

Notice No. SLPB-006-17  
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***Consultation on the Spectrum Outlook 2018 to 2022, Notice No. SLPB-006-17***

**Comments  
of  
SHAW COMMUNICATIONS INC.**



**February 16, 2018**

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## **I. INTRODUCTION AND EXECUTIVE SUMMARY**

1. The following constitutes the initial comments of Shaw Communications Inc. (“Shaw”), on behalf of itself and of Freedom Mobile Inc. (“Freedom”), to Innovation, Science and Economic Development Canada (the “Department” or “ISED”) in connection with the proceeding initiated by *Consultation on the Spectrum Outlook 2018 to 2022*, Notice No. SLPB-006-17 (the “Consultation Document”).
2. These comments are comprised of three sections. In the introduction and executive summary, Shaw highlights its perspective on this proceeding as a new competitor in the wireless industry that is committed to offering a strong, sustainable and differentiated alternative to the big three dominant incumbents. We provide an overview of our recommendations on how the Department can continue to promote competition through measures that include the expeditious release of 600 MHz and 3500 MHz spectrum under pro-competitive policies, earmark spectrum for backhaul, develop and implement pro-competitive spectrum policies for millimetre wave spectrum bands, and make available additional licence-exempt spectrum in the 5 GHz band. We also recommend that, to facilitate competition and ensure spectrum is deployed efficiently, the Department examine and address the various barriers to infrastructure access that will become increasingly challenging as we move towards the deployment of 5G. In the second section, Shaw unpacks these policy recommendations and explains how these actions are critical for meeting the Department’s policy objectives for its five-year Spectrum Outlook. In the third and final section, Shaw answers the specific questions set out in the Consultation Document.

### **A. Bringing Innovation, Change and Choice to Canada’s Wireless Market**

3. With the burgeoning Internet of Things and looking ahead to 5G, we are at the dawn of a new era in telecommunications. In this new era, the scope and scale of connections among people, things, sensors, crops, natural ecosystems, resources, data, systems and networks will transform the way we interact economically, socially and culturally. Realizing for Canadians the full potential of this new world will require an ambitious new approach to wireless connectivity that emphasizes competition, innovation and investment. Shaw, with its proven track-record of innovation and customer focus, has recently entered the wireless market with a commitment to bring a truly differentiated

alternative that is responsive to the ever-changing needs of Canadians. As we strive to compete – and bring the attendant benefits of choice, quality and pricing discipline to an industry long dominated by the big three entrenched incumbents – Shaw will disrupt the status quo and bring a new dynamic approach to Canada’s connectivity market. This transformative thinking extends to all aspects of our business – from how we deliver products and services, to how we manage our internal operations.<sup>1</sup>

4. Shaw is still in the early days of its wireless story. Indeed, we are still in the process of building our wireless network and require critical spectrum resources, including 600 MHz spectrum, in order to establish our coverage. However, our impact in the market is already being felt. In 2017, Freedom launched its transformative “Life is a Big Gig” data plans, which include an offer of 10GB for only \$50 per month, with no financial penalties for data overages. Freedom also recently began offering the newest iPhone models to consumers for \$0.<sup>2</sup> These offers show Freedom’s effectiveness in responding to Canadians’ growing, and previously un-met, needs for fair and valuable data plans. Freedom listened to Canadians and responded. We also forced the big three incumbents to take notice, demonstrating the impact of our presence in the market.<sup>3</sup>
5. On the network side, Shaw is also investing and innovating to make the most of our spectrum resources. For example, in December, 2017, Shaw completed a re-farming of 10 MHz of AWS-1 spectrum in Vancouver, Calgary and Edmonton. Because AWS-1 spectrum supports nearly all LTE devices currently in use in Canada, this re-farming significantly expanded Freedom’s addressable market. At the same time, we have also begun deploying our recently acquired 2500 MHz spectrum, further improving network capacity and quality. Through our efficient use of spectrum, millions of Canadians can now bring their own device to Freedom’s LTE-Advanced (“LTE-A”) network.

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<sup>1</sup> See “Shaw Communications Announces Total Business Transformation Initiative to Reinvent Operating Model in Response to New Customer Service Expectations,” Calgary, January 30, 2018, available online: <http://newsroom.shaw.ca/materialDetail.aspx?MaterialID=6442452086> (accessed 8 February 2018).

<sup>2</sup> Subject to conditions, including the activation of a new service and a 24-month service agreement.

<sup>3</sup> “Big Three wireless carriers take aim at Freedom with discounted plans”, Christine Dobby, <https://www.theglobeandmail.com/report-on-business/big-three-wireless-carriers-take-aim-at-freedom-with-discounted-plans/article37372993/>; “Wireless competition heats up as Big Three telecoms chase rival with \$60 deal”, <http://business.financialpost.com/telecom/wireless-competition-heats-up-as-big-three-telecom-companies-offer-10-gb-plans-for-60>

6. We have employed this same innovative approach to leverage licence-exempt spectrum for the benefit of consumers. For example, the Department's 2017 decision to enhance the utility of the 5150-5250 MHz band for Wi-Fi by increasing power limits and lifting the ban on outdoor use by Radio Local Area Network Devices ("RLANs") has allowed Shaw to deliver a faster and higher quality Wi-Fi experience to its customers.<sup>4</sup>
7. Shaw is doing the hard work internally, with our network, and in the market, to build a strong alternative to the big three incumbents. Yet, we continue to face fundamental barriers to sustainable competition in the wireless industry, including dramatic imbalances between our spectrum holdings and those of the incumbents. These imbalances contribute to Shaw's disadvantages in cost-effectiveness, speed, quality, capacity and coverage.
8. Our participation in this important proceeding is founded on Shaw's commitment to build a strong, network-based alternative to the big three incumbents, and to bring truly innovative offerings that are responsive to Canadians' needs. We commend the Department on the progress it has made to date to consult on a number of important spectrum policy matters, and we look forward to the next five years of progress and transformation.

**B. The Importance of this Proceeding for Canadians**

9. Spectrum is increasingly the lifeblood of our digital economy. It has allowed technologies that were once seen as futuristic to become part of our every day lives. The rapidly expanding Internet of Things is already changing the way we drive our cars, the way we manage our homes, and the way we grow our food. As we transition to 5G, the pace of change will accelerate with virtual reality and artificial intelligence inevitably becoming mainstream. These technological developments will create myriad economic, social and cultural opportunities for Canadians. They will also drive demand for valuable, finite spectrum resources.
10. Accordingly, the policies under which spectrum is allocated and released have major implications on the evolution of our communication system and its ability to keep pace with

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<sup>4</sup> *Decision on the Technical and Policy Framework for Radio Local Area Network Devices Operating in the 5150-5250 MHz Frequency Band*, SMSE-013-17, May 2017 (the "5150 MHz Decision").

technological change. This broad Consultation, covering multiple important spectrum bands and communications services, will help to inform ISED's overall approach and planning related to spectrum releases in the following five years, which will be an incredibly transformative period. Hence, as the Department has acknowledged, the policy blueprint resulting from this Consultation will have wide-reaching impacts for Canadian consumers and businesses, the wireless industry, and the competitiveness of our digital economy.

