through DSL and cable Internet leveraging wireless 802.11 technologies to provide access within the home continues to contribute to the growing wireless connectivity market share, but the more significant impact to market share in wireless connectivity has been driven by the explosive growth in smartphone adoption that has accompanied the rich investment in ubiquitous mobile broadband networks.
68. The market categories framing demand begin to blur as consumers increasingly carry around licence-exempt Wi-Fi devices that anchor to their smartphones for connectivity. To further blur the categories, Licensed Assisted Access (or LAA, which combines licensed and unlicensed spectrum together within a single LTE system) radio technology in licence-exempt bands has begun to make its way into smartphones as another means for device connectivity that may underpin the Wi-Fi hotspot connectivity. The growing<sup>25</sup> market for smart wearable devices (driven mainly by the smartwatch) that have traditionally relied on Wi-Fi connectivity are now beginning to more frequently use 4G LTE connectivity instead. Further still, there is momentum in the IoT ecosystem to leverage 3GPP based radio interfaces, whereas licence-exempt was originally anticipated as the first mass market low-cost ecosystem.
69. Licence-exempt devices today belong to one of many categories of wireless devices that are expected to experience growth so long as it provides a differentiated product amongst the emerging technology solutions. No one predicted the popularity of 2.4 GHz Wi-Fi during the early connectivity market development that served portable laptops; however, the market evolved to include many more consumer-friendly devices. With this increasing penetration came the ever increasing expectation for higher speeds and more reliable connectivity with Wi-Fi, in turn leading to product designs which preferred the 5 GHz band

---

<sup>25</sup> IDC Intelligence forecasts shipments of 71 million smartwatches, 116 million fitness bands and basic watches, and 25 million Rest of Wearable. *IDC Media Centre*, December 2017. Link: <https://www.idc.com/getdoc.jsp?containerId=prUS43408517>

while abandoning the less capable 2.4 GHz band (unless for fallback). Already, 2.4 GHz Wi-Fi usage is in decline when compared to 5 GHz Wi-Fi usage as the preferred band for devices as service quality expectations rise. The 5 GHz ecosystem is constantly adapting beyond simply Wi-Fi-based products to include 3GPP based technologies that will similarly impact market expectations for quality of service.

70. From the perspective of a mobile service provider, licence-exempt spectrum is no substitute for the more valuable licensed spectrum that is in high demand. With the growing popularity of smartphone driven data services, demand for licensed spectrum is at risk of rapidly exceeding available supply. At the same time, whereas Wi-Fi congestion was historically not a significant concern, the ubiquity of wireless connectivity today (driven by the adoption of both digital lifestyles and the digital economy) has put pressure on demand for both licensed and licence-exempt spectrum. This pressure applies across a range of applications, but is primarily led by mobile broadband (as demonstrated by the varied and volume of 4G devices today, and in the future with 5G).
71. TELUS agrees with the Department's relative growth projections of Wi-Fi data usage (3x) but asserts that the relative growth of commercial mobile data usage is higher still at 5x. Licence-exempt spectrum may experience congestion at some point in the future, but licensed commercial mobile spectrum will experience congestion before 2022 and with potentially significant impact to the digital economy.
72. Licence-exempt spectrum is important to Canada, but Canada alone cannot pioneer the development of licence-exempt spectrum or the creation of new global ecosystems. TELUS believes that Canada should continue to act in a fast follower role, tracking new trends as both wireless technology and market demand emerge (as supported by Enabling Guideline "F" of the Department's Spectrum Policy Framework for Canada<sup>26</sup>).

---

<sup>26</sup> "Spectrum management practices... should be responsive to changing technology and market place demands." *Spectrum Policy Framework for Canada* (Enabling Guideline "F"), Canada Gazette DGTP-001-07, published June 2007. Link: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08776.html>

## Q6: New Technologies and Sharing Techniques

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

73. Licence-exempt Wi-Fi standardised in the next generation of products (802.11ax) are expected to be more spectrally efficient due to the inclusion of new technologies that include multi-user MIMO (MU-MIMO) both in downlink and uplink directions, multiple access via the introduction of OFDMA (instead of contention-based access), mobility enhancements and 1024 QAM modulation. These new technologies are similar to the technology standardised by LTE and 5G New Radio (5G-NR) and are targeted to improve spectral efficiency by as much as 3x (based on 5G targets).
74. TELUS views more spectrally efficient technology and sharing techniques as one important factor to delaying congestion in licence-exempt bands. More intelligent networks based upon 3GPP network slicing enablers could interwork with both 3GPP and IEEE access interfaces to optimise performance and minimise congestion in licensed and licence-exempt spectrum bands.
75. Licensed Assisted Access (LAA) and NR-Unlicensed (NR-U) are the next evolutions of licence-exempt technologies offering the potential for greater spectral efficiency. In parallel with the spectrum efficiency improvements (beyond LTE) being realised in 5G-NR, a similar path will exist for LAA in its evolution to NR-U, with 3x-6x gains expected once standardisation is finalised.
76. Technologies associated with LAA and NR-U are already beginning to trickle down to IEEE technologies (e.g., 802.11ax enhancements), which will likely help to mitigate near-term congestion. TELUS anticipates wireless technology efficiency along with investment in intelligent networks will diminish licence-exempt congestion sufficiently to not negatively impact TELUS' business plan based on licence-exempt spectrum.

## Q7: Band Evolution and IoT

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

77. Two types of technologies have been developed to serve IoT applications: proprietary technologies that utilise unlicensed spectrum (e.g., LoRaWAN and Sigfox are the best known such solutions), and 3GPP standardised technologies that utilise licensed spectrum. While unlicensed technologies have appeared in the marketplace first, they have had limited success, and parallels to WiMax technology have been drawn<sup>27</sup>. Licensed technologies such as NB-IoT and LTE-M (eMTC), standardised by 3GPP, have been embraced by the operators around the world for many reasons. Some of the key reasons are: quality of service which can only be guaranteed in an interference free environment, easy integration with the cellular network and global ecosystem, a clear path for technology evolution and much higher connection densities achievable via licensed networks. For example, a preliminary 3GPP study has shown that connection densities of 1,000,000 connections per km<sup>2</sup> can be achieved easily with today's technologies using less than 2 MHz<sup>28</sup> of spectrum with NB-IoT technology, and using around 3.6 MHz of spectrum using LTE-M technology.
78. IoT is a service that is currently dominated by licensed spectrum technologies, and future IoT forecasts suggest that the majority of IoT traffic will continue to rely upon licensed spectrum technologies.
79. Currently the unlicensed 915 MHz ISM band is targeted by Sigfox and LoRaWAN technologies as possible low power wide area networks (LPWAN) solutions to serve very low data rates (e.g., less than 100 kbps) and long battery life IoT requirements. The 915 MHz ISM band is the most likely band in which licence-exempt IoT could take hold. IoT in licence-exempt spectrum is forecasted to comprise a small fraction of the global IoT

---

<sup>27</sup> Nokia, *Is Sigfox/LoRa the new WiMAX?*, published October 2015. Link: [https://www.nokia.com/en\\_int/blog/is-sigfoxlor-the-new-wimax](https://www.nokia.com/en_int/blog/is-sigfoxlor-the-new-wimax)

<sup>28</sup> Ericsson, *On 5G mMTC requirement fulfilment, NB-IoT and eMTC connection density*, published April 2017. Link: [http://www.3gpp.org/ftp/TSG\\_RAN/WG1\\_RL1/TSGR1\\_88/Docs/R1-1703865.zip](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_88/Docs/R1-1703865.zip)



market by 2022 (0.6 billion devices or 30%<sup>29</sup> globally), with Canada serving only a small fraction of that global market share.

80. In TELUS' view, licence-exempt spectrum capacity is not materially impacted by IoT. Even if adoption were to exponentially increase, the nature of licence-exempt IoT systems (with their extremely low data rates and infrequent transactions) suggests that their deployment using existing licence-exempt spectrum is quite feasible and within LPWAN, 4G and 5G technology capabilities.

### **Q8: Carrier Grade / Managed Wi-Fi Service Trends**

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

81. Carrier Wi-Fi is the de facto standard for enterprise and small medium businesses; however, that demand may shift as newer technologies and market capabilities arrive in the form of LAA, MulteFire, and the development of 5G end-to-end services. TELUS foresees the 5 GHz band as being the most relevant band for carriers given the availability of wide channels, but today's solutions may not be reflective of how carrier led services will be architected in the future. The potential changing marketplace for carrier grade or managed wireless service alongside the introduction of 5G-NR and licence-exempt mmWave spectrum vastly increases the uncertainty in attempting to predict the impact of carrier grade Wi-Fi on the congestion of existing bands (such as the 5 GHz band).

