CANADA GAZETTE NOTICE NO. SLPB-006-17

CONSULTATION
ON THE SPECTRUM OUTLOOK 2018 TO 2022

PUBLISHED IN THE *CANADA GAZETTE, PART I*
ON 21 OCTOBER 2017

COMMENTS
OF
BELL MOBILITY INC.

16 FEBRUARY 2018

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1.0 INTRODUCTION

1. In accordance with the procedure set out by Innovation, Science and Economic Development Canada (the Department or ISED), in Notice No. SLPB-006-17, *Consultation on the Spectrum Outlook 2018 to 2022* (the Consultation), dated 6 October 2017, Bell Mobility (Bell) is pleased to present its Comments on the overall approach and planning activities related to the release of spectrum for commercial mobile services, licence-exempt applications, satellite services and wireless backhaul services over the next five years.

2. We support the release of additional spectrum over the next five years, and generally accept the Department's proposed allocations. While technological advancements will help to increase network capacity and reduce congestion on existing bands, they will not be sufficient to meet anticipated demand for commercial mobile services. Further, new applications and services will emerge which will require user data speeds that can only be achieved with additional spectrum.

3. Demand for commercial mobile services will vastly outpace all other services in the coming years, and the Department's greatest priority should be allocating licensed spectrum for flexible fixed and mobile use. While Licence-Exempt spectrum may see some growth in demand, we believe that for the most part, any low band spectrum (below 6 GHz) that is released should be exclusively reserved for licensed use. Sufficient high band spectrum exists to support all future Licence-Exempt spectrum demand.

4. Given the anticipated decline in satellite use of the C-band and advances in spectral efficiency for satellite technology, we recommend that the Department consolidate all satellite users into the top portion of the C-band in order to allow flexible (fixed and mobile use) to expand into the lower portion of the band. This would result in the more efficient use of C-band spectrum.

5. We strongly recommend that newly released spectrum above 3400 MHz is made available in blocks of 100 MHz or larger whenever it is technically possible to increase spectral efficiency, thereby increasing the overall utilization of this scarce resource. This approach will ensure that there are sufficient spectrum resources available to meet future wireless demand growth and support the development of Canada's digital economy.

6. The spectrum proposed for release in this Consultation should be licensed via open auction in accordance with the current licensing regime, and using the flexible use licensing approach. Untested technologies such as dynamic access spectrum sharing are not yet viable, and we urge the Department not to introduce such changes into the licensing regime at this time.

7. Finally, we actively participated in the development of the comments submitted to the Department by the Radio Advisory Board of Canada (RABC) on the Consultation. We generally support those comments with the exception of two areas. First, we take exception to the RABC's statement that dynamic spectrum access technology "shows great possibility".[1] With respect to dynamic access, it is uncertain whether the use of these techniques, outside of the multi-operator core network sharing approach, could support the requirements of future high-reliability public broadband services. Second, with respect to the Board's statement that "demand for C-band FSS is expected to remain relatively constant over the next five years"[2], we are of the view that these comments are not consistent with the references provided by the Department in the Consultation.[3] We believe that C-band is currently underutilized and we continue to support the Department's proposal to consider how C-band can be used in the future for other services.

2.0 OVERALL DEMAND FOR DATA

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?

8. Canadians rely heavily on wireless applications on a day-to-day basis. As the Department has recognized, the growing reliance on wireless technologies and the introduction of innovative services are driving demand for ever-increasing amounts of data, which translates into a greater demand for spectrum. Canadian consumers, businesses, and public institutions must continue to benefit from the latest wireless telecommunications services. Keeping pace with this increasing demand requires timely access to additional spectrum. The release of additional spectrum over the course of the next five years (2018-2022) will allow commercial

1 RABC, Comments, paragraph 19.
2 RABC, Comments, paragraph 44.
3 See the Northern Sky Research (NSR) *Global Satellite Supply and Demand Study, 13th Edition* and the CRTC's *2014 Satellite Inquiry Report*, cited in the Consultation at paragraph 75.

mobile service providers to substantially increase network capacity to meet the anticipated unprecedented traffic demands of the future. This will also put Canada at the forefront of advancements in commercial mobile networks by facilitating the rapid deployment of next-generation wireless technologies such as 5G.