### **C. Policy Focus and Goals**

11. The Spectrum Outlook resulting from this proceeding will set the tone for the consultations and policy actions that unfold in the next five years. It is therefore critical that the Department pursue a set of coherent policy objectives. In addition to the objectives set forth in the *Telecommunications Act* (the "Act") and the *Spectrum Policy Framework for Canada* ("SPFC"), the Department has dictated three clear and simple pillars of focus for this proceeding:
  - Quality: supporting networks to allow for the latest technologies to be deployed
  - Coverage: enabling services available to Canadians where they live and work
  - Prices: encouraging services that are affordably priced<sup>5</sup>
12. In doing so, the Department correctly has made Canadian consumers and businesses the focus of this proceeding. These are commendable policy goals that are fully consistent with the objectives set forth in the Act and SPFC. Moreover, they are also complementary to the Minister's mandate to keep Canada at the leading edge of the digital economy through support for competition, choice, and service availability.<sup>6</sup>
13. Shaw submits that, if the Department is to achieve the above stated objectives, it must take a holistic view of the telecommunications landscape and prioritize a few key policy items. In light of our commitment to provide a sustainable alternative to the incumbents for the long-term, Shaw will need access to a sufficient quantity and diversity of spectrum

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<sup>5</sup> See Consultation Document, paragraph 5.

<sup>6</sup> Mandate Letter to the Minister of Innovation, Science and Economic Development, November 12, 2015.

in a wide variety of spectrum bands, including low-band, mid-band and high-band spectrum.

14. Currently, Shaw does not have access to the low-frequency spectrum that it needs to build the coverage foundation for its network. Issuing a decision on its *Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band*, SLPB-005-17 (the “600 MHz Consultation”), and progressing to auction, should therefore be the first step in the sequence. The Department should also proceed expeditiously with the release of 3500 MHz band spectrum for mobile use, earmark more spectrum for backhaul, and make additional 5 GHz spectrum for licence-exempt use. These actions will help unleash the full potential of 5G and ensuring the ongoing availability of high-quality services in the face of growing data demands.
15. As we encourage the Department to move quickly on the release of 600 MHz and 3500 MHz spectrum, we also commend it for launching its *Consultation on Releasing mmWave Spectrum to Support 5G* (the “mmWave Consultation”).<sup>7</sup> The mmWave Consultation positions Canada very well for the future and the decision from this Consultation will be critical for 5G development. As Shaw demonstrated through its submissions in the mmWave Consultation, spectrum policy measures, such as set asides, will be no less important for the mmWave spectrum as for other bands. We are seeing in the U.S. a degree of spectrum concentration in the mmWave bands that Canada can avert through pro-competitive spectrum policies. This is essential in order to ensure that all Canadians have choice in the next generation of wireless services.<sup>8</sup>
16. With the deployment of 5G, we will see an incredible densification of radio installations and intense connectivity infrastructure builds over the next five years. This will not be limited to wireless installations. 5G build-outs, including mmWave deployments, will depend on wireline deployment as well. As a result, infrastructure access will be critical to building the networks that will advance the Department’s quality, coverage and pricing goals, and to provide the foundation for Canada’s economic, social and cultural future. We therefore encourage ISED to look holistically at the myriad infrastructure access barriers that beset service competitors. Infrastructure access reform will be critical to

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<sup>7</sup> SLPB-001-17, September 15, 2017

<sup>8</sup> Citations to specific paragraphs in Shaw submission.

achieving coverage across the country, as well as enabling efficient deployment of cutting-edge network technology, especially 5G.

17. Finally, the Department must pursue policies that promote facilities-based competition, which is the best way to drive innovation, value and affordability of service, which we turn to below.

## **II. POLICY PRIORITIES**

### **A. Addressing Affordability through Facilities-Based Competition**

18. The policies that emerge from this Consultation and subsequent proceedings must promote facilities-based competition in the mobile wireless market. With the high level of spectrum concentration in the wireless market today, paired with the anticipated exponential growth in mobile data traffic over the next five years, the quality and reach of competitive networks, such as Shaw's, and the affordability of services delivered over them, depends on policies that support sustainable competition. Enhancing facilities-based competition in the wireless marketplace is the best way to improve affordability and stimulate innovation in the market for wireless services.<sup>9</sup>
19. While competition is beginning to emerge in Canada today, the big three incumbents continue to dominate, collectively holding more than 90% of the market share. If mobile wireless spectrum continues to be concentrated in the hands of the incumbents, they will continue to exercise market power in the downstream provision of wireless services, forestalling a truly competitive wireless marketplace from materializing and preventing the maximum economic and social potential of that spectrum from being realized. Accordingly, the Department must adopt appropriate pro-competitive spectrum policies for future commercial mobile use.
20. Promotion of competition should be an overarching principle of the five-year Spectrum Outlook, and a guiding principle for each of the subsequent related proceedings. Pro-

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<sup>9</sup> See, e.g., *Competition Bureau statement regarding Bell's acquisition of MTS*, February 15, 2017; Innovation, Science and Economic Development Canada, *Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band*, August 2017, SLPB-005-17, at paragraphs 17 and 22; and Dr. Eric Emch (Bates White Economic Consulting), "An assessment of wholesale roaming policy in Canada: The relationship between competition, regulation, investment and access," September 8, 2017, report prepared for Shaw Communications Inc. in the proceeding initiated by Telecom Notice of Consultation CRTC 2017-259, Section III.A.6, Figure 1.



competitive policies should extend to all elements of the spectrum allocation and release process, including timing, band and channelization plans, and licensing and auction rules, so that they can begin to correct the staggering spectrum imbalances that currently exist in the market. The three incumbents enjoy a considerable advantage with respect to spectrum holdings across all bands, controlling more than three-quarters (approximately 77%) of all licensed commercial mobile spectrum in Canada, as depicted below. The spectrum imbalance is made even worse as a result of the extensive spectrum sharing arrangement between Bell and Telus, which allows these incumbents to control almost half of available commercial mobile spectrum in Canada.