---

<sup>29</sup> Ericsson Mobility Report, published June 2017. Link: <https://www.ericsson.com/assets/local/mobility-report/documents/2017/ericsson-mobility-report-june-2017.pdf>

## Satellite

### Q9: Demand for MSS / EESS

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

82. TELUS has no comment on the assessment of demand for MSS and earth observation applications at this time.

### Q10: Band-Specific Demand (C, Ku, Ka)

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

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

83. TELUS has no comment on the assessment of demand for FSS/BSS services at this time.

### Q11: New Technology Developments and Usage Trends

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

84. TELUS has no comment on technology developments and usage trends for satellite services at this time.

### Q12: Priority Applications

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

85. TELUS has no comment on the priority of satellite applications at this time.

## Backhaul

### Q13: Demand

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

86. TELUS generally agrees with the Department’s assessment for backhaul in the next five years. However, even though particular bands (such as the Lower 6 GHz, Upper 6 GHz, 11 GHz, 15 GHz, 18 GHz, and 23 GHz bands) are facing congestion in urban and surrounding centres which “may increase in the next five years”, TELUS forecasts that this congestion is manageable in the bands listed above as new radio technology becomes available and is deployed before 2022.
87. In Paragraph 93 of the Consultation, the Department differentiates between remote and rural areas (where wireless microwave solutions are more prevalent for backhaul) and densely populated urban areas (where fibre tends to be the prevalent backhaul solution). TELUS agrees with this characterisation, but suggests that dense urban areas can be further separated into markets with high fibre availability and with low fibre availability. Simultaneously, the introduction of flexible use will further facilitate managing congestion in “high-fibre” and “low-fibre” dense urban markets.
88. TELUS anticipates continued demand for both sub-10 GHz and 10-24 GHz backhaul bands with increasing traditional point-to-point microwave technologies being deployed in the Lower 6 GHz, Upper 6 GHz, 8 GHz, 11 GHz, 15 GHz, 18 GHz and 23 GHz bands. These two frequency ranges for backhaul spectrum are generally serve two different types of areas: the sub-10 GHz frequency bands typically serve sparsely populated rural areas, whereas the 10-24 GHz frequency bands typically serve “low-fibre” dense urban areas.
89. The Department’s *Microwave Licence Application Evaluation Criteria*<sup>30</sup> was released in 2016 to provide general guidance to prospective licensees of microwave links regarding the

---

<sup>30</sup> *Microwave Licence Application Evaluation Criteria*, published November 2016. Link: [http://www.fcsa.ca/Microwave\\_Licence\\_Application\\_Evaluation\\_Criteria.pdf](http://www.fcsa.ca/Microwave_Licence_Application_Evaluation_Criteria.pdf)

technical and policy considerations appearing in Standard Radio Systems Plans (SRSP), Spectrum Policy (SP), and general Radio Systems policy (RP-Gen) documents. Adherence to the guidance summarised therein should greatly improve the operational efficiency across backhaul bands and hence the spectral efficiency of any individual band over time.

90. TELUS forecasts demand in the sub-10 GHz and 10-24 GHz frequency bands being largely satisfied by the introduction of wider contiguous channel allocations with relocation (e.g., two 30 MHz channels would be repacked as one 60 MHz channel and two 40 MHz channel would be repacked as one 80 MHz channel). The reconfiguration of the channels will provide sufficient spectral and operational efficiency within the 2022 timeframe.
91. TELUS agreed that in considering spectrum demand for today's backhaul requirements, the required backhaul for LTE-Advanced can reach up to gigabit speeds. TELUS' analysis indicates that gigabit backhaul speeds are achievable by even modest 60 MHz channel sizes, as long as operators are willing to modernise their infrastructure and leverage mature technologies. By combining techniques such as co-channel dual polarisation (CCDP) antennas, 1024-QAM modulation and cross polarisation interference cancellation (XPIC), a 60 MHz backhaul link could achieve roughly 1030 Mbps at 17 bps/Hz. As new microwave capabilities continue to develop, TELUS expects that data rates approaching 3200 Mbps could be achieved in an 80 MHz channel at 40 bps/Hz using advanced 4096-QAM modulation, 4x4 line-of-sight MIMO, and advanced interference cancellation.
92. TELUS supports the broad adoption of flexible use licensing in mmWave bands (i.e. above 24 GHz), and envisions flexible use licensing to play an important role in addressing backhaul demand. Over time, integrated access and backhaul (IAB) TDD backhaul could serve the vast majority of wireless backhaul and self-backhaul needs in dense urban tier 1 and tier 2 markets. TELUS' response to Question 14 highlights the importance of flexible use technology to improve spectral efficiency and alter the planning for backhaul in urban areas. Such a market shift would diminish the need for dedicated backhaul allocations in dense urban areas. The remaining demand for dedicated wireless backhaul spectrum would be satisfied by legacy backhaul bands that did not necessarily fit a flexible use model or belong to an ecosystem supporting self-backhaul solutions.

93. TELUS notes that there may be an insufficiency of sub-10 GHz backhaul spectrum, but that congestion only applies to some rural areas. TELUS anticipates being able to manage its sub-10 GHz frequency band requirements for backhaul within the Outlook timeframe but expects that more spectrum will certainly be required beyond 2022.

#### **Q14: Landscape for Backhaul – Comparison of Solutions**

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

94. TELUS continues to prioritise fibre optic investment over microwave radio or satellite for connecting our mobile networks. TELUS will continue to invest in fibre as an increasing and fundamental component for both 4G and 5G across a variety of macro and small cell infrastructure. TELUS plans to leverage new radio technology available in mmWave that make use of self-backhaul technologies for extending backhaul to more areas otherwise not economical before and not feasible with the traditional regulatory rules on backhaul specific bands.
95. Traditional backhaul spectrum and radio techniques will persist in TELUS' mobile network for some time; however, continued investment in fibre and new investment in self-backhaul technologies will significantly diminish the need for dedicated backhaul spectrum in modern urban terrestrial data networks.
96. TELUS has considered the use of satellite backhaul only to address extremely remote locations for its mobile network. TELUS has not required satellite backhaul solutions for its 4G network to date and has considered satellite backhaul only for niche rural markets where having basic connectivity outweighs the penalties of higher latency or lower data rates. TELUS does not foresee satellite backhaul as being sufficient to address stringent latency requirements for 5G networks.
97. TELUS foresees the landscape for traditional backhaul to include a steady demand of wireless backhaul spectrum but expects the majority of growth in backhaul demand to be

addressed through the expansion of fibre across many geographies. TELUS believes that the same trend will apply for other modern networks serving different applications.

#### **Q15: New Technology Developments and Usage Trends**

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

98. In its response to Question 13 above, TELUS described some of the recent incremental technology developments which will help enable spectral efficiency improvements in backhaul bands below 24 GHz. TELUS is aware of technology developments which are still in the R&D stage (e.g., full duplex, higher order line-of-sight MIMO, multi-band radios, higher order modulation and advanced interference cancellation) but have not yet been trialled in TELUS' network. At this time, TELUS has no comment on the expected timing for these advanced technologies to become available.

#### **Q16: Impact of Access Traffic on Backhaul Demand**

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

99. TELUS' only need for backhaul spectrum is for access networks; TELUS' response to Questions 13 - 15 are provided in that context.

### Q17: Specific Frequency Ranges for Backhaul

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

100. TELUS has no comment on specific frequency ranges for backhaul that should be considered in new policy at this time.

### Q18: Impact of In-Band Flexible Use on Backhaul

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

101. As described in TELUS' response to Questions 13 and 14 above, TELUS envisions self-backhaul as playing a potentially important role in 5G networks, particularly in the case of mmWave bands.
102. 3GPP is currently in the process of studying<sup>31</sup> Integrated Access and Backhaul (IAB) for 5G-NR (TR 38.874), with the objective of evaluating potential solutions for frequency ranges of up to 100 GHz. Some of the areas that are being explored include: topology management, route selection, dynamic resource allocation between the backhaul and access links and high spectral efficiency. Both in-band and out of band scenarios are being examined in the study, which could have an impact on how the backhaul is planned and used in the future. In order to manage signal blockages of wireless backhaul links, autonomous reconfiguration of the backhaul topology is expected to be supported. This will further change the planning of the backhaul as some portion of the transport network will no longer have static configuration.
103. Implementation of self-backhaul using IAB is not expected to happen immediately. While the preliminary study item emphasises the need to leverage existing Rel-15 NR specifications, it also states that backhaul links will have additional requirements not

---

<sup>31</sup> 3GPP TR 38.874 V0.1.0, *Study on Integrated Access and Backhaul*, published February 2018. Link: [http://ftp.3gpp.org/Specs/archive/38\\_series/38.874/38874-010.zip](http://ftp.3gpp.org/Specs/archive/38_series/38.874/38874-010.zip)

currently addressed in NR standards. One example is that while the base station and phones have different capabilities, the backhaul link end points need to have similar technical radio capabilities that will drive additional technical standards based upon applications in the flexible use licensing framework.

104. The notion of a self-backhaul architecture can only exist in the context of flexible use and would only be implemented successfully with exclusive area licensing that eliminates coexistence scenarios with another terrestrial operator. TELUS asserts that in-band flexible use on backhaul (i.e. self-backhaul) will introduce new urban backhaul planning and design considerations for 5G networks beyond how networks backhaul is designed today.
105. Traditional macro-to-macro site backhaul spectrum planning may likely be impacted by IAB in the coming future once intelligent macro backhaul technologies integrate with self-backhaul in the initial mmWave bands (i.e. high-band backhaul). It is conceivable that when IAB technologies mature, it may be possible to identify spectrum in the 10-24 GHz range that was previously considered unsuitable for flexible use (which could help address the future need for more mid-band 5G spectrum). TELUS recommends that the Department consider the notion of flexible use only in the mmWave bands for now until the 10-24 GHz radio technologies are better understood.