9. The Department's current licensing regime continues to meet the needs of Canadians and we believe it should remain largely intact. Below we elaborate on some elements of the licensing regime where we have specific recommendations.

Open Auctions

10. Open auctions are the cornerstone of the current spectrum licensing policy as it relates to commercial mobile spectrum and we support the Department's continued commitment to assigning licences through auctions. As recognized in the *Framework for Spectrum Auctions in Canada*, auctions are a fair and efficient method of allocating resources.[4] Regional providers have secured both low-band (700 MHz) and higher-band spectrum (AWS-1, AWS-3 and 2500 MHz) so any policy objectives in this regard have been achieved. It is appropriate for the Department to return to a regulatory approach that has a greater reliance on market forces. Doing so would be consistent with guidelines (a) and (d) of the Department's *Spectrum Policy Framework for Canada*. These guidelines state that market forces should be relied upon to the maximum extent feasible, and regulatory measures, where required, should be minimally intrusive, efficient and effective, respectively.[5] Market forces, in short, will ensure that those willing and able to put the spectrum to its best use will bid for and acquire spectrum.

Flexible Use

11. We support the use of flexible licensing as a way for the Department to achieve one of its stated objectives; namely to: "allow new 5G technologies and innovations to evolve without overly prescriptive requirements".[6] The flexible use approach should be used for all bands contemplated for release in this Consultation. Historically, bands above 2 GHz were licenced for fixed use because the technology was not capable of supporting the fast changing radio

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4 *Framework for Spectrum Auctions in Canada*, March 2011, page 7.

5 Industry Canada, *Spectrum Policy Framework for Canada*, June 2007, page 9, available at http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08776.html#s44.

6 The Consultation, paragraph 21.

frequency (RF) environment in a form factor that was both compact and economical enough to support mobile applications. In addition, the primary use of this spectrum was for point-to-point applications that were thought to be inconsistent with mobile use. This is changing, however, and spectrum bands once thought to be useful for only fixed services can now support mobile applications as well.

12. In addition, bands currently reserved for mobile applications are seeing advancements in radio technology that will support much higher spectral efficiencies, such as multiple input/multiple output (MIMO) techniques in antennas, greater adoption of small cell technology, and LTE-A features such as Carrier Aggregation supporting Gigabit speeds. As a result, mobile bands will soon be able to accommodate the traffic load associated with fixed Internet applications and services.

13. Therefore, it is no longer appropriate to restrict certain spectrum bands for fixed-only or mobile-only applications. All bands should be able to support both, and the licencing regime should enable both use cases. Permitting existing licensees to offer both fixed and mobile services today will accelerate technical and service innovation. Such an approach will ensure that spectrum users are able to quickly respond and adapt to market dynamics and technological advancements.

Licence Areas

14. We recommend that the Department reject calls to use licence areas more granular than Tier 4, and we generally support licensing on a Tier 1 to Tier 3 basis. The current approach has successfully allowed wireless carriers to extend high quality service to more than 99% of all Canadians. It also allows market forces to govern network rollouts and investments while facilitating deployment and minimizing co-ordination requirements with other operators.

Opportunistic and Dynamic Access

15. Commercial mobile operators will continue to depend on dedicated licenced spectrum to develop their networks. Dedicated licenced spectrum allows operators to easily expand and evolve wireless networks as required, and is the best way to stimulate investment and maintain a high level of service quality. Therefore, we urge the Department to exercise caution when

exploring spectrum sharing through opportunistic or dynamic spectrum access and other database-type tools.

16. Much of the research supporting cognitive radio and dynamic spectrum access was completed over ten years ago in an academic setting and the solutions that have been proposed have not been proven for use with commercial networks. Further, the fundamental assumptions may be outdated. Cognitive radio, for instance, proposes to use underutilized spectrum resources to support unmet demand for data traffic, but much has changed in the marketplace since this technology was first envisioned. Satisfying the demand for increasing data traffic is no longer the only issue wireless operators must address. Recently the need to support higher data speeds (user perceived throughput) has become equally, if not more important, as network operators must meet demand to support new and innovative services and applications. Given that researchers likely did not take into account this recent requirement (and possibly others), there may be multiple technical issues to resolve in order to employ it today.