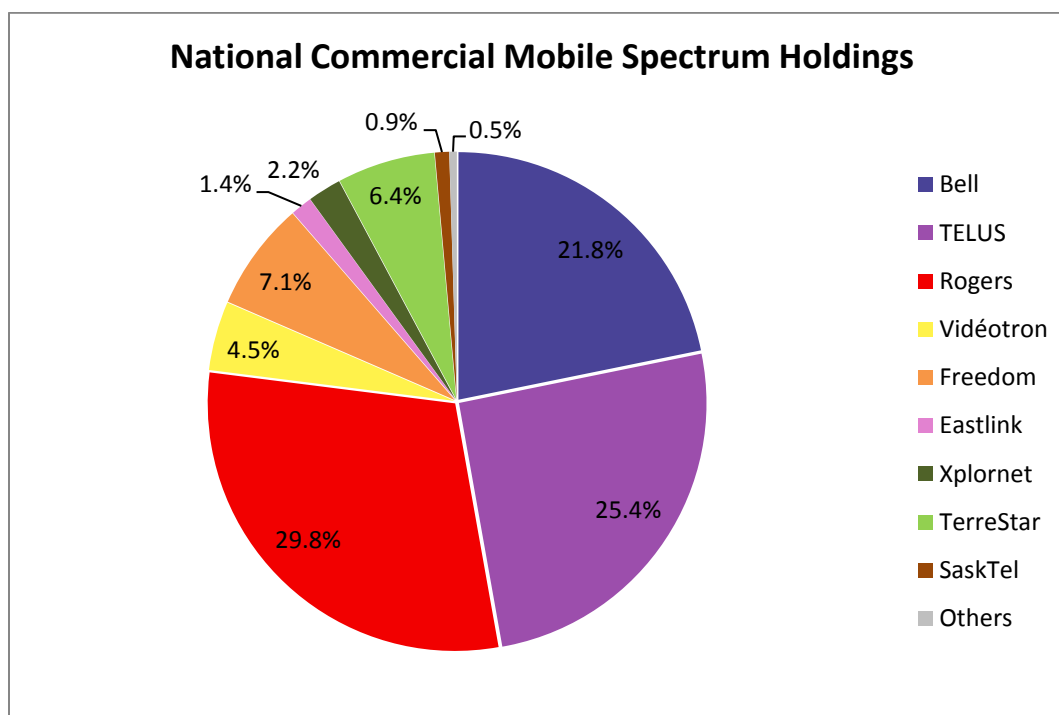


Figure 1 - Weighted MHz/Pop estimate, based on ISED's *National Holdings of Commercial Mobile Spectrum*, July 14, 2016, updated to reflect licence transfers approved by ISED after this date.<sup>10</sup>

21. As illustrated above, Freedom and other non-incumbent providers face a serious disadvantage in the quantity and diversity of spectrum resources relative to the spectrum assets amassed by the incumbents over the last 35 years. Even after Freedom's recent purchase of licences from Quebecor, Freedom still has significantly less, and significantly

<sup>10</sup> See ISED, *National Holdings of Commercial Mobile Spectrum*, current as of July 14, 2016, available online: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11210.html> (accessed 30 January 2018).

less diverse, spectral holdings compared to the three national incumbents.<sup>11</sup> Our spectrum holdings seriously constrain our ability to compete with the incumbent national wireless carriers, and to the extent that this situation persists, it will significantly constrain the establishment and maintenance of sustainable competition in the wireless market. These imbalances can only be rectified by enacting appropriate pro-competitive measures, such as spectrum set-asides. Adoption of such pro-competitive measures will also guard against the significant foreclosure risk posed by incumbents, including in low and mid-band spectrum that need to be released as soon as possible. The incumbents are incented and able to pay a premium that will ensure new competitors are not able to access this fundamentally important spectrum that can support a truly competitive offering. As Shaw has argued previously, without regulatory intervention to mitigate this risk, incumbents will be able to block new competitors from challenging their market dominance.<sup>12</sup>

*Providing the Foundation for Sustainable Competition with 600 MHz Spectrum*

22. In the near future, the Department can give a direct boost to facilities-based competition in the wireless market by proceeding expeditiously with the release of 600 MHz spectrum under pro-competitive policies. As Shaw and others detailed in their submissions to the 600 MHz Consultation, the physical properties of low-band spectrum make it essential to establishing and expanding wireless network coverage, particularly in the early stages of building out a network, making it of significant value to new competitors.<sup>13</sup> Moreover, low band spectrum will also be a critical component of 5G deployments.
23. Further driving the importance of this spectrum is the extreme concentration of low-band spectrum with the incumbents. Shaw and other new wireless competitors together currently hold only 9.2% of existing low-band spectrum.<sup>14</sup> Rogers, Telus and Bell hold

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<sup>11</sup> Comments of Shaw Communications Inc., Consultation on a Licence Renewal Process for Advanced Wireless Services and Other Spectrum, *Canada Gazette*, Part I, June 17, Notice No. SLPB-002-17, at para. 13 (filed July, 25, 2017).

<sup>12</sup> See Submission of Shaw Communications Inc. to 600 MHz Consultation, October 2, 2017, pages 22-23.

<sup>13</sup> This is highlighted by the results of the FCC's 2017 Incentive Auction: new competitors T-Mobile, DISH and Comcast secured by far the most licences in the 600 MHz forward auction. See Federal Communications Commission, *Incentive Auction Closing and Channel Reassignment Public Notice*, DA 17-314, April 13, 2017.

<sup>14</sup> Based on cellular and 700 MHz spectrum. See Submission of Shaw Communications Inc. to 600 MHz Consultation, October 2, 2017, page 12.

90.8%. Lack of access to a mix of high, low and mid-band spectrum significantly hinders a provider's ability to compete in the market against the national incumbents, who have long-standing incumbency advantages, including with respect to spectrum and physical infrastructure.

24. New facilities-based competitors like Shaw offer the best chance to counter the dominance of the incumbent national wireless carriers – both today and in the next generation – and create the type of sustainable competition that drives choice and affordability. But to do so, competitors require access to the same mix of spectrum that their incumbent competitors have had years to amass. Therefore, the Department must proceed expeditiously with its auction of 600 MHz spectrum in a manner that ensures equitable access by new facilities-based carriers, specifically, by adopting an appropriate set-aside that addresses the severe low-band spectrum imbalance in Canada. In the view of Shaw and others,<sup>15</sup> the best way to rectify this imbalance is to implement a 40 MHz set-aside mechanism (consistent in all respects other than size with the parameters contemplated by ISED in its 600 MHz Notice of Consultation).
25. The upcoming 600 MHz auction represents the last meaningful opportunity for the Department to address the current imbalance in low-frequency spectrum held by new facilities-based competitors and to kickstart truly sustainable facilities-based competition in the wireless market. It should not be missed.

**B. Building High-Quality and Innovative Networks in the Face of Explosive Data Consumption**

26. Shaw commends the Department for commencing this Consultation to ensure that future spectrum releases render the maximum benefit of Canadians. There is great value in this exercise: a five-year blueprint for the allocation of spectrum can provide the industry with the certainty necessary to plan and deploy network investments. For the most part, Shaw agrees with the Department's comprehensive assessments of technological developments and spectrum use and availability set forth in the Consultation Document, as discussed in our answers to the Department's specific questions in the following section. However, with so much technological change on the horizon, maintaining the

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<sup>15</sup> See Reply of Shaw Communications Inc. to 600 MHz Consultation, November 3, 2017. See also Submission of Bragg Communications Inc., O/A Eastlink, October 2, 2017, paragraph 28; and Submission of Québecor Média inc., October 2, 2017, paragraphs 3 and 5.

high quality of our networks and ensuring Canadians reap the same benefits of 5G and Internet of Things enjoyed by their international peers will require ambitious and expeditious policy making. To that end, there are a few key spectrum bands that merit prompt consideration.