## Potential Bands for Future Release

### Q19: Assessment of Listed Bands

<p><b>Q19</b>— Provide, with rationale, your view of the above assessments on the bands being considered internationally for commercial mobile, fixed, satellite, or licence-exempt.</p>
--

106. TELUS limits the scope of its response to this question to the list of “ongoing and planned spectrum releases” (Table 6 of the Consultation); the bands listed as “potential frequency bands for release between 2018 and 2022” (Table 7 of the Consultation) are addressed in TELUS’ response to Question 20, which asks specifically about consideration of the bands therein.



107. Table 4 below lists the bands presented in the Consultation along with TELUS' views on the priority of release, suggested timing, and a brief description of the rationale behind TELUS' recommendations. (TELUS has omitted the 7 and 9 GHz band, proposed for satellite Earth exploration services, for which it has no comment at this time.)

**Table 4: TELUS' assessment of bands listed in Table 6 of the Outlook Consultation (ordered by decreasing priority)**

Band / Frequency Range	Service/application	Priority of Release (Timing)	Rationale
<b>3500 MHz</b> <b>3400-4200 MHz</b>	Commercial mobile and fixed (flexible use)	Very High (ASAP)	Critical for ubiquitous urban/suburban 5G
<b>28 GHz</b> <b>37/38 GHz</b> <b>27.5-28.35 GHz</b> <b>37-40 GHz</b>	Commercial mobile and fixed (flexible use)	Very High (ASAP or immediately following 3500 MHz)	Key for hotspot / campus 5G; complementary to 3500 MHz
<b>600 MHz</b> <b>614-698 MHz</b>	Commercial mobile	High (2020+)	Key for rural 5G, but the OTA TV transition will delay access for launch
<b>AWS-2 / PCS H-Block</b> <b>1915-1920 / 1995-2000 MHz</b>	Commercial mobile	Medium	3GPP standards support deployment on its own or in combination with AWS-3 unpaired uplink
<b>64-71 GHz</b>	Licence-exempt	Low-Medium (2020+)	Opportunistic offload for urban 5G & other applications; complementary to licensed spectrum
<b>13 GHz</b> <b>12.7-13.25 GHz</b>	Backhaul	Low-Medium	Lower relative priority as compared to commercial mobile bands
<b>32 GHz</b> <b>31.8-33.4 GHz</b>	Backhaul	Opposed to backhaul-only release	Backhaul applications will be enabled by flexible use assuming IMT identification in WRC-19. Avoid encumbering the band a priori.

### **3500 MHz**

108. In TELUS's view, the 3500 MHz band is without question the most important band being addressed in this consultation. In the following section, TELUS provides a rationale behind its recommendations for the Department to enable 5G in the band using a multi-phased

approach. First, the Department must immediately address the incomplete policy treatment of the 175 MHz of the existing “3500 MHz” band (3475-3650 MHz) and create a competitive process to reassign the spectrum to support 5G launch networks. In parallel with this process, the Department must consult on longer-term expansion of the band (targeting at least 400 MHz through a second phase and ideally the full 3400-4200 MHz band in a third phase shortly thereafter) in consideration of the lengthy process required to set appropriate policy in time to meet growing 5G demand and the evolution of enhanced capabilities in the band that will ensure the health of Canada’s 5G future and digital economy.

*3500 MHz is the critical band for enabling ubiquitous 5G*

109. In its responses to last year’s 600 MHz and mmWave band consultations, TELUS submitted comments addressing the importance of the 3500 MHz band as a key enabler for 5G in Canada. Whereas the 28 GHz and 37-40 GHz mmWave bands will enable order of magnitude increases in mobile broadband service capabilities in the densest of urban markets and the 600 MHz band will be critical for enabling rural 5G, the 3500 MHz band will provide the fundamental and ubiquitous coverage overlay that provides 5G enhanced mobile broadband services to the broader urban and suburban landscape.
110. Achieving the peak capabilities of 5G will require pairing newly developed technologies with the right type of spectrum. The 3500 MHz band possesses three characteristics that are unlike today’s commercial mobile spectrum bands, and which qualify it as both suitable and without substitute for the first 5G network deployments:
  - a) TDD spectrum: Unlike most of today’s commercial mobile spectrum bands (and the upcoming 600 MHz spectrum) which are assigned as FDD frequency pairs, the global assignments in the 3500 MHz band (and their support in technology standards) are unpaired TDD, unlocking some of the key 5G technology advances that will drive new eMBB capabilities. In TDD bands, advanced techniques such as multi-user spatial multiplexing and high resolution beamforming are made possible using near-perfect channel knowledge at the base station by exploiting the channel reciprocity characteristic of TDD (where channel estimates made from

uplink pilot symbol transmissions can be transformed into equivalent estimates of the downlink channel).

- b) Wider channel bandwidths: Historically, Canadian frequency assignments have been made in 5 MHz or 10 MHz blocks; it was only recently in the 2015 BRS (2500 MHz) auction that multiple operators were able to secure channels supporting 20 MHz of contiguous bandwidth. While LTE carrier aggregation (CA) technology has helped operators “stitch together” sets of non-contiguous spectrum across multiple bands, such technologies come with financial and performance costs, as well as increased system and implementation complexity. In contrast, the 3500 MHz band holds the potential to create contiguous channel bandwidths of 50-100 MHz and beyond, enabling new enhanced mobile broadband capabilities in its deployment for 5G.
- c) Higher-frequency / shorter wavelength: Mid-band<sup>32</sup> spectrum such as 3500 MHz (with its shorter wavelength compared to other commercial mobile bands in use today) will enable massive MIMO (multiple-input / multiple-output) gains. Today’s LTE radios already support the use of 8T8R antenna arrays (e.g., 8 transmit and 8 receive paths) and the first generation of 5G-NR (New Radio) technology is expected to support 64T64R. While even larger antenna arrays will be feasible in mmWave bands, the propagation characteristics of 3500 MHz provide the ideal compromise between enabling the promised gains of massive MIMO while not sacrificing geographic coverage due to limited propagation.

111. As noted in Paragraph 140 of the Consultation, much of the technical groundwork to enable the 3500 MHz band for 5G has already been established. Whereas previous standardisation efforts at 3GPP have focused on defining multiple LTE band classes to address frequency assignments in different jurisdictions (with Band 42 covering 3400-3600 MHz and Band 43 covering 3600-3800 MHz as the global bands, and Band 48 covering 3550-3700 MHz for the yet-to-be-proven CBRS flavour of LTE in the United States), the 5G NR standards

---

<sup>32</sup> Whereas 3500 MHz spectrum would have previously been considered *high-band* spectrum, the introduction of mmWave bands above 24 GHz have led to three new informal classifications for spectrum being considered for mobile use: *low-band* (below 1 GHz), *mid-band* (between 1 GHz and 24 GHz, but with current assignments only in the sub-6 GHz range), and *high-band* (above 24 GHz).

development efforts are intended to lead towards the establishment of a single globally unified ecosystem. As such, Band n77 has been defined to cover the entirety of the 3300-4200 MHz range; the additional definition of Band n78 (comprising the 3300-3800 MHz subset of n77) is mainly to enable early 5G deployment, as the reduced frequency range will primarily facilitate more efficient power amplifier designs and simpler antenna implementation<sup>33</sup> due to its relative bandwidth percentage being closer to that of existing technology at this early stage of radio development. These bands in the 3500 MHz frequency range are viewed as the lead bands for 5G NR, garnering the support at 3GPP from operators across Asia, Europe, Australia and North America for both NR connectivity and for deployment in combination with existing LTE networks.

*Canada's wireless leadership at risk if we do not move quickly on 3500 MHz*

112. In its response to last year's mmWave band consultation, TELUS also submitted the following comments detailing the criticality of 5G network deployment to fostering economic growth and innovation:

*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.*

113. As described in the previous section, the use of mid-band large block TDD spectrum assignments (like 3500 MHz) will extend the reach of 5G technologies, benefitting Canadians who are beyond the reach of mmWave networks whose deployments are only economic within the densest urban areas. The 3500 MHz band is critical to providing

---

<sup>33</sup> GTI Sub-6 GHz 5G Device Whitepaper, published November 2017. Link: <http://www.gtigroup.org/Resources/rep/2017-11-10/11513.html>

ubiquitous 5G connectivity to Canadians across who live in population centres across the country.

114. Canadian operators have continually demonstrated repeated and sustained leadership in delivering best-in-class wireless networks to Canadians everywhere; as a result, Canada has been a world leader for the past two consecutive years in delivering 4G LTE speed (ahead of all other G8 countries). If further delays are incurred in making decisions to complete the repurposing, liberation and reassignment of the 3500 MHz band, Canada will be at risk of losing this leadership position.
115. The 3500 MHz band's importance was confirmed as an outcome of the International Telecommunication Union's (ITU) World Radiocommunication Conference in November 2015 (WRC-15), where global IMT identifications were created in the 3300-3400 MHz, 3400-3600 MHz, and 3600-3700 MHz frequency ranges (with adoption of particular ranges varying by region). Consequently, countries across all regions have begun planning for release of the spectrum, with auctions either planned for 2018 (or in a few cases, auctions have already been completed). Some highlights include:
  - The European Commission's designation of the 3400-3800 MHz frequency range as Europe's primary 5G spectrum band. An auction of 350 MHz (3410-3435 and 3475-3800 MHz) was already completed in Ireland in May 2017, an auction of 300 MHz in Switzerland (3500-3800 MHz) is planned for H2 2018, and the UK has finalised its policy (bringing rules into Regulations in late January 2018) for the auction of 150 MHz (3410-3480 and 3500-3580 MHz) as early as this year, and has begun consultation on the 3600-3800 MHz band.
  - The Republic of Korea plans to auction 300 MHz (3400-3700 MHz) in June 2018
  - Australia plans to auction 125 MHz of repurposed spectrum in the 3575-3700 MHz range in October 2018
  - Many other countries not listed above already have public consultations well underway and have openly supported trial assignments of spectrum across different portions of the 3500 MHz band

116. If the Department does not act quickly on issuing a detailed consultation followed by rapid decisions on the treatment of the 3500 MHz band, Canada will be at risk of falling behind the rest of the world and potentially losing the well-established wireless leadership position which serves as a pillar for our digital economy.