17. Thus, we caution against reserving spectrum for an unproven technology when commercial mobile operators are on the verge of deploying the latest 5G technology.

International Alignment

18. We agree with the Department that spectrum allocations should take into account "international markets and global technology development".[7] This allows Canada to take advantage of economies of scale, resulting in more affordable equipment enabled by the use of globally harmonized spectrum. Canada is particularly influenced by technology deployments and equipment availability in the U.S. and as a result, we generally recommend aligning with the U.S. However, there may be instances where the U.S. usage of spectrum/technology is not aligned with the international community and Canada would be better off aligning with the International community rather than the U.S. Therefore, the Department should still conduct case-by-case assessments and adopt spectrum alignments that provide Canada with greatest opportunity to take advantage of economies of scale.

7 The Consultation, paragraph 17.

3.0 COMMERCIAL MOBILE SERVICES

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.

19. Please refer to our response to Question 3.

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

20. We agree with the Department's assessment that continued growth of data traffic will be a significant challenge for mobile operators in the coming years. While there are various technologies that can increase network capacity and reduce congestion, they will not be sufficient to meet anticipated demand for commercial mobile services. In addition, future applications and services will drive demand for higher data speeds, and only additional spectrum can satisfy this requirement.

21. Further to the Department's assessment of future demand, there are two additional use cases which should be considered: fixed wireless Internet connectivity and High Definition/4K video. We do not have overall demand forecasts for these use cases but note that the amount of per subscriber traffic associated with fixed wireless Internet connectivity and High Definition/4K video is orders of magnitude greater than that of mobile services.

22. We anticipate that several developments will allow wireless networks to accommodate greater traffic levels and higher user throughput going forward.

- **mmWave:** There is an order of magnitude more spectrum available at mmWave versus sub 6 GHz. This spectrum will support higher user throughput. Additionally, mmWave technologies employ smart antennas which will further increase spectral efficiency and user throughput.

- **Higher Spectrum Utilization:** Commercially deployed wireless technologies (high-speed packet access (HSPA) and long-term evolution (LTE)) utilize, at most, 90% of the spectrum bandwidth, while the remainder is used for guard bands that protect against interference from adjacent bands. Next generation 5G waveforms use more advanced modulation and filtering techniques to eliminate

the need for guard band spectrum, thus allowing more spectrum to be utilized for data transport.

- **Advanced Antenna Systems (AAS):** AAS have evolved from supporting simple 2X2 MIMO systems with two independent data streams to a single user, to Massive MIMO antenna systems supporting dozens of simultaneously data streams to multiple users. AAS have the potential of increasing spectral efficiency (i.e., network capacity) several fold, although the increase in user throughput will not be as dramatic. AAS are slowly being phased into the network as the need for capacity increases.

- **Increased use of Carrier Aggregation (CA)**: CA is the most effective LTE-Advanced feature in terms of improving user throughput. Four-carrier aggregation is currently available, and CA of up to 16 carriers will be possible in the future. CA also supports data traffic growth by balancing traffic across many carriers and thus mitigate congestion of individual carriers.

23. Although the above technical advancements will assist in meeting some of the anticipated growth in wireless usage, it is also essential that sufficient additional spectrum is released and wider broadband channels are assigned.

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?

24. Over the next five years, wireless carriers are expected to continue to undertake massive investments to ensure that Canada's wireless networks remain among the fastest in the world. Using small cells to achieve densification will be one of the key ways to support future traffic growth in conjunction with the deployment of 5G mmWave networks. Not only will small cells enable the growth of wireless traffic by increasing the number of access points, they will also help to address the RF propagation challenges associated with 5G mmWave networks. LTE small cells are currently being deployed, and 5G mmWave networks will be launched within a few years of mmWave spectrum becoming available.

25. While small cells will increase network capacity, they will also result in highly mobile subscribers experiencing increased handoffs as they move rapidly between small cells. To improve the quality of the customer experience, it may be necessary to utilize techniques to make handoffs between cells more seamless. In the case of LTE, there are two techniques that can be used:

- **Adaptive Single Frequency Network (ASFN)**: ASFN is a vendor specific feature that makes multiple base stations appear as one large base station for users located at the edge of the cell.