### *3500 MHz Spectrum – A Cornerstone for 5G*

27. First, immediate action must be taken to make spectrum available for mobile use in the 3500 MHz band. This band is critical to 5G development, and without access to it, Canada risks falling further behind its international peers in the race to deploy 5G services.
28. As the Consultation Document acknowledges, this band is considered one of the key bands for 5G, making access to it critical for the roll-out of 5G in Canada. In 2013, the Department recognized the importance of this band, taking steps in 2014 to establish an allocation for mobile service in the 3475-3650 MHz range. However, the Department never completed the licensing process, on the basis that there was too much uncertainty internationally regarding the use of the band.
29. Today, the international status of this band is far more settled; many countries have proceeded with the necessary regulatory actions to make the spectrum available for mobile use, fuelling 5G development in these countries.
30. In Europe, the band is already harmonized for mobile networks. With a band plan that enables wide channel bandwidth (consisting of up to 400 MHz of continuous spectrum), the European Commission's Radio Spectrum Policy Group deemed the 3500 MHz band the primary band for the introduction of 5G services in Europe, and noted that it "has the possibility to put Europe at the forefront of the 5G deployment."<sup>16</sup>
31. Independently, France, Switzerland, Germany, the United Kingdom, and Ireland have proceeded to make this frequency range available for 5G development. The French regulator Arcep recently announced the grant of temporary licences to test 5G in the 3400-

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<sup>16</sup> European Commission Directorate-General for Communications Networks, Content and Technology, Radio Spectrum Policy Group, "Strategic Roadmap Towards 5G for Europe: Opinion on spectrum related aspects for next-generation wireless systems (5G)," RSPG16-032, Brussels, November 9, 2016, available online: [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) (accessed 26 January 2018).

3800 MHz bands.<sup>17</sup> Qualcomm reports that Arcep is expected to award 340 MHz (between 3460-3800 MHz) later this year.<sup>18</sup> Following a public consultation in the summer of 2017, Switzerland announced that it would auction off 300 MHz of TDD spectrum in the 3500-3800 MHz range in the second half of 2018.<sup>19</sup> Last month, Germany's telecommunications regulator released a proposal for its 5G spectrum auction, which, as currently formulated, will include 300 MHz of unpaired spectrum from the 3.6 GHz range.<sup>20</sup> The United Kingdom is also expected to commence its auction of spectrum in the band this year,<sup>21</sup> and Ireland auctioned off 350 MHz of spectrum between 3400-3800 MHz last year.<sup>22</sup>

32. Regulators in Asia have been equally active in allocating 3.5 GHz band spectrum for 5G. Last year, Singapore held a public consultation on 5G bands, including in the 3.5 GHz band.<sup>23</sup> Japan already has allocated and licensed 120 MHz of spectrum between 3400-3600 MHz for mobile broadband, and its regulator has identified the wider band (up to 4.2 GHz) as a candidate for 5G. In 2017, China held a public consultation on the use of 3300-3600 MHz for 5G and is currently leading a multi-vendor interoperability verification process across the 3500 MHz band.
33. Closer to home, in the U.S., the 3550-3700 MHz band is almost available for wireless broadband use and the FCC is now considering making more mid-band spectrum,

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<sup>17</sup> Mathieu Rosemain and Gwénaëlle Barzic, "France temporarily opens up radio waves to test 5G benefits," *Reuters*, Paris, January 16, 2018, available online: <https://www.reuters.com/article/france-telecoms-frequencies-5g/france-temporarily-opens-up-radio-waves-to-test-5g-benefits-idUSL8N1PB5GU> (accessed 26 January 2018).

<sup>18</sup> Qualcomm Technologies, Inc., "Spectrum for 4G and 5G," available online: <https://www.qualcomm.com/media/documents/files/spectrum-for-4g-and-5g.pdf> (accessed 26 January 2018).

<sup>19</sup> "Switzerland lines up 5G spectrum auction for H2 2018," *TeleGeography*, November 9, 2017, available online: <https://www.telegeography.com/products/commsupdate/articles/2017/11/09/switzerland-lines-up-5g-spectrum-auction-for-h2-2018/> (accessed 26 January 2018).

<sup>20</sup> "German regulator proposes 5G auction terms," *Mobile World Live*, January 31, 2018, available online: <https://www.mobileworldlive.com/featured-content/top-three/german-regulator-proposes-5g-auction-terms/?ID=00Qw00000128POMEA2&BU> (accessed 31 January 2018).

<sup>21</sup> See Ofcom, "Award of 2.3 and 3.4 GHz spectrum by auction," January 25, 2018, available online: <https://www.ofcom.org.uk/spectrum/spectrum-management/spectrum-awards/awards-in-progress/2-3-and-3-4-ghz-auction> (accessed 26 January 2018).

<sup>22</sup> Commission for Communications Regulation, *Results of the 3.6 GHz Band Spectrum Award – Information Notice*, ComReg 17/38, May 22, 2017.

<sup>23</sup> *Consultation Paper Issued by the Info-Communications Media Development Authority of Singapore – 5G Mobile Services and Networks*, May 23, 2017, available online: <https://www.imda.gov.sg/-/media/imda/files/inner/pcdg/consultations/consultation-paper/public-consultation-on-5g-mobile-services-and-networks/5g-public-consultation.pdf?la=en> (accessed January 26, 2018).

including 3700-4200 MHz, available for use to meet projected future demand for mobile broadband.<sup>24</sup>

34. Eager to leverage the new spectrum available for mobile use, device manufacturers have responded in haste to these international regulatory developments. As the Consultation Document notes, the 3500 MHz band is already standardized in the 3GPP, and there is a nascent equipment ecosystem that leverages the band. Concurrent with the development of 5G New Radio standard equipment, which is expected to come to market next year, 3GPP is working on a new band class that would cover the entire band (3400-4200 MHz). With equipment available, consumers and businesses in many of the abovementioned countries are poised to begin accessing 5G services. Canadians deserve the same.
35. Opening new parts of the 3500 MHz band could make a uniquely large amount of mid-band spectrum available for mobile services. With appropriate interference mitigation measures to protect incumbent FSS users in the lower part of the C-band, close to 1 GHz of wide channel spectrum could potentially be made available to support the enormous growth in mobile broadband traffic. In this respect, Shaw commends the Department for expanding its future consultation on the 3500 MHz band to include 3400-4200 MHz.
36. Mid-band spectrum is critical for both LTE and 5G deployments due to the availability of wide channels and favourable propagation characteristics relative to higher frequency bands. The 3500 MHz band is the only band where Gigabit LTE can be deployed in a single band, and it is the lowest frequency band where 5G could be deployed with large channel bandwidths, making it one of the best bands for deployment of 5G New Radio technology. Although mmW spectrum is undeniably important for the deployment of 5G, the 3500 MHz band has characteristics that make it a crucial complement:
  - **Versatility:** The range and relatively better in-building penetration of the 3500 MHz band allow for deployments that leverage significantly larger cells than mmW spectrum. The spectrum can be used in macro, small cell, and indoor applications;

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<sup>24</sup> Federal Communications Commission, *Exploring Flexible Use in Mid-Band Spectrum Between 3.7 GHz and 24 GHz, Notice of Inquiry*, GN Docket No. 17-183, July 13, 2017 (the “Mid-Band Spectrum Consultation”).