*Historical fixed licensing should not determine Canada's 5G future*

117. While the definition of a new flexible use band plan and a technical, policy and licensing framework are necessary to complete the repurposing of the existing 175 MHz of “3500 MHz” band spectrum (as specified in the Department’s 2014 Decision), it remains clear<sup>34</sup> from that Decision paper that such a repurposing of the band constitutes a fundamental reallocation of the spectrum. It is a particularly significant reallocation given the importance of the band for 5G mobile. As such, the Department must ensure that there are no structural disadvantages created in the clawback and auctioning of 3500 MHz spectrum for flexible use. All mobile operators must have the ability to fully participate from the beginning in this critical band in Canada to create meaningful competition in 5G services. There is no justification for FWA licensees to reap a massive mobile windfall. The lion’s share of the 5.86 billion MHz-pops of fixed only FWA spectrum was purchased in a short auction in 2004 for 11.2 million dollars. It was largely left fallow for a decade and as documented<sup>35</sup> by the Department in its *Consultation on Renewal Process for 2300 MHz and 3500 MHz Licences* in 2012. The licensees have petitioned for two separate deployment requirements extensions. The Department must liberate and reassign this spectrum in a competitive process that provides all interested parties with a fair opportunity to bid on this crucial band which will provide the urban/suburban coverage layer for Canadian 5G launch networks.

*To move quickly, focus on existing 175 MHz in Phase 1; 400+ MHz in Phase 2*

118. For Canada to repurpose the entire 3400-4200 MHz frequency range would take some time, with domestic and international considerations across multiple services requiring new

---

<sup>34</sup> “A co-primary allocation to the mobile service in the 3500 MHz band will be added to the *Canadian Table of Frequency Allocations*. This modification constitutes a fundamental reallocation of the 3500 MHz band.” *Decisions Regarding Policy Changes in the 3500 MHz Band (3475-3650 MHz) and a New Licensing Process*, Paragraph 25, Canada Gazette DGSO-007-14, published December 2014.

<sup>35</sup> In July 2011, Industry Canada had requested an update on the status of deployment from all licensees; 98% of licences in the 2300 MHz band and 75% of licences in the 3500 MHz band were not deployed.

policy for the coordination and coexistence with or displacement of a wide variety of existing incumbent operations. While an ideal outcome for the Canadian mobile industry would be to address the entire band in the near-term, TELUS suggests that a multi-phased approach would be far more feasible.

119. Canada can take advantage of the outcomes of WRC-15 and leverage the existing Region 2 IMT identification and frequency arrangement in the 3400-3700 MHz frequency range to build upon the international treaties for the band to determine domestic rules for its use for 5G mobile. TELUS viewed the decisions made in the Department's 2014 Decision on the 3475-3650 MHz band as a good step forward (in that Canada's domestic allocations are already prepared to support mobile use of the band), but suggests further steps to address the immediate repurposing of this frequency range which are essential in keeping pace with the developed countries listed above, thereby enabling 5G for the majority of Canadian citizens before 2020. Concurrent with the planning of this first phase, a more measured approach can be taken to considering expansion of the 3500 MHz band (potentially downwards to 3300 MHz or upwards to 4200 MHz) to ensure that Canada's 5G capabilities are able to grow in parallel with increasing 5G demand.
120. **Phase 1:** While long-term expansion which maximises large contiguous assignments in the 3500 MHz band (e.g., with channel bandwidths of 100 MHz or greater available to each operator) is necessary to maximise its 5G capabilities, the Department must first and foremost ensure that sufficient spectrum is available to support early 5G network deployments. The Department must complete the fundamental reallocation of the existing 175 MHz in the "3500 MHz" band (3475-3650 MHz) by defining a flexible use band plan and a licensing framework for flexible use in the band. The existing operations of rural WISPs will not constrain near term 5G rollouts and should be permitted to continue operating as-is until the application of the final transition policy.
121. In considering TELUS' proposed Phase 1 of repurposing the 3500 MHz band to support 5G, it is important to consider whether there is merit in the band plan being pursued in the United States – the Citizen's Broadband Radio Service (CBRS) band in the 3550-3700 MHz range. The Canadian mobile industry has historically made strong arguments in favour of

aligning both band plans and technical rules with the United States, as Canada tends to benefit from the economies of scale provided by U.S. product development, and border coordination efforts tend to be simplified when band plans are aligned.

122. The CBRS band was developed in the U.S. as the result of a July 2012 report by the President's Council of Advisors on Science and Technology (PCAST)<sup>36</sup>. There, in recognition of the vast amounts of underutilised Federal spectrum, the Council made several recommendations for Federal incumbents to share spectrum with commercial mobile services. One outcome of this recommendation was the three-tiered sharing framework of the 3500 MHz CBRS band.
123. In light of the fact that development of the CBRS band began early, with consultations (Notices of Proposed Rulemaking or NPRMs, in the language of the FCC) and the eventual policy and licensing frameworks (Reports and Orders) being developed and released during the December 2012 – May 2016 timeframe, it is clear that 5G was not a consideration in their design. For example, the original CBRS Report and Order originally proposed a limitation for priority access licensees (PAL) grants of 30 MHz, although this was changed after much furor and protestation from the mobile industry to 40 MHz (however, it remains that only 70 MHz of the 3550-3650 MHz portion of the band will be assigned for PALs). Additionally, the CBRS band comes with highly specific restrictions on emitted power, out of band emissions, and is accompanied by geographic limitations necessary to protect U.S. Federal incumbent radiolocation systems; the combination of these technical rules make the band highly U.S.-specific and inherently incompatible with the 3GPP ecosystems (Band n77/n78) described above as being developed for 5G-NR. These unique characteristics of the CBRS band make it ill-suited for supporting 5G – both inappropriate for an initial network launch but also not supportive of a multi-phased repurposing approach. While the inertia of the regulatory processes in the U.S. likely prevented the overturning of the framework which was five years in the making to enable the band for 5G, the FCC itself in

---

<sup>36</sup>President's Council of Advisors on Science and Technology, *Report to the President: Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth*, published July 2012. Link: [https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/pcast\\_spectrum\\_report\\_final\\_july\\_20\\_2012.pdf](https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf)



its October 2017 NPRM<sup>37</sup> has itself recognised that the CBRS band is not fully suitable for 5G. As such, the FCC has reopened consultation on a band whose rules were already finalised (and whose standardisation is nearly complete), seeking industry input on modifications to out of band emissions that might support wider bandwidths. TELUS does not believe that these changes, if accepted, would sufficiently address the fundamental limitations as described above – both having an insufficient amount of PAL spectrum to support 5G competition in the band, and maintaining requirements for the protection of incumbent radiolocation operations which seem unlikely to be compatible with Band n77/n78 specifications.

124. Clearly, there is no reason why Canada should encumber the 3500 MHz band with a regulatory framework that was conceived long before the global importance of this band for 5G was clear, and whose rules remain to be determined in light of the U.S. administration's own admission of its incompatibility with 5G requirements. In light of these concerns and the incomplete overlap of the CBRS band with Canada's existing 3500 MHz band (3475-3650 MHz) that TELUS proposes for Phase 1 repurposing, TELUS advocates strongly against any further consideration of the CBRS framework.
125. **Phase 2:** With an initial allotment of 5G spectrum being made available to support Canadian 5G networks in Phase 1, there will be some additional time to effect the expansion of the band. TELUS recommends that through Phase 2, the Department aspire to release at least 400 MHz of contiguous spectrum such that a target block size of 100 MHz (the largest contiguous bandwidth currently supported by the 3GPP 5G New Radio specification for bands below 6 GHz)<sup>38</sup> can enable competition between four operators per region. Where this contiguous 400+ MHz of spectrum should fall in the overall 3GPP band n77 (3300 – 4200 MHz) would be based on the various issues to overcome in displacing or coexisting with incumbent licensees in the name of the larger Canadian agenda for 5G. In order to address this second phase of expansion, the Department will need to consult upon and

---

<sup>37</sup> *Promoting Investment in the 3550-3700 MHz Band*, FCC 17-134 / GN Docket No. 17-258, published October 24, 2017. Link: [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-17-134A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-17-134A1.pdf)

<sup>38</sup> 3GPP TS 38.101-1 V15.0.0, *NR User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone*, published December 2017. Link: [http://www.3gpp.org/ftp/Specs/archive/38\\_series/38.101-1/38101-1-f00.zip](http://www.3gpp.org/ftp/Specs/archive/38_series/38.101-1/38101-1-f00.zip)

determine appropriate policy for coexistence with or the displacement of domestic and international radiolocation (radar) systems below 3475 MHz, non-exclusively licensed systems in the Wireless Broadband Service (WBS) in the 3650-3700 MHz frequency range, and C-band satellite systems in the 3700-4200 MHz frequency range. Canada could potentially leverage policy developments from the U.S. (where the FCC, in light of the concerns described above about the CBRS band, is currently considering the 3700-4200 MHz frequency range for 5G in its Mid-Band Notice of Inquiry<sup>39</sup>) as well as from discussions or decisions leading up to WRC-23, assuming the 3700-4200 MHz band is included in its agenda.