- **Coordinated MultiPoint (CoMP)**: A family of 3rd Generation Partnership Project (3GPP) features that improve user throughput at the cell edge by coordinating downlink transmission scheduling from multiple base stations.

26. Both of these techniques will enhance the seamlessness of travelling between cells, likely at the cost of a slight reduction in capacity. Since small cells themselves will provide a large increase in capacity, it may be a worthwhile trade-off to improve the quality of the user's experience.

27. To facilitate the rapid roll-out of small cells, carriers must be able to deploy these sites without undue interference by Land Use Authorities. Small cells typically make use of existing structures, which, under the Department's Client Procedures Circular, means that a public consultation need not occur before installation.[8] However, Land Use Authorities continue to challenge carriers on small cell deployments, especially with concerns related to Health Canada's Safety Code 6.[9]

28. We suggest that the Department consider implementing a campaign to educate Land Use Authorities and the general public on the consultation and approval requirements related to antenna structures. Further, we request that the Department abstain from intervening in complaints related to sites that are clearly within the regulatory limits and that meet Health Canada's Safety Code 6 requirements.

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8 CPC-2-0-03 Issue 5 - Radiocommunication and Broadcasting Antenna Systems, 15 July, 2014.
9 *Safety Code 6: Health Canada's Radiofrequency Exposure Guidelines,* Health Canada, 2015.

29. The operational measures discussed above to support the increase in traffic demand are not expected to be sufficient to address the requirement for higher user data speeds and the anticipated data traffic growth. As we discussed above, it is imperative that the Department also make available additional spectrum in order to ensure that demand for future applications and services can be accommodated.

4.0 LICENCE-EXEMPT

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.

30. We agree that the two key uses of the Licence-Exempt spectrum, Wi-Fi and Internet of Things (IoT) applications, will lead to growth in demand for this spectrum. In addition to these uses, Licence-Exempt spectrum can also play a role in improving end-user throughput speeds, which has led to increased interest in implementing LTE-Unlicensed (LTE-U) technology.

31. LTE-U employs LTE technology in unlicensed spectrum, and offers a number of advantages over Wi-Fi. A 3GPP-standardized version of LTE-U exists called Licensed Assisted Access (LAA), which employs a protocol called Listen-Before-Talk (LBT) designed to ensure fair coexistence in the unlicensed band with other technologies. In addition to their ability to offload traffic from the macro cellular network, LTE-U and LAA offer improved spectral efficiency over Wi-Fi, which allows operators to achieve higher data rates and capacity.[10] Further, when used with carrier aggregation, they can protect the end-user from the effects of interference. For the network operators, use of LTE in both licensed and unlicensed spectrum can simplify network management by using LTE as the underlying technology for both deployments, instead of relying on alternative radio technology in the unlicensed band such as LTE-WLAN Aggregation (LWA).

32. While LAA is mandated in most countries for Licence-Exempt spectrum, some American carriers have implemented, or are considering implementing, LTE-U technology. Although we believe commercial mobile networks must be deployed using licenced spectrum, we anticipate that Licence-Exempt spectrum will continue to be utilized for its offloading capability and to improve end-user throughput, especially if LTE-U or LAA is employed.

[10] The key role of LAA in delivering gigabit LTE, Sean Kinney, RCRWireless News, https://www.rcrwireless.com/20170804/carriers/key-role-laa-gigabit-lte-tag17-tag99.

33. The increased use of Licence-Exempt spectrum for Wi-Fi will also increase the risk of user interference, quality degradation, and loss of service. However, as noted above, LTE-U technology may aid in reducing the inter-system interference, because it is better than existing Wi-Fi systems at protecting and coexisting with other unlicensed systems.

34. We recognize that there may be a requirement for additional Licence-Exempt spectrum. Future Licence-Exempt applications are generally best suited to high band spectrum that can provide short-range RF coverage, such as the 60 GHz "WiGig" band, and these bands should provide sufficient capacity to meet future demand. Licence-Exempt channels in the lower frequencies range (sub-6 GHz) should only be allocated on an exceptional basis in bands that will not be required for licensed use.

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?