- **Consistent signal performance:** While mmW spectrum suffers from path loss, affecting signal consistency, the 3500 MHz band can provide a more consistent connectivity experience;
  - **Simple mobile antenna design:** mmW spectrum faces significant challenges in terms of physical blockage (e.g., by walls, trees, etc.), and further development is required to reduce the size and form factor of the antenna to enable it to fit into a mobile form factor. The 3500 MHz band does not face these challenges, and can be easily integrated into today's generation of devices, or future 5G devices.
37. To ensure that Canadian consumers and businesses enjoy the same benefits as their counterparts in other countries, we urge the Department to prioritize its consultation on this band. Given the anticipated benefits of 5G, this band will be vital to the future competitiveness of Canada's digital economy. Though there will be a number of incumbency issues to address in the expanded 3500 MHz band, they should not be seen as a reason to delay action on this band. Indeed, significant incumbency challenges in the U.S. – which are not present in Canada – did not stop the FCC from proceeding with its reforms.<sup>25</sup> Furthermore, Canada will not be alone in grappling with perhaps the most complex issue, being the treatment of fixed satellite service ("FSS") in the C-band. Both Ofcom and the FCC focused on this issue in their 2016 and 2017 respective consultations.<sup>26</sup> Mitigation techniques will need to be developed to protect these users in

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<sup>25</sup> In the U.S., the 3550-3700 MHz band was used by a number of federal agencies for radiolocation operations, including Department of Defense radar systems, as well as fixed satellite earth stations in licensed to receive on frequencies in the extended C-band (3600-3650).

<sup>26</sup> Certain major American satellite operators appear amenable to sharing C-band spectrum with mobile through market driven arrangements. In October, Intel and satellite operator Intelsat submitted a joint proposal to the FCC's Mid-Band Spectrum Consultation to allow co-primary terrestrial mobile operations in the 3700-4200 Mhz band through commercial agreements. The proposal asks that the FCC "encourage primarily affected FSS satellite operators to develop a centralised clearance mechanism that, in consultation with prospective terrestrial mobile users, would consolidate satellite operations in a portion of the 3700-4200MHz band in specific geographic areas of terrestrial interest and thus 'clear' portions of the C-band for terrestrial use free of interference issues in those geographic areas". Satellite operators would be permitted to enter into "market-driven private agreements" with mobile operators for clearance of the spectrum and subsequent use by mobile. In early 2018, major satellite provider SES confirmed its backing for the proposal. See Joint Comments of Intelsat License LLC and Intel Corporation to the Federal Communications Commission to the Mid-Band Spectrum Consultation, *supra* note 24, October 2, 2017. See also Diana Goovaerts, "Intel, Intelsat pitch C-band 5G to FCC," Mobile World Live, October 4, 2017, available online: <https://www.mobileworldlive.com/featured-content/top-three/intel-intelsat-pitch-c-band-5g-to-fcc/> (accessed 14 February 2018); and Kavitha Majithia, "Satellite players back spectrum proposal to speed 5G," Mobile World Live, February 9, 2018, available online:

Canada, but the Department will be able to draw on the work already begun by its international counterparts in concert with industry.

38. Future consultations on this band must contemplate the measures that will promote facilities-based competition, including through band plan channelization and licensing frameworks. The future band plans for the 3500 MHz band, should generally align with international developments, allowing for optimal 5G deployments and facilitating the use of spectrum by competitive players. For example, since 5G will comprise primarily time division duplex (“TDD”) technology, the spectrum that will be reallocated in 3475-3650 MHz will need to be licensed as unpaired blocks, consistent with recommendations of the RABC in the 2014 consultation. The band plan will also need to envisage wider block sizes – 15 MHz or 20 MHz – required to support modern broadband technologies. If the allocation for mobile service is extended to 3400 MHz and upwards of 4200 MHz, larger, optimal block sizes of 40 MHz could be considered.
39. Appropriate measures to prevent spectrum concentration and ensure competition, such as set-asides, will need to be implemented to ensure equitable access to this valuable mid-band spectrum. As discussed above, the national incumbent providers continue to enjoy a considerable advantage with respect to spectrum holdings across all bands, including important mid-band holdings, which reinforces their dominance of the market.

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<https://www.mobileworldlive.com/featured-content/home-banner/satellite-players-back-spectrum-proposal-to-speed-5g/?ID=00Qw00000128POMEA2&BU> (accessed 14 February 2018).