126. **Phase 3:** Subsequent to these first two proposed phases, TELUS recommends that the Department further consult on maximising the longer-term expansion of the band (ideally targeting the full 3400-4200 MHz frequency range) in possible alignment with developments under consideration in the U.S. and other nations.
127. In consideration of the lengthy process anticipated to make the significant policy changes proposed through Phases 2 and 3, TELUS recommends that the Department include questions on its proposed band expansion in a Phase 1 consultation (as suggested in the Outlook consultation, where the Department states that it will “include a review of 3400-4200 MHz”). In proactively addressing future expansion at this early stage, the Department will ensure that Canada’s 3500 MHz band is able to meet growing 5G demand and the evolution of enhanced capabilities in the band that will ensure the health of Canada’s 5G future and digital economy.

*Ensure contiguity across phased release via reassignment process*

128. While TELUS strongly believes that the criticality of the 3500 MHz band to near-term 5G network deployments justifies an early (Phase 1) repurposing of the 175 MHz currently assigned as FWA spectrum, TELUS recognises that a phased approach to repurposing the band would likely lead to, after two or more phases, operators having a non-contiguous assignment among their spectrum holdings, leading to inefficiencies in deployment and

---

<sup>39</sup> *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, FCC 17-104 / GN Docket No. 17-183, published August 3, 2017. Link: [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-17-104A1\\_Rcd.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-17-104A1_Rcd.pdf)

reduced spectral efficiency. TELUS proposes the following special measures be prescribed before any licensing process to ensure the contiguity of an operator's spectrum holdings across phases.

129. First and foremost, TELUS proposes that licensees bidding on spectrum in the Phase 1 (175 MHz) assignment of the 3500 MHz band be given clear expectations that while their licence duration may extend across multiple phases of the repurposing of the band, assignments would be temporary and limited to the duration of Phase 1. On these Phase 1 licences, TELUS recommends that the Department include a condition of licence which specifies the temporary nature of the frequency range. When additional spectrum release takes place in the band, all licences could once again be made generic, with new specific licences being issued following a competitive assignment round process which guarantees contiguity for all spectrum holdings (existing and incremental) issued to each operator. A licensee could opt out of bidding in such an assignment round process and would still be guaranteed contiguity of its own holdings, but would still be subject to a new frequency assignment.
130. TELUS' proposed reassignment process would be especially critical for Phase 2, which should enable contiguous 100 MHz blocks for each operator.

#### *Summary of recommendations for 3500 MHz*

131. In TELUS' view, the Department must act immediately on repurposing the existing 175 MHz of FWA spectrum in order to enable the 3500 MHz band in the near-term to support 5G deployments in Canada. This begins with the Department resuming where it left off over three years ago with its 2014 decision, when it took the first steps to enable mobile use in the band, but stopped short of taking the requisite four steps which would complete the process:
  - i. Determine a flexible use band plan for the 175 MHz of spectrum in the 3475-3650 MHz frequency range
  - ii. Define a clawback policy for licences currently assigned for fixed service (FWA spectrum) in the band
  - iii. Determine a licensing framework for the auction of 3500 MHz flexible use spectrum

- iv. Conduct an auction of the liberated and unassigned spectrum by mid-2019 to support Canada's sustained wireless leadership with 5G network deployments in 2020.
132. In parallel with addressing the four steps of Phase 1, the Department should consider a second and third phase, aspiring to exceed 400 MHz of flexible use spectrum being made available in the 3500 MHz band through Phase 2 and ideally targeting the full 3400-4200 MHz frequency range through Phase 3.
133. TELUS therefore calls for the Department to immediately issue a consultation (i.e., following the reply comment deadline for this Spectrum Outlook consultation), making a rapid decision and moving forward on the Phase 1 repurposing of the 3500 MHz band to enable Canada's early mover opportunity for 5G in the band while consulting on its longer-term expansion.

#### **28 GHz & 37-40 GHz**

134. As TELUS describes above in its executive summary and summary of recommendations, mmWave releases are needed as soon as possible to enable Canada's 5G leadership and are a close second to 3500 MHz in terms of urgency for 5G. In its response to the Department's June 2017 mmWave consultation<sup>40</sup>, TELUS indicated its strong support for the release of licensed mmWave spectrum in the 28 GHz and 37-40 GHz bands. In its comments, TELUS addressed several policy issues in these mmWave bands including:
- Introducing flexible use for 5G in the 28 GHz and 37-40 GHz bands
  - Enabling large channel bandwidths (400+ MHz), avoiding fragmentation and not forcing inefficient assignments across both licensed mmWave bands
  - As necessary, displacing legacy fixed-service licensees to ensure that legacy operations do not constrain 5G flexible use deployments

---

<sup>40</sup> *Consultation on Releasing Millimetre Wave Spectrum to Support 5G*, Canada Gazette SLPB-001-17, published June 2017. Link: <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11298.html>

- Defining effective geographic restriction policies to achieve coexistence between 5G flexible use deployments and a small number of satellite earth stations that lives up to the proposed CTFA footnotes C47C and C51 stating “*Fixed-satellite service implementation in this band will be limited to applications which will pose minimal constraints upon the deployment of fixed and mobile service systems, such as a small number of large antennas for feeder links*”.

135. TELUS refers the reader to its public mmWave consultation comments<sup>41</sup> for its detailed proposals.

### 600 MHz

136. As TELUS noted in its summary of recommendations, 600 MHz spectrum will, in the medium term, provide the critical ubiquitous low latency urban / rural overlay for 5G. However, because of its limited available bandwidths, its large wavelengths which do not easily support massive MIMO and its FDD configuration which does not enable efficient beamforming, 600 MHz spectrum on its own will not deliver the 5G enhanced mobile broadband (eMBB) experience. The 600 MHz band will be key in enabling 5G massive machine type communications (mMTC) and ultra-reliable low-latency communications (URLLC) while remaining a critical band for rural and urban mobile broadband coverage.
137. In its response to *Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band* (SLPB-005-17), TELUS offered its extensive input including on the auction timing, the assignment phase but most extensively on the supposedly “pro-competitive” measures proposed by the Department.
138. TELUS is confident that with the robust consultation process and the evidence put on the record that ISED must conclude that a blanket 43% set aside is not justifiable given the distribution of low band holdings among the set-aside-ineligible operators.

---

<sup>41</sup> TELUS’ *Comments for the Consultation on Releasing Millimetre Wave Spectrum to Support 5G*, submitted September 2017. Link: [https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapi/SLPB-001-17-comments-received-TELUS.PDF/\\$FILE/SLPB-001-17-comments-received-TELUS.PDF](https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapi/SLPB-001-17-comments-received-TELUS.PDF/$FILE/SLPB-001-17-comments-received-TELUS.PDF)

139. We have shown above in our summary of recommendations that the proposed rules grossly overprovision regional operators with low band spectrum while exacerbating TELUS' disproportionately under provisioned state with respect to low band spectrum. TELUS is underprovisioned as a function of TELUS' history as the original new entrant<sup>42</sup>, whereby TELUS only holds Cellular 850 MHz spectrum in BC, Alberta and part of Eastern Quebec and had the same opportunity as the regional operators to acquire 700 MHz spectrum in 2014.
140. The rules also relegate almost half the band in rural markets to the warehouses of regional providers to sit fallow for 20 years. TELUS is strongly opposed to a large direct set aside of rural 600 MHz spectrum to the regional challengers who are urban / suburban focused and have limited wireline and wireless network facilities in rural and remote markets. TELUS recommends the splitting of each of the 14 Tier-2 licence areas into a rural and an urban sub licence and removing the set aside provision in the rural portion of each licence area (i.e., in the 111 of 172 Tier 4 service areas without a population centre over 30,000).
141. We have shown in our summary of recommendations how Shaw and TELUS, both challenger brands in the important Southern Ontario retail market, would fare drastically differently there under the proposed 600 MHz auction rules. Shaw would have low band spectrum there that was utilised at about 20% of the industry average and TELUS' low band spectrum would be utilised at almost three times the industry average. This would be unsustainable. The proposed auction design is very problematic and needs to be changed.
142. The Government should amend its 600 MHz low-band spectrum policy. There should be at most a 20 MHz set aside in urban areas. The amount of spectrum set aside for urban areas should be reduced in size from 30 MHz to at most 20 MHz to enable a fairer distribution of spectrum to best serve Canadians and to ensure innovative 5G applications and growth markets are not foreclosed from national operators who have a longstanding track record of investing in Canadian innovation.