35. LTE-U and LAA technologies can effectively relieve traffic pressures and address spectrum demand for Licence-Exempt applications because they are better able to detect channel activity than existing Wi-Fi technologies. The use of advanced technologies such as LTE-U and LAA for commercial mobile deployments will therefore allow carriers to increase cell capacity and end-user throughput. In addition, small cells will be deployed to serve high-density areas, providing increased spectral efficiency and enhanced coverage.

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?

36. We believe that the following bands will see the most evolution over the next five years:

a. the Industrial, Scientific and Medical (ISM) and Radio LAN bands;
b. Vehicular radar bands 46.7 – 46.9 GHz and 76-77 GHz; and
c. 60 GHz (WiGig) bands.

37. All of the above bands are suitable for IoT applications. The low band ISM and Radio LAN bands are currently being utilized in IoT technologies, and we expect that their use will increase. We note, however, that they will not be ideal to support mission critical, time

sensitive, or data sensitive IoT applications, such as applications involving industrial control. In addition, as interference increases in these bands, their utility will be reduced.

38. We believe that the desire for cable-free wireless connection in the home will drive the further development of the WiGig bands. While this will primarily be for broadband connections, such as HDMI replacement, it is conceivable that this same home hub/gateway could generally be used for smart home applications involving IoT.

39. Vehicle-to-vehicle (V2V) applications surrounding intelligent traffic systems, driver assist, and self-driving vehicles will see a huge expansion over the coming years. Most of this activity will be seen in the ITS bands and the vehicular radar bands listed above. These vehicular subnets will at some point connect to, and increase pressure on, commercial mobile networks through licensed spectrum.

40. As discussed above, additional Licence-Exempt spectrum below 6 GHz should only be allocated on an exceptional basis. Most of the growth in demand for Licence-Exempt spectrum to support IoT applications will be well suited to high band spectrum like the WiGig band.

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?

41. Recent changes to Wi-Fi standards as well as the overall growth in use of Wi-Fi devices and carrier offloading, will lead to increased traffic on the Wi-Fi bands. Nonetheless, we believe that sufficient bandwidth is available to support this increased demand. Additional low band (sub-6 GHz) spectrum for Wi-Fi use should only be allocated on an exceptional basis in bands that are not suitable for licensed use.

5.0 SATELLITE

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?

42. We agree with the Department that, while MSS services are expected to grow nominally on a global basis, the existing MSS spectrum allocations are sufficient to meet this demand in Canada.

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

a) C-band

43. We concur with the Department's assessment that the overall demand for C-band applications in Canada will decrease over the next five years due to the increasing migration to fibre and other terrestrial services. The Department has recognized that, given this downward trend and an anticipated surplus of capacity, there is an opportunity to consider how the C-band could be used more efficiently in the future.

44. Currently, only 648 MHz of spectrum is available for Commercial Mobile Radio use, compared to the 28,817 MHz allocated for MSS, FSS, BSS and earth observation satellite services. Consolidating the satellite users in the C-band would result in the more efficient use of this band in the future, while at the same time providing the Department with additional needed spectrum for commercial mobile services.

45. C-band spectrum will be important for 5G deployment internationally. Analysts have identified it as "one of the few spectral bands on which the global telco industry is converging, due to the abundance of available spectrum and its relatively favorable propagation characteristics, especially when compared with mmWave."[11] Therefore, a reconsideration of the C-band presents an opportunity to make much-needed additional spectrum available for high-growth fixed and mobile applications. We recommend consolidating existing and future C-band satellite services into the upper portion of the band to allow for the expansion of fixed and mobile services into the lower portion of the band.

46. Specifically, we suggest making 3400 - 3800 MHz available for flexible use, which would allow for the creation of four 100 MHz blocks. This reallocation would facilitate the deployment of 5G, and the larger license blocks would maximise spectrum efficiency, spectrum utilisation, device-processing power and energy utilisation. This reallocation would also require existing C-band satellite users to shift into the upper portion of the band (from 3800 – 4200 MHz), which

[11] "Is C-Band the next frontier for 5G spectrum?" RCR Wireless, 26 July 2017. https://www.rcrwireless.com/20170726/opinion/20170726wirelessanalyst-angle-is-c-band-the-next-frontier-for-5g-spectrum-tag9.

we believe provides sufficient spectrum for satellite use in the short term. In the longer term, as satellite demand further diminishes, the department should consider freeing up the remaining C-band spectrum from 3800 – 4200 MHz for flexible use to provide additional capacity to meet traffic demands.