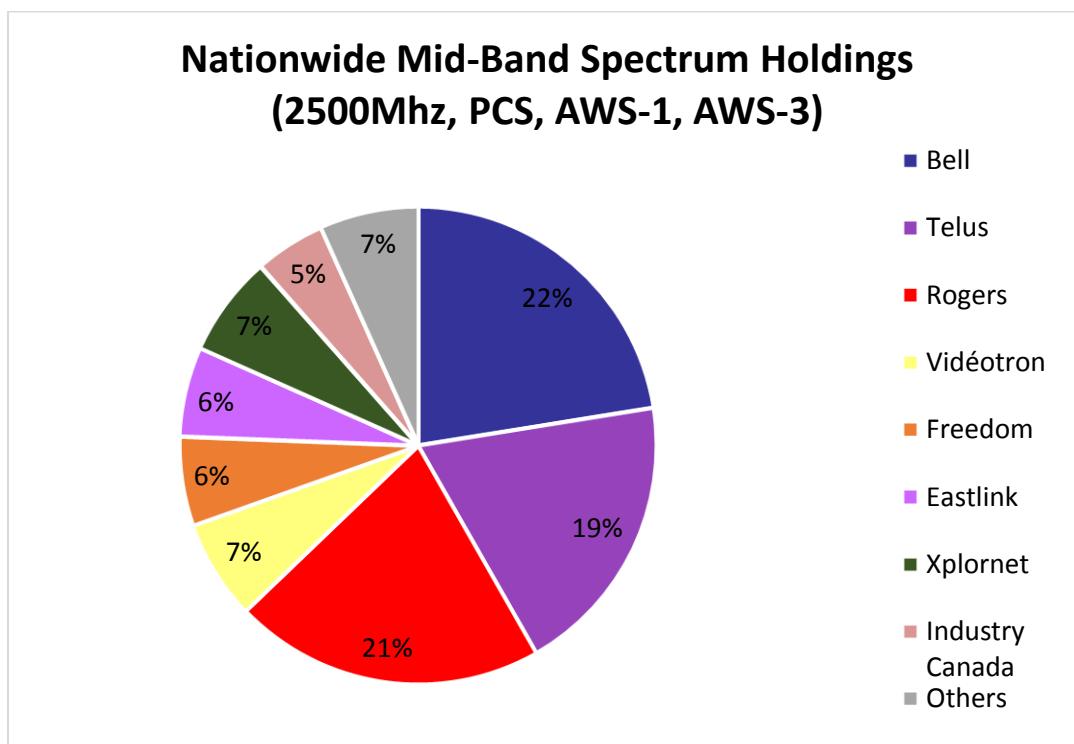


Figure 2 - Weighted MHz/Pop estimate, based on ISED's *National Holdings of Commercial Mobile Spectrum*, July 14, 2016, updated to reflect licence transfers approved by ISED after this date.<sup>27</sup>

40. Failure to implement appropriate pro-competitive measures in licensing and auction frameworks will see existing spectrum concentration barriers persist into the 5G era, further entrenching the dominance of the incumbents and limiting the potential that 5G holds for Canadians.
41. It is also critical for the promotion of facilities-based competition that the Department proceed expeditiously to finalize a licensing framework for the 3475-3650 MHz portion of the band and open it for mobile use. For the reasons discussed above, this spectrum will be a key part of the network plans of non-incumbent competitors aiming to roll-out 5G. Delays could further entrench the incumbent uses in the band, making it harder to proceed with the repurposing contemplated in its 2014 decision, *Decisions Regarding Policy Changes in the 3500 MHz Band (3475-3650 MHz) and a New Licensing Process*, DGSO-007-14 (the "3500 MHz Decision").

<sup>27</sup> See ISED, *National Holdings of Commercial Mobile Spectrum*, current as of July 14, 2016, available online: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11210.html> (accessed 30 January 2018).

42. Existing licensees seeking a new spectrum licence under the flexible use policy must be required, as contemplated in the 3500 MHz Decision, to furnish detailed technology and economic impact analyses evidencing the need for specific spectrum to continue provision of existing fixed wireless broadband service. In cases where such evidence supports a finding of active use, Shaw submits that partial conversion would be appropriate, similar to the Department's approach toward the 2500 MHz band, in which existing licensees were awarded flexible use licences equal to a set amount of their existing holdings, and the balance was returned for auction. Partial conversion will ensure that non-incumbents are not foreclosed from accessing certain critical spectrum bands. As others have noted previously, there are numerous similarities between the 3500 MHz and 2500 MHz bands in terms of their evolution,<sup>28</sup> making the Department's approach toward incumbent users in the 2500 MHz band a model for the future 3500 MHz consultation.

#### *The Importance of Backhaul in the 5G World*

43. Backhaul is a critical input of wireless service provision. As discussed further below in Part III, it will become even more important with 5G networks, which will necessitate denser and higher capacity backhaul links. Although technological advancements are expected to yield spectrum efficiency gains, there is no doubt that more spectrum will be needed for backhaul purposes if we are to meet the anticipated demands associated with 5G and rapidly growing data consumption. Further, as explained in our answer to Question 13, below, the fee calculation methodology for backhaul spectrum needs to be updated so that carriers are incentivized to use the most spectrally efficient technology available.
44. We also note the importance of backhaul spectrum to new competitors, like Shaw, who often rely on wireless backhaul to provide services outside of their wireline footprint. Thus, consistent with Shaw's submissions above, future allocations and releases of spectrum for backhaul should incorporate appropriate pro-competitive measures.

#### *Meeting Capacity Demands and Driving Innovation with Licence-Exempt Spectrum*

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<sup>28</sup> See 3500 MHz Decision, paragraph 15.

45. Enhanced access to licence-exempt spectrum should also be a policy priority for the government. Licence-exempt spectrum will ensure our telecommunications networks have the capacity to meet the growing demands for data while concurrently supporting the proliferation of innovative uses and technologies enabled by the Internet of Things. As the Department recognizes in the Consultation Document, licence-exempt spectrum will be a crucial component of the ultra-connected Internet of Things era and will be critical to supporting anticipated mobile broadband data growth. As discussed in recent proceedings,<sup>29</sup> these events are imminent – not five years out – creating a need for urgent policy action that will unlock more spectrum for licence-exempt use. The Department's 5150 MHz Decision was an important first step toward liberalizing the 5 GHz band for optimum use,<sup>30</sup> but it alone will be insufficient to fend off congestion in this key licence-exempt band, even in the near term. Two additional actions can be taken to significantly enhance the efficiency of the band for licence-exempt use.
46. First, the Department should reconsider the restriction on use in the 5600-5650 MHz portion of the band. RLANs are currently restricted from transmitting in the 5600-5650 MHz band to protect Environment Canada's weather radars operating in this band. Due to this constraint, which is unique to Canada, 80 and 160 MHz channels in the 5 GHz band are severely limited. However, given recent improvements in Dynamic Frequency Selection ("DFS") technology, the Department should consider relaxing that restriction. Both the FCC and European Telecommunications Standards Institute have implemented DFS procedures that can now detect smaller, faster pulse weather radars. The Department should examine these new DFS procedures to determine if they resolve the interference concerns.
47. Second, the Department should consider sharing in the 5850-5925 MHz band that is currently designated for use by Dedicated Short Range Communications ("DSRC") in support of Intelligent Transport Systems ("ITS"). Regulators in the U.S. and Europe have already examined the expansion of RLANs into this band,<sup>31</sup> which could enable the use of

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<sup>29</sup> See 5150 MHz Decision, *supra* note 1, paragraph 11.

<sup>30</sup> To preserve the benefits to Canadians stemming from the 5150 MHz decision, the Department should also promote international harmonization for outdoor use and higher power limits in this portion of the band at the World Radiocommunication Conference 2019 ("WRC-19"). At a minimum, the Department should ensure that the WRC-19 decisions do not impact the extensive use already being made of this band by higher power and outdoor RLAN devices.

<sup>31</sup> See, e.g., Federal Communications Commission Public Notice, FCC 16-68, June 1, 2016.

a full 160 MHz 802.11 ac Wi-Fi channel, alleviating congestion in the Wi-Fi bands and enabling Wi-Fi to operate at substantially higher speeds than those that are achievable today. In the U.S., there is bipartisan support at the FCC for opening this band for sharing with RLANS.<sup>32</sup> Initial technical analysis suggests that co-existence between DSRC and Wi-Fi is workable, particularly because DSRC has not yet been deployed, leaving flexibility for pre-operational technical planning among system engineers.<sup>33</sup> However, some have questioned whether DSRC will ever actually be used for ITS, as innovation in the automobile industry is outpacing DSRC development,<sup>34</sup> casting further doubt on the need for DSRC exclusive spectrum. There are ample reasons for the Department to proceed with its own examination and undertaking of use cases and sharing studies in this band, particularly because there currently is very little use being made of this spectrum by ITS.