---

<sup>42</sup> Paragraph 53 of TELUS' *Reply Comments to the Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band*, submitted November 2017. Link: [https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SLPB-005-17-reply-comments-Telus.pdf/\\$file/SLPB-005-17-reply-comments-Telus.pdf](https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SLPB-005-17-reply-comments-Telus.pdf/$file/SLPB-005-17-reply-comments-Telus.pdf)

143. There should be no set aside in rural areas. Canadians living in rural areas would be best served through the elimination of the set-aside in rural Canada and the acceleration of rural deployment requirements to ensure that operators who bid on rural spectrum have every intention of deploying it in the near term and utilising it to its fullest potential.
144. As important as 600 MHz spectrum is to Canada, it is not associated with Canada's early entry into 5G. The band in the U.S. and Canada is going through a coordinated transition plan and while some markets in Canada will be clear in 2020 or 2021, the transition is not scheduled to end, all going well, until January 2022. TELUS recommends that Department resources be focused on the auctioning of 3500 MHz and mmWave spectrum ahead of 600 MHz spectrum. If the Department auctions one band before the next Federal election in the fall of 2019, it should be the 3500 MHz band.
145. TELUS has supported the proposals by Rogers in response to the *Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band* (SLPB-005-17) to bid on specific frequency assignments in an innovative new way to optimise the outcome for operators and by extension all Canadians. TELUS believes that these principles are applicable to the upcoming frequency assignment processes in all bands. We discuss this further in our response to Question 1.

## **AWS-2 / PCS-H**

146. TELUS has previously filed comments on the AWS-2 (PCS H-Block) in response to both the Department's consultation on AWS-4<sup>43</sup> spectrum and also its publication of a TerreStar request<sup>44</sup> for the grant of a nationwide (Tier 1) spectrum licence in the AWS-3 unpaired (1695-1710 MHz) and PCS H-Block (1910-1915 / 1995-2000 MHz) blocks.

---

<sup>43</sup> *Consultation on a Policy, Technical and Licensing Framework for Use of the Bands 2000-2020 MHz and 2180-2200 MHz*, Canada Gazette SMSE-011-14, published May 2014. Link: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10817.html>

<sup>44</sup> *Notice of Application Received from TerreStar Solutions Inc. for a Tier 1 Spectrum Licence in the 1695-1710 MHz Frequency Band and in the PCS Block H (1910-1915 / 1995-2000 MHz)*, published May 2017. Link: <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11297.html>

147. In each of these submissions, TELUS expressed concerns regarding the harmonisation of AWS-2 (PCS H-Block) technical standards with those of the U.S., and also expressed interest in the release of the PCS H-Block as commercial mobile spectrum (noting TELUS' adjacent spectrum holdings in the PCS-G Block in most of Canada). TELUS notes that in the December 2014 AWS-4 decision<sup>45</sup>, the Department indicated that its own "technical analysis demonstrates that the satellite protection criteria would not be exceeded under the adopted rules governing out-of-band emissions, which are harmonized with U.S. technical rules." If the Department addresses the PCS H-Block in consultation for commercial mobile release, TELUS recommends that the Department address these technical rules, and proposes to confirm that no additional protection obligations will be required by PCS H-Block licensees on MSS licensees in the adjacent 2000-2020 MHz spectrum.
148. TELUS previously illustrated that the PCS H-Block could be deployed in carrier aggregation with other bands or in combination with the AWS-3 unpaired uplink as supported by Band 70 3GPP standardisation.
149. For these reasons, TELUS repeats its recommendation for the Department to release the PCS H-Block under a competitive licensing process (following consultation on a licensing framework and confirmation of the appropriate technical rules).

#### **64-71 GHz**

150. TELUS indicated support for licence-exempt use of the 64-71 GHz bands in its response to the Department's June 2017 mmWave consultation, recognising that harmonisation with the U.S. would be highly beneficial in enabling early innovation in 5G unlicensed technologies.

#### **13 GHz**

151. TELUS considers the 13 GHz band to be a low to medium priority for release, but has no further comment at this time.

---

<sup>45</sup> *Decision on a Policy, Technical and Licensing Framework for Mobile Satellite Service and Advanced Wireless Service (AWS-4) in the Bands 2000-2020 MHz and 2180-2200 MHz*, Canada Gazette SLPB-008-14, published December 2014. Link: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10899.html>



## 32 GHz

152. In the Consultation, the Department refers to the 32 GHz band (31.8-33.4 GHz) as a band which was identified for two-way backhaul in its December 2014 Backhaul Decision<sup>46</sup> -- a decision which followed a consultation process which was initiated in December 2012 when flexible use for 5G could not have been conceived.
153. TELUS notes that despite this band first being addressed in the Backhaul Consultation more than five years ago, technical standards for the use of the band and for the certification of radios that would operate in the band have not yet been defined. Consequently, there is no use of the band in Canada today. This “clean slate” creates an ideal position for the 32 GHz band – a candidate for IMT identification under WRC-19 Agenda Item 1.13 which possesses strong regional support from many other countries – as a potential flexible use band.
154. As such, TELUS opposes the use of this band for two-way backhaul only in the fixed service, and recommends that its disposition be deferred so that it may be kept unencumbered and available for a future flexible use assignment if it is identified for IMT band at WRC-19 as TELUS would support.

## Q20: Services/Applications, Timing and Priority of Listed Bands

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

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

Provide supporting rationale for your responses.

155. Table 5 below lists the bands in the order presented in the Consultation (i.e., increasing in frequency) along with TELUS’ views on the priority of release and a brief description of the rationale behind TELUS’ recommendations.

---

<sup>46</sup> *Decisions on Spectrum Utilization Policies and Technical Requirements Related to Backhaul*, Canada Gazette SMSE-022-14, published: December 2014. Link: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10880.html>

**Table 5: TELUS' assessment of bands listed in Table 7 of the Outlook Consultation (ordered by ascending frequency)**

<b>Band / Frequency Range</b>	<b>Service/application</b>	<b>Priority of Release for Commercial Mobile / Flexible Use</b>	<b>Rationale for Commercial Mobile / Flexible Use</b>
<b>800 MHz (Band 26)</b>  <b>814-824 / 859-869 MHz</b>	Commercial mobile	High (Consult ASAP)	Ready to use ecosystem with devices already in market More efficient air interface Elimination of sharing zone impairments Required to resolve border issues for Sprint
<b>900 MHz</b>  <b>896-960 MHz</b>	Commercial mobile Fixed Licence-exempt	Low	No ecosystem, encumbered by ISM
<b>L-Band</b>  <b>1427-1518 MHz</b>	Commercial mobile Fixed	Medium-High	Developing ecosystems in EU + Asia for LTE/NR. Promising potential for mid-band TDD spectrum
<b>AWS-3 unpaired</b>  <b>1695-1710 MHz</b>	Commercial mobile Fixed	Medium	Supported by 3GPP Band 70 standard in combination with PCS H-Block
<b>24.25-27.5 GHz</b>	Commercial mobile Fixed Licence-exempt	High	WRC-19 band with possible IMT identification Europe pioneer band, FCC designated for terrestrial flexible use
<b>32 GHz</b>  <b>31.8-33.4 GHz</b>	Commercial mobile Fixed	Medium-High	WRC-19 band with possible IMT identification U.S. deferred a decision but significant regional support almost everywhere else
<b>40-42.5 GHz</b>	Commercial mobile Fixed Satellite	Medium	WRC-19 band with possible IMT identification Core satellite in U.S. but significant regional support almost everywhere else
<b>45.5-50.2 GHz</b>	Commercial mobile Fixed Satellite	High	WRC-19 band with possible IMT identification 47.2-48.2 designated for terrestrial flexible use in U.S.
<b>51 GHz</b>  <b>50.4-52.6 GHz</b>	Commercial mobile Fixed Satellite	Medium	WRC-19 band with possible IMT identification
<b>71-76 GHz</b>	Fixed Commercial mobile Licence-exempt	Medium	WRC-19 band with possible IMT identification
<b>81-86 GHz</b>	Fixed Commercial mobile Licence-exempt	Medium	WRC-19 band with possible IMT identification
<b>Bands above 95 GHz</b>	Licence-exempt Fixed	Low	Technology development expected beyond forecast period

## 800 MHz

*800 MHz has been authorised for mobile service since 1995*

156. 800 MHz spectrum has been authorised for commercial mobile service in Canada (and the U.S.) since 1995<sup>47</sup> and played a unique role in Canadian 2G commercial mobile innovation<sup>48</sup>. iDEN (integrated digital enhanced network) technology from Motorola brought dispatch radio functionality to the cell phone and operators like TELUS successfully transitioned this technology to the consumer market with the very popular MiKE service and the colourful ruggedised phones. TELUS' commercial mobile use of the ESMR band since the mid-1990s represents more than 60% of the licensing in the band. Public Safety agencies as a whole have been the next largest stakeholder.

*Broadband use brings economic and social benefit*

157. Commercial mobile narrowband systems (due to a restrictive channelisation standard) have become less relevant with the demand shift to mobile broadband over the last decade. Commercial mobile broadband service over the 3GPP Band 26 subset of the 800 MHz band (814-824/859-869 MHz) was authorised<sup>49</sup> in 2012 in the U.S. as a natural extension of the Cellular band. Allowing broadband use in Canada would not only increase the economic and social benefit realised by the Band 26 portion of the 800 MHz band, but it is required to address the incompatibility between the use of the sub-band in the U.S. – Canada border regions affecting millions of Canadians and Americans.
158. Repacking narrowband channels to enable broadband service is not only a better and more efficient use of a scarce resource, but introducing commercial mobile broadband service in the U.S. – Canada border regions would also eliminate the need for the vast inefficient cross border sharing zones in the Band 26 sub band. This would have the effect, as compared to today's use, of doubling the amount of 800 MHz spectrum available to about 80% of the

---

<sup>47</sup> RP-014, *Radio Systems Policies RP-003 and RP-005 Relevant to the Level of Usage of Mobile Systems and Also the Definition of a Cellular Mobile Radio Service as Originally Set Out in October, 1982*, Canada Gazette DGTP-009-95, August 1995.