47. We note that the demand for cable head-end feeds is primarily in remote communities, where coincidently there is less requirement for terrestrial fixed-mobile service. As a result, we recommend that the Department explore the use of geographic exclusion zones in the larger band of 3400 – 4200 MHz to allow for both mobile and satellite use. This could maximize spectrum utilization in the band and allow for a natural shift to mobile use as more communities become connected by terrestrial means and satellite demand diminishes.

b) Ku-Band

48. We agree with the Department's assessment regarding the existing use and trend of services being deployed on Ku-band satellite systems. Existing demand for the Ku-band will continue to be strong over the next five years.

c) Ka-Band

49. We agree with the Department's assessment regarding the existing use and trend of services being deployed on Ka-band satellite systems. Given the smaller antenna requirements, ease of installation, and the low cost of equipment, it is expected that the use of Ka-band satellites in remote areas of the country will continue to expand over the next five years. The spectral efficiencies gained with High Throughput Satellite (HTS) systems will support growth in demand for broadband Internet access in rural and remote areas, including for data intensive applications such as over-the-top (OTT) television.

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?

50. A number of technological advancements are in use today that have improved spectral efficiency and will support any potential demand growth for satellite services in the coming years. Higher power satellites, higher order modulation schemes, and statistical multiplexing have all allowed satellite operators to increase the amount of capacity they can transmit over

existing bandwidth. Compression standards and video encoder efficiencies continue to improve, allowing broadcasters to reduce bit rates and maintain quality while adding incremental services within the same occupied bandwidth.

51. We agree with the Department that HTS systems will offer significant improvements in spectral efficiency by incorporating innovations such as frequency reuse, multiple regional spot beams, and bi-directional capabilities in order to increase spectral capacity and support both up and downlink capabilities at each user terminal. As this technology continues to mature, additional gains in spectral efficiency will continue to be realized.

52. Given these recent advancements, we suggest that the Department carefully consider the spectral efficiency of existing satellite systems and not allocate additional spectrum where outdated and inefficient satellites are in operation. Systems should be upgraded to more spectrally efficient systems before additional spectrum is made available.

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

53. Over the next five years, we will continue to serve our Bell TV Direct to Home (DTH) satellite customers, and plan to further enhance the service by adding 4K capabilities to the network. In addition, we will continue to utilize the C-band and Ku-FSS band for Satellite News Gathering (SNG) for Bell Media-related operations. This will enable continued use of remote feeds, as well as coverage of special events and sporting events using mobile uplinks. We will also continue to utilize C-band spectrum to feed Bell Media content to our remote affiliates, certain over-the-air (OTA) transmitters, and U.S. news agencies. While we plan to continue to use C-band spectrum to deliver these services, we are confident that our operations will not be affected by a reduction in the size of the C-band for satellite use. Our proposed consolidation and reallocation provides sufficient spectrum for satellite use to meet our requirements.

54. We anticipate that the provision of broadband internet via satellite will continue to play a part in serving Canada's rural and remote communities. For example, we have partnered with Northwestel to provide a new high speed internet service to all 25 Nunavut communities on T19V, Telesat's Ka-band HTS which will be launched in 2018. HTS offer the possibility of high-speed internet to areas that cannot be served by other broadband solutions. It can also act as backhaul for small- to medium-sized business applications.

55. Certain emerging use-cases could potentially drive demand for additional satellite capacity. For instance, makers of 'connected cars', as well as autonomous cars and tractor-trailers, could leverage satellite technology. In addition, satellite holds potential for the provision of live video feeds and in-flight Wi-Fi during air travel – an area that has seen increasing demand in recent years. If these new demand streams emerge, they will be best served on the higher Ku- and Ka-bands that can support bandwidth-intensive applications.

6.0 BACKHAUL

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.

56. We agree with the Department that demand for backhaul over the next five years will increase and that additional backhaul spectrum will be required.

57. In addition, we support allowing flexible fixed and mobile use in the bands above 24 GHz, as has been done in the U.S., to allow for some of the new backhaul network approaches to be implemented as part of 5G deployments. For instance, flexible use will permit the re-use of spectrum for self-backhaul (relay). Although this cannibalizes capacity from radio access use, it can be beneficial in providing rapid deployment until primary backhaul is installed.