48. Shaw urges the Department to consider opening these bands for broader licence-exempt use, in addition to those bands considered in the Consultation Document (and discussed by Shaw in its specific responses in the following section).

### **C. Promoting Efficient Deployment and Extensive Network Coverage**

49. Barriers to infrastructure access impede both the efficient deployment of networks and the expansion of networks in rural and remote parts of the country. Given the increasing importance of wireline infrastructure to wireless deployments, these challenges are not limited to radio installations. For all the reasons described above, it is critical that the Spectrum Outlook resulting from this Consultation contemplate the expeditious allocation and release of more wireless spectrum in a pro-competitive manner. However, this will not be sufficient to satisfy the Department's stated objectives for this proceeding if it is not joined by policies to address infrastructure access challenges.

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<sup>32</sup> Billy Mitchell, "FCC commissioners: Free up smart car spectrum for general use," *FedScoop*, January 12, 2016, online: <https://www.fedscoop.com/fcc-commissioners-free-up-connected-car-spectrum-for-general-use/> (accessed 16 January 2018).

<sup>33</sup> Rob Alderfer, Dirk Grunwald & Kenneth Baker, "Optimizing DSRC Safety Efficacy and Spectrum Utility in the 5.9 GHz Band," October 20, 2014, available online through SSRN at <https://ssrn.com/abstract=2841346> (accessed 22 January 2018). For example, technical analysis indicates that rechannelization – wherein DSRC safety applications have access to the top part of the band and RLANS use the lower part – is the most effective way to protect safety-critical, latency-sensitive DSRC operations.

<sup>34</sup> *Supra*, note 19. Many car companies are choosing to instead adopt cellular v2v technology for ITS. See, for example, 5GAA Automotive Association, <http://5gaa.org/5g-technology/experience-the-future/> (accessed 22 January 2018).

50.     Densification and small cell deployment present economical solutions to growing traffic pressures, but significant challenges remain in the Canadian market relating to access rights. Non-incumbent competitors, in particular, continue to face significant barriers to access, preventing us from executing small cell deployments efficiently, and consequently undercutting the benefits of such densification. It also has the effect of reducing our ability to deal with local mobile traffic growth in a timely and cost-effective manner. Immediate attention is required to resolve access issues to ensure that small cells can be deployed quickly, and are available to all operators. This will require a constructive, collaborative effort by the Department, the CRTC and industry.
51.     Other regulators have taken notice of the potential for access issues to impede the deployment of 5G. Last month, in a public address, the Assistant Secretary of the National Telecommunications & Information Administration ("NTIA") in the U.S. highlighted the important role that government can play to facilitate the roll-out of 5G:

Of course, wireless networks aren't powered purely by spectrum - in many if not most cases, they require wired backhaul connections, principally fiber. These connections will be even more important with 5G, which will need hundreds of thousands of small cells to be installed across the country.

Even as demand for 5G infrastructure grows, many areas in the United States still don't have the foundational broadband infrastructure needed to compete in a 21<sup>st</sup> century economy. We need to do everything we can to encourage infrastructure development.

One way to do this: Congress and the Executive Branch can work with private industry to look at how federal action might address the patchwork of permitting, citing [*sic*] and other regulatory provisions, in order to potentially streamline or eliminate any rules that pose unnecessary barriers to deployment. This would apply to the deployment of backhaul connections as well as the infrastructure where small cells would be installed, such as poles, streetlights, rooftops and other structures.

And it's important to remember that the federal government is the single largest landowner in the country, and it can boost deployment immensely by actively reducing barriers to deployment on public lands and in government-owned buildings.<sup>35</sup>

52.     In Canada, infrastructure access challenges fall into four categories: (a) access to privately-owned support structures (i.e., telephone poles); (b) access to antenna tower

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<sup>35</sup> Remarks of David Redl, Assistant Secretary of Commerce for Communications and Information, at CES 2018, 9 January, 2018, available online: <https://www.ntia.doc.gov/speechtestimony/2018/remarks-assistant-secretary-redl-ces-2018> (accessed 22 January 2018).

and sites; (c) access to public and privately-owned utility poles; and (d) access to municipal rights-of-way.

53. Connectivity competitors like Shaw regularly face challenges in all four categories. Disputes and challenges are arising more frequently over terms of access, rates, and conditions of access to all four types of infrastructure. Excessive, unjustified rate increases, such as the Hydro One Pole attachment charges recently imposed by the Ontario Energy Board (“OEB”), with an even higher province-wide rate being contemplated by the OEB, have a number of implications for our ability to use spectrum efficiently and effectively, including increasing the cost of maintaining current telecom networks, reducing resources available for network expansion; delaying the deployment of networks, especially in less densely populated areas where access to a greater number of support structures are required to serve a smaller number of customers; and ultimately increasing the cost of service to consumers.
54. Further complicating matters is the patchwork of permitting and siting approvals and policies that apply to the various types of infrastructure across the country. For example, in respect of utility poles, disputes are adjudicated by provincial utility boards, which have no mandate to advance telecommunications service availability. For this reason, the Department should consider, as the NTIA has, how it can work to address this patchwork of approval processes and reduce barriers to deployment. As Shaw has argued previously, an initial step would be for the Department to review the recommendations of the 2006 Telecom Policy Review Panel as they relate to support structures,<sup>36</sup> and consider whether actions could be taken to expand subsection 43(5) of the *Telecommunications Act* to regulate access by carriers to the support structures of all support structure owners, including provincially-regulated electrical utilities. This would empower the CRTC to resolve disputes between telecom carriers and support structure owners on matters of attachment charges and other terms and conditions of access.

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<sup>36</sup> In its 2006 Report, the Telecom Policy Review Panel recommended that the *Telecommunications Act* be amended to “ensure that it applies to support structures owned by electrical utilities, municipalities and other parties.” See Telecommunications Policy Review Panel, Final Report 2006 (2006) (Can.) available at: [https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/tp-rp-final-report-2006.pdf/\\$FILE/tp-rp-final-report-2006.pdf](https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/tp-rp-final-report-2006.pdf/$FILE/tp-rp-final-report-2006.pdf) (accessed 15 January 2018).

55. As the Consultation Document and SPFC recognize, spectrum is a scarce public resource, and the Department has a responsibility to Canadians to ensure it is used in a manner that maximizes economic and social benefit to Canadian consumers and businesses. If it is to discharge this responsibility, the Department must look beyond allocation and release of spectrum to see how it can also facilitate efficient deployment by working with industry and the CRTC to reduce barriers to infrastructure access. This will be critical to delivering world-class connectivity to all Canadians in the 5G era.