<sup>48</sup> The 800 MHz band is allocated for mobile use in Canada, the US and the rest of the Americas, and the Band 26 subset has been repacked for broadband in the US and other parts of the Americas

<sup>49</sup> *Improving Spectrum Efficiency Through Flexible Channel Spacing and Bandwidth Utilization for Economic Area-based 800 MHz Specialized Mobile Radio Licensees*, FCC 12-55, May 24, 2012.

Canadian population in the most highly populated regions of Canada (with almost all major urban centres falling within the Sharing Zones along the border)<sup>50</sup>.

*Repacking is feasible*

159. TELUS notes that there is a trend of narrowband 800 MHz incumbents beginning to transition away from narrowband 800 MHz systems to much larger and well supported band platforms such as 700 MHz and 400 MHz. The transition is largely led by critical public safety agencies (though not exclusively) with requirements for interoperability with U.S. public safety agencies. Nationally, the RCMP<sup>51</sup> and Canadian Border Security Agency (CBSA) are prime examples, but even EMS agencies that rely on local coordination with these agencies are transitioning to compatible non-ESMR platforms. There will remain narrowband ESMR incumbents, such as municipalities, that will persist with legacy systems due to funding gaps and/or limited near term need for mobile broadband and interoperability, but these remaining incumbents can be accommodated within the 806-813.5 / 851-858.5 MHz sub-band.
160. TELUS has completed successful Band 26 technical trials using various LTE system bandwidths (1.4, 5 and 10 MHz) in a number of geographic regions (Windsor, ON; Whistler, Kelowna and Kamloops, BC; and Devon, AB). In these trials, TELUS has demonstrated the successful coexistence of LTE broadband with narrowband land mobile radio (LMR) systems. Available mobile broadband equipment aligned with FCC technical requirements provides further assurance to ISED that a transition of the 800 MHz band to a legacy sub-band adjacent to a new Band 26 mobile broadband sub-band is feasible today and would not compromise the operations of adjacent legacy narrowband 800 MHz incumbents.

---

<sup>50</sup> Arrangement F defines Sharing Zones which extend 100 km into both Canada and the US along most of the shared border, and 140 km into British Columbia. These Sharing Zones capture roughly 80% of the Canadian population.

<sup>51</sup> While TELUS understands that the RCMP has migrated many of their systems to the 700 MHz band, it is aware that the RCMP intends to re-enter the 800 MHz band for the deployment of Digital Vehicular Repeaters.

*U.S. paved the way and now needs Canada to align*

161. Initiating changes in spectrum policy in the 800 MHz band is necessary to address the misalignment between the Canadian and U.S. band plans. In 2017, the transition out of the Band 26 portion of the 800 MHz band of legacy U.S. narrowband licensees in the U.S. – Canada border regions was completed. As of 2017, the state of the Band 26 portion of the 800 MHz band in Canada is limiting Sprint’s ability to deploy Band 26 LTE service with 100 kilometres of the Canadian border, affecting a very large population.

*Several key stakeholders concur*

162. Key stakeholders concur on the long-term goal of a band repacking including the RCMP, CACP, Ontario Public Safety, CECA (Motorola, Harris, SureCall, Ericsson, Nokia) and TELUS. However, there is also general agreement that the repacking will be challenging and costly and it is unclear where the funding will come from.

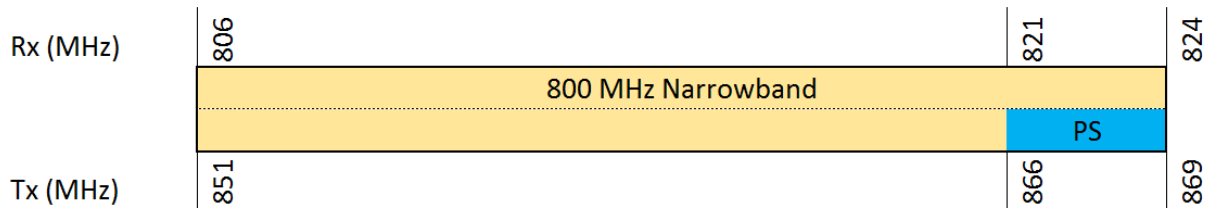
*Summary of recommendations for 800 MHz*

163. TELUS agrees with the Department when it states, “Given that there is an available commercial mobile ecosystem and a reduced demand for commercial narrowband wireless systems, ISED believes that it would be beneficial to review this band for potential commercial mobile services in the next five years. Additionally, harmonizing this band would ease cross-border coordination, interoperability, economies of scale and roaming between countries.”
164. Specifically, TELUS recommends, just as the RABC has, that ISED conduct a review of the 800 MHz band to support the introduction of mobile broadband in one portion of the band while ensuring its coexistence with legacy narrowband applications including Public Safety, public works, and commercial users in another portion of the band. Such coexistence could be enabled by re-channeling or replacing incumbent systems that require continued narrowband operations to the 806 - 814 / 851 - 859 MHz portion of the band. Commercial mobile broadband services could then be introduced in the 814 - 824 / 859 - 869 MHz portion of the band (as part of 3GPP Band 26), and appropriate technical rules including the definition of a guard band (e.g., potentially in 813.5-814 / 858.5-859 MHz) and out of band emissions requirements could be introduced in the technical framework portion of a

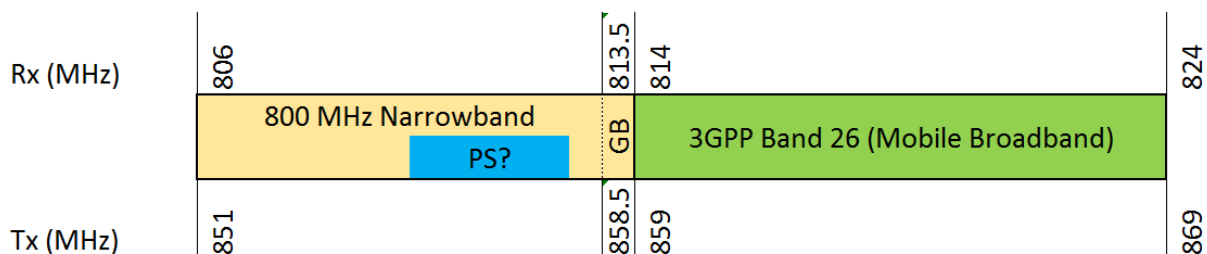
repacking consultation in order to ensure the protection of narrowband operations in the lower sub-band. This would allow U.S. and Canadian jurisdictions to align border agreements for commercial mobile broadband, public safety and other narrowband applications, as well as avoiding the creation of new international issues (such as those that have arisen in the BRS band where the incongruous band plans between Canada and the U.S. are resulting in the impairment of the BRS spectrum of Canadian operators in Canada's top markets). An illustration of the existing 800 MHz band plan and TELUS' proposed band plan (illustrating 3GPP Band 26) is provided below for reference.

**Figure 2: 800 MHz Band Plan (Current & Proposed)**

Current



Proposed



165. Relocating PS users out of the 821-824 / 866-869 MHz sub-band is expected to be costly and operationally complicated. In order to avoid introducing additional complications, TELUS recommends that ISED put a moratorium on new licensing in the full 800 MHz band for all but key new public safety applicants that cannot be addressed via other assignments (e.g., in 700 MHz narrowband spectrum). In such cases, TELUS recommends that ISED assign channels in the 806-813.5 / 851-858.5 MHz sub-band to new Public Safety systems or to systems that are being upgraded or expanded. If 806-813.5 / 851-858.5 MHz spectrum is not available and assignments within Band 26 are proposed, ISED should advise the applicants that their channel assignments may change in the future.

166. TELUS further recommends that ISSED open a consultation on a Band 26 transition to allow all stakeholders to provide input on how best to effect a transition to enable mobile broadband in the 800 MHz band.

**mmWave bands addressed in WRC-19 Agenda Item 1.13**

167. In Table 5 above, TELUS has assigned different priorities for the release of the seven mmWave bands above 24 GHz which are being addressed in Agenda Item 1.13 at WRC-19, but for the most part, does not specify the potential timing for such releases. This is primarily due to the high level of uncertainty regarding regulatory outcomes in each of these bands. One thing is clear, however: the release of these mmWave bands is certainly a lower priority than the release of 3500 MHz, 28 GHz and 37-40 GHz spectrum in supporting Canada's Innovation Agenda and enabling the near-term deployment of 5G terrestrial networks.
168. TELUS notes that due to the potential global importance of any band being identified for IMT at WRC-19, all of the mmWave bands being treated under Agenda Item 1.13 are of at least medium priority by the simple virtue of their inclusion in that process. In the following paragraphs, TELUS provides its rationale behind the relative priorities specified above for three bands with higher priority for consideration and release.