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?

58. We currently employ all three solutions referred to in the Consultation – fibre optics, microwave radio and satellites. However, we increasingly rely on fibre to provide backhaul to cell sites where possible. For the more rural and remote areas of Canada where there are no fibre facilities, we plan to utilize Ka-band satellite spectrum. We believe that there will be sufficient bandwidth capacity on these high throughput satellites to meet the needs for cellular backhaul for the next five years and beyond. These satellites are expected to be capable of delivering approximately 10 Gbps of capacity in Canada's far north.

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?

59. The use of higher order modulation schemes, channel concatenation, and packet compression techniques will help in relieving pressure on the microwave backhaul network to support increasing data traffic.

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?

60. Commercial mobile, licence-exempt, satellite, and fixed wireless services/applications will continue to increase the demand for backhaul spectrum. Commercial mobile services and fixed wireless services will have by far the greatest impact. Currently, most backhaul traffic supports commercial mobile and fixed wireless services, with very little supporting licence-exempt services (i.e., Public Wi-Fi).

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?

61. All microwave backhaul spectrum bands are expected to see increased usage over the next five years as a result of increased demand for the services discussed above, and in particular the higher data rates associated with 5G commercial mobile services. It is expected that the higher spectrum bands (11 – 38 GHz as well as the 80 GHz band), with their inherent wider bandwidth availability, will be in greater demand due to their ability to support higher data throughputs associated with higher bandwidth applications.

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

62. It is our experience that allowing flexible fixed and mobile services within the same frequency band has no effect on how backhaul is planned or used. Backhaul provisioning is based on the amount of traffic that is transmitted at the cell site and not whether the traffic is for mobile or fixed services. As indicated above, permitting flexible network topologies will drive effective and efficient spectrum use. This will allow licensees to assess how best to deploy spectrum in a given area and will work to provide new spectrum opportunities for mobile and fixed applications as technology and business cases permit.

7.0 POTENTIAL FREQUENCY BANDS FOR FUTURE RELEASE

63. The Department considered the AWS-2 band in its 2013 Spectrum Outlook and has indicated that it intends to launch a consultation in the future. With respect to the AWS-2, we recommend that the Department wait until the status of this spectrum becomes more certain in the U.S. before initiating any licensing action. With this approach, the current users of the 1695–1710 MHz spectrum would not be displaced unnecessarily and the most efficient use of the spectrum can be identified.[12]

64. Once the U.S. deployment becomes better understood, the Department could then decide to hold further consultations as to how to proceed with the band, determine the level of interest for this spectrum to other industry players in Canada and then decide whether to auction the spectrum in question.

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

65. The Department noted that Australia has expanded Licence-Exempt use of the 900 MHz band to 902-935 MHz, but we do not support a similar extension in Canada. As we recommended above, additional low band spectrum should only be made available for Licence-Exempt use in bands that will not be required for licensed use. 900 MHz could provide valuable long-range bandwidth for 5G mobile services, and would be best employed as licensed spectrum in order to control interference levels.

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.

66. Table 1 provides a summary of our recommendations for the release of all spectrum bands proposed in Table 7 of the Consultation. In the second column of Table 1, we indicate our priority of release based on international developments and when we anticipate the existence of an equipment ecosystem, with 1 being the highest priority and 5 being the lowest.

[12] For additional context, please see our comments in: TerreStar Solutions Inc. (TerreStar) *Application for a Tier 1 Spectrum Licence in the 1695–1710 MHz Frequency Band and in the PCS Block H (1910–1915 MHz/1995–2000 MHz).*

The third column of Table 1 indicates the year in which we recommend that a particular band should be released.

Table 1
Proposed Priority and Timing of Spectrum Release

Band	Priority of release	Proposed timing of release
814-824 paired with 859-869 MHz (800 MHz)	4	2024
896-960 MHz (900 MHz)	4	2024
1427-1518 MHz (L-Band)	1	2020
1695 – 1710 MHz (AWS-3 unpaired)	5	2025
24.25-27.5 GHz	1	2020
31.8-33.4 GHz (32 GHz)	5	2025
40-42.5 GHz	3	2023
45.5-50.2 GHz	5	2025
50.4-52.6 GHz (51 GHz)	5	2025
71-76 GHz	2	2021
81-86 GHz	2	2021
Bands above 95 GHz	5	Not suitable for release in near future

- **800 MHz & 900 MHz:** We agree with the Department's views that these bands should be made available for commercial mobile use and auctioned. As stated above, we do not agree with designating any of the 900 MHz band as Licence-Exempt.