*24.25-27.5 GHz*

169. TELUS believes that the 24.25-27.5 GHz band should be considered as a high priority for release within the Spectrum Outlook's proposed 2018-2022 timeframe, due to a common interest in establishing the band (in part or in whole) for 5G across multiple jurisdictions.
170. In addition to being assessed for possible IMT identification at WRC-19, the FCC has determined<sup>52</sup> in its second mmWave Report & Order that the 24.25-24.45 GHz and 24.75-25.25 GHz portions of the band will be designated for what the FCC refers to as the Upper

---

<sup>52</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, FCC-17-152 / GN Docket No. 14-177, published November 22, 2017. Link: [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-17-152A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-17-152A1.pdf)

Microwave Flexible Use Service (UMFUS); i.e., flexible use licensing for fixed or mobile applications.

171. Additionally, in its November 2016 study on spectrum suitability for 5G, the European Commission's Radio Spectrum Policy Group (RSPG) recommended<sup>53</sup> the 24.25-27.5 GHz frequency range as its 5G pioneer band in the mmWave range.
172. TELUS notes that portions of the 24.25-27.5 GHz band will require similar considerations regarding the treatment of legacy fixed service licensees as are being addressed in the 37-40 GHz band. Consistent with its position on the 37-40 GHz band, TELUS recommends that such legacy operations at term be permitted to continue operating on a secondary (no interference / no protection) basis until displaced by flexible use licensees deploying 5G networks.

### *32 GHz*

173. In TELUS' response to Question 19 above, TELUS suggests that the 32 GHz band should be preserved in an unencumbered state and not assigned for two-way backhaul (as is suggested by the Department). This recommendation is primarily driven by the near-global support described above spanning all ITU Regions.
174. In proposals to the ITU-R Task Group 5/1 (TG5/1), strong multi-regional support was offered for prioritisation of this band in the Task Group's studies on the coexistence of IMT with existing services in the mmWave bands. Supporting parties included the EU (CEPT), Korea, Japan, and Russian Federation (RCC). Additionally, the U.S. has previously indicated interest in this band by consulting upon it in the Further Notice of Proposed Rulemaking on Spectrum Bands above 24 GHz, but deferred addressing the band in its decision (perhaps awaiting further developments at WRC-19). TELUS suggests that for these reasons, the priority for consideration of the 32 GHz band (31.8-33.4 GHz) is slightly

---

<sup>53</sup> European Commission Radio Spectrum Policy Group, *Strategic Roadmap Towards 5G for Europe: Opinion on spectrum related aspects for next-generation wireless systems (5G)*, published November 2016. Link: [http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion\\_5G.pdf](http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf)



higher than for the remainder of the WRC-19 Agenda Item 1.13 bands listed below (i.e., other than the high priority 24.25-27.5 GHz band).

#### *45.5-50.2 GHz*

175. TELUS views the 45.5-50.2 GHz band as being of high priority in its release, primarily due to the FCC's determination in the same Second mmWave Report & Order that the 47.2-48.2 frequency range will be designated for flexible use. While there does not appear to be as much international support for this band as for the 24.25-27.5 GHz band, its early introduction in the U.S. context suggests that it may support earlier ecosystem developments than those which might arise following the formal WRC-19 process for IMT identification.

#### *71-76 and 81-86 GHz*

176. In TELUS' view, the 71-76 bands and 81-86 GHz bands merit similar treatment to the 32 GHz band. Canada has progressed further in standardising these two bands than in the case of the 32 GHz band, with the Department's May 2017 publication<sup>54</sup> of SRSP-371.0 defining technical rules for the implementation and coordination of their deployment with both paired (FDD) and unpaired (TDD) configurations in different portions of the bands. However, with licensing currently remaining under an interim site-specific process, the band is very lightly used (primarily for R&D and trial applications).
177. As in the case of the 32 GHz band, the U.S. did not make a determination to allow mobile use (under UMFUS rules) in these bands in its recent rulemaking<sup>55</sup>; however, the FCC did suggest that it would "reserve the right to revisit this issue as mobile use deploys in other millimeter wave bands, technology develops, and as further thought is given to mobile/fixed coexistence." Given their potential for IMT identification, TELUS recommends that the Department maintain the option to allocate these bands for mobile use by preserving their unencumbered state.

---

<sup>54</sup> SRSP-371.0 — Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Bands 71-76 GHz and 81-86 GHz, Canada Gazette SMSE-008-17, published May 2017. Link: <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11217.html>

<sup>55</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, FCC-17-152 / GN Docket No. 14-177, published November 22, 2017. Link: [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-17-152A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-17-152A1.pdf)

### **L-Band (1427-1518 MHz)**

178. TELUS notes (as did the Department in the Consultation) both the global IMT identification of portions of the band and the ongoing 3GPP standardisation efforts to define LTE band plans in a number of regional variations (including TDD, FDD and supplemental downlink). TELUS further notes that beyond the existing 3GPP LTE band plans, more recent standardisation efforts are developing the band for 5G-NR in both FDD (Band n74) and TDD (Bands n50/n51) configurations. Given the potential opportunity to allocate mid-band spectrum for commercial mobile applications, TELUS suggests that the release of L-Band spectrum is of medium to high priority (relative to the other bands addressed in Table 5).

### **AWS-3 Unpaired (1695-1710 MHz)**

179. TELUS views the release of AWS-3 unpaired spectrum as medium priority relative to the other bands addressed in Table 5.
180. In its response to Question 19 above, TELUS commented on the linkage between this spectrum and the AWS-2 / PCS H-Block spectrum. Specifically, when the PCS H-Block spectrum and AWS-3 unpaired uplink spectrum are combined, they can be used under the 3GPP Band 70 standard as paired spectrum or in combination with other bands via carrier aggregation.
181. For this reason, TELUS repeats its recommendation requesting that the Department release the AWS-3 unpaired uplink block under a competitive licensing process (following consultation on a licensing framework and confirmation of the appropriate technical rules).

### **Bands above 95 GHz**

182. TELUS is aware of international developments taking place to study channel arrangements in these bands for backhaul (e.g., the W band in 92-114.25 GHz<sup>56</sup> and the D band in 130-

---

<sup>56</sup> ECC Recommendation and ECC Report containing guidelines on deployment of fixed services operating in the allocated in the bands 92 – 94 GHz, 94.1 – 95 GHz, 95 – 100 GHz, 102 – 109.5 GHz and 111.8 – 114.25 GHz., Link: [http://eccwp.cept.org/WI\\_Detail.aspx?wiid=534](http://eccwp.cept.org/WI_Detail.aspx?wiid=534)

174.8 GHz<sup>57</sup>), as well as the inclusion of study of the 275-450 GHz frequency range for the fixed service in the WRC-19 Agenda Item 1.15. That said, TELUS does not envision these regulatory studies leading to the development or deployment of radios within the 2018-2022 timeframe that this Spectrum Outlook addresses; therefore, TELUS does not have any specific comments, other than to say that the priority of releasing frequency bands above 95 GHz (beyond the purposes of experimental/trial licences) is low.

#### **900 MHz**

183. TELUS welcomes the Department's suggestion to review the 900 MHz band in consultation on potential new uses but has no specific comment at this time.

#### **Q21: Other Bands for Consideration**

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

184. TELUS notes that in preparing Table 7 of the Consultation, the Department seems to have overlooked the inclusion of the 42.5-43.5 GHz band (which was included in Table 5 of the Consultation, referring to Agenda item 1.13) for possible commercial mobile service applications. TELUS views this band as medium priority for release along with the other WRC-19 bands with possible IMT identifications.
185. TELUS in its recommendations above has emphasised the importance of allocating mid-band TDD spectrum in the 3500 MHz band to support 5G. In the Department's proposals for spectrum under consideration for commercial mobile applications, there is ample mmWave spectrum, but relatively little mid-band TDD spectrum. TELUS recommends that the Department look beyond the 3400-4200 MHz band to identify potential mid-band

---

<sup>57</sup> ECC Recommendation and ECC Report containing guidelines on deployment of fixed services operating in the allocated bands 130 – 134 GHz, 141 – 148.5 GHz, 151.5 – 164 GHz and 167 – 174.8 GHz, Link: [http://eccwp.cept.org/WI\\_Detail.aspx?wiid=537](http://eccwp.cept.org/WI_Detail.aspx?wiid=537)

spectrum to consider for commercial mobile or flexible use release, with specific recommendations:

- Extending the 3500 MHz band downwards (i.e., to 3300 MHz)
- Addressing the two bands considered in the FCC's Mid-Band NoI (5925-6425 MHz & 6425-7125 MHz)
- The 4400-5000 MHz band (addressed in Japan and China)

186. Beyond these specific recommendations, TELUS encourages the Department to consider any other bands in the 6-24 GHz mid-band range which could support flexible use allocations.

## **Q22: Application-Specific Frequency Ranges / Bands**

<b>Q22</b> — Are there specific frequency ranges/spectrum bands that should be made available for specific applications?
--

187. TELUS notes that within commercial mobile allocations, spectrum licensing policy has historically tended to be technology neutral and not specific to any particular use-case. TELUS supports the continued licensing of commercial mobile spectrum which is not application-specific.
188. TELUS recognises that there are instances where certain mobile bands (but not commercial mobile bands) have been made available for specific applications, including public safety applications. For example, dedicated short range communications (DSRC) technologies are the only permitted application within the 5.9 GHz ITS band. When such application-specific licensing is created, TELUS recommends that the Department should consider periodic review of the band and its use to ensure that licensing reflects the current best use of the band as supported by available technologies.

### **Q23: Factors Impacting Release of Specified Bands**

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

189. TELUS has highlighted the factors that would impact the potential release of commercial mobile spectrum in its response to the foregoing questions.

\* \* \* \* \*

End of document