- **L Band:** We agree that L-band should be auctioned for commercial mobile use and its usage aligned, to the extent possible, with international bands and technical rules.

- **AWS-3 unpaired:** Once the equipment ecosystem becomes readily available, we agree that this band should be auctioned.

- **5 GHz:** Further to the Department's recent decision[13] on the framework for Radio Local Area Network (RLAN) Devices Operating in the 5150 – 5250 MHz band, we support the decision to allow the use of higher power RLAN devices both indoor and outdoor under a licensed regime basis. Given that this is already a well-established Licence-Exempt band, we suggest that the Department endeavour to align with international standards that allow unhindered -Licence-Exempt use of this band.

- **24 GHz – 51 GHz:** With respect to the use of the following bands: 24.25 – 27.5 GHz; 31.8 – 33.4 GHz; 40 – 42.5 GHz; 45.5 – 50.2 GHz; and 50.4 – 52.6 GHz; we believe that the Department should, where feasible and compatible with existing usage, adopt a "flexible use" licensing model. This would provide licensees with the freedom to decide whether to deploy fixed systems, mobile systems or a combination of fixed and mobile systems. Further, such an approach will serve to ensure that Canada is at the forefront of 5G network development and that Canadians are able to enjoy access to advanced applications and services.

  Bands above 71 GHz: With respect to 71 – 76 GHz; 81 -86 GHz; and bands above 95 GHz; we support the Department's proposals, as outlined in Table 7 of the Consultation, regarding assignment of commercial mobile, fixed and licence-exempt uses. The proposed assignments will support future services/applications, including 5G network deployments.

67. In relation to 24.25 – 27.5 GHz specifically, we recommend that the Department not wait for the outcome of WRC-19 to initiate the process of releasing this band. We note that the international community has taken an interest in developing this band, and while the ITU's work has not yet been completed and analysis and compatibility studies are still being carried out, it seems likely that this band will be identified at WRC-19 for mobile use. Therefore, in the interest of rapid deployment of 5G, the Department should release this band as soon as possible.

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[13] SMSE-013-17, *Decision on the Technical and Policy Framework for Radio Local Area Network Devices Operating in the 5150-5250 MHz Frequency Band*, May 2017.

68. In addition, we do not agree with designating any of the 24.25-27.5 GHz band as Licence-Exempt. This band is expected to be valuable for the deployment of 5G mobile services, and thus, it should be reserved for licensed use. However, we do support allocation of other Licence-Exempt bands as indicated above.

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.

69. There are no additional bands that we believe should be considered at this time.

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

70. Historically, allocation of spectrum bands for specific applications has resulted in a limited ecosystem and stranded technology that required migration to global technologies. With this hindsight, the Department should endeavour to make all bands currently licensed for fixed or mobile services to be available for flexible (fixed and mobile) use to the greatest extent possible. We believe that adopting a flexible use approach will allow licensees to more effectively deploy all available spectrum.

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

71. We have no comments at this time.

8.0 CONCLUSION

72. Access to sufficient spectrum is critical to ensuring the timely and sustained development and evolution of existing networks and to permit rapid deployment of new and innovative 5G systems and services in Canada. Despite technical advancements in spectral efficiency, growing demand for commercial mobile services necessitates the release of additional spectrum in the near future. Before allocating new spectrum to other types of applications such as Licence-Exempt and satellite, we urge the Department to first consider the needs of commercial mobile operators and ensure that they have sufficient spectrum to meet demand. Spectrum should be released as soon as possible to allow operators to meet increasing traffic demand and to allow the rapid deployment of the best and most innovative services to Canadians.

73. The release of additional spectrum will put Canada at the forefront of commercial mobile network deployments, allowing Canadians to continue to benefit from cutting-edge wireless services and applications and ensuring Canada's mobile networks remain world-class.

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