### III. RESPONSES TO THE SPECIFIC QUESTIONS RAISED IN THE CONSULTATION DOCUMENT

***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?***

56. Shaw is generally supportive of flexible use licencing models in bands which provide capacity for mobile use, subject to our response to Question 7 below. This gives wireless operators the ability to use the spectrum for mobile access, fixed wireless access, and/or backhaul, based on the needs in a given area, often resulting in greater spectral efficiency.
57. Also, in Shaw's view, the Department should be cautious about the prospect of providing access to licensed spectrum on an opportunistic basis. Such a change to spectrum management and licensing policy would create uncertainty, particularly related to the prospect of possibly undermining the value of spectrum licences and jeopardizing the business case for commercial mobile wireless carriers. The Department should also be cautious about promoting technologies related to dynamic spectrum access and cognitive radio at this time. These technologies are in their infancy and not commercially available.

#### ***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.***

58. Shaw generally agrees with the assessment of demand in the Consultation Document. As shown in the Consultation Document, the demand for commercial mobile services and connectivity will increase dramatically over the next few years.
59. Based on Shaw's own projections, however, the demand assessments cited in the Consultation Document may understate the projected demand.
60. Mobile traffic growth will be driven by increasing use of various advanced applications. Use of video services, such as video streaming, video conferencing, video downloads and video interactions over social media and gaming, represent the highest proportion of the mobile traffic, and we expect this trend of video consumption to continue.
61. The use of IoT solutions, such as those related to security monitoring and video surveillance technologies (e.g., connected security cameras, video-enabled locks and door bells, video streaming from drones, connected vehicles and dash-board cameras), will also substantially increase data consumption. These developments will also require improvements in network infrastructure given the large variety of devices, applications and capabilities associated with IoT devices.
62. Similarly, the evolution of mobile networks will enable the proliferation of virtual and augmented reality applications, further driving demand for mobile services. For example, the reduced latency associated with 5G will enable virtual presence applications, remote machinery operations and remote surgeries. These applications will integrate voice/audio, video and physical experiences into a single application, with extremely high demand for network resources and capacity.
63. Social networks will also contribute to growth of these services. Such networks effectively integrate multiple communications channels, and contribute to the multiplication of consumption of contents and services (for example, re-tweeting, and re-distributing). Vertical and industrial use of mobile data, such as data and video communication for remote machine operation, will also contribute to growth. We are already witnessing this today with drones.
64. These are just some examples of known applications and use cases that will drive demand for such services over the next few years. However, as the internet is a driver of great



innovation and disruption, it is impossible to predict the countless other applications and services that will arise in the next few years, further increasing demand.

**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?**

65. With respect to licenced spectrum, more spectrally-efficient technologies such as LTE-A are already being rolled out, with new developments such as 5G New Radio on the horizon. Shaw has been an industry leader in utilizing LTE-A technology, having recently launched our LTE-A network in Calgary, Edmonton, Vancouver, Toronto and Ottawa. With respect to licence-exempt spectrum, technologies such as 802.11ax and Licenced Assisted Access (“LAA”) will improve the amount of traffic that can be served effectively over existing 5 GHz spectrum. Both of these solutions are now coming to market.
66. Other developments include the use of more efficient antenna technologies, such as a higher order of multiple-input and multiple-output (“MIMO”) with hundreds of antenna elements,<sup>37</sup> more sophisticated antenna technologies, such as beam forming and beam steering,<sup>38</sup> and the use of high-order modulations, such as 256 Quadrature Amplitude Modulation (“QAM”).<sup>39</sup> These technologies are being gradually introduced and we expect that large-scale development will take place over the next 1 to 4 years.
67. However, Shaw notes that even with these developments, and the operational measures described in our response to Question 4 below, additional spectrum allocations will be required to meet both the short-term and long-term mobile needs in Canada. Spectrum expansion is essential to address growing mobile traffic demands today. However, consumers will not enjoy the full benefits of additional spectrum allocations if existing

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<sup>37</sup> MIMO technology is based on the establishment of un-correlated propagation paths of multiple antennas on both the transmit and receiving sides. The un-correlated paths make it possible to establish an orthogonality of antennas.

<sup>38</sup> Beam forming and beam steering are techniques that modify or form antenna radiation patterns of a base station, typically on a horizontal plane, so that the highest antenna gain is directed in the area of the relevant mobile device.

<sup>39</sup> QAM is a technique of modulation of digital signals in a way that carries more bits of information into a single “code word”. It is an adaptive modulation technique, and when noise levels are high, it dynamically adapts to lower modulation levels.

spectrum concentration levels are carried over into future spectrum bands. It is therefore critical that the Department adopt pro-competitive measures in future allocations.

***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?***

68. Shaw is pursuing every possible means to support increasing mobile traffic. Capabilities to accommodate increased traffic are of critical importance to Shaw particularly in light of our low spectrum capacity and lack of diverse spectrum assets relative to the large national incumbents. We are pursuing technologies such as LAA and carrier aggregation in order to maximize our use of existing spectrum in addition to the operational measures discussed below. However, the allocation of additional low-, mid- and high-band spectrum (i.e., 600 MHz, 3500 MHz and mmW), made available with appropriate pro-competitive measures, are necessary to meet projected mobile capacity and coverage demands, and enable effective competition in the Canadian market.
69. Small cell technology is available today, and is continuing to evolve rapidly. The advent of technologies such as LAA and LTE-A are making small cells even more effective by enabling spectrum densification, one of the most effective operational measures to respond to and support traffic growth. Densification will also be critical to enabling effective use of millimeter wave spectrum, which is needed for 5G deployments.
70. However, challenges in the Canadian market relating to infrastructure access make it difficult for Shaw and other providers to harness the full potential of densification to address rising traffic demands. As discussed in detail in paragraphs 49 to 55 above, non-incumbent competitors continue to face significant barriers to accessing incumbent providers' towers and other infrastructure. This prevents us from executing small cell deployments efficiently, consequently undercutting the benefits of spectrum densification.
71. Advanced traffic management is also a way to deal with broad traffic growth concerns. However, traffic management does not create new capacity – it only prevents

significant degradation in customer experience where other solutions (such as additional spectrum, densification or increased efficiency) are not available.

72. Shaw notes that Wi-Fi offload is also an effective measure for dealing with increasing mobile traffic demands for licenced spectrum. Although Wi-Fi is a very cost effective and efficient tool today, it will face the same challenges from traffic growth in the near future, as detailed in the following section.

### ***Licence-Exempt Use***

***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.***

73. Shaw generally agrees with the assessment of demand for licence-exempt spectrum in the Consultation Document. Demand is expected to increase dramatically in the next five years, primarily due to the proliferation of Wi-Fi devices.
74. According to a recent report by Quotient Associates,<sup>40</sup> between 500 MHz and 1.5 GHz of additional spectrum will be needed in the U.S. by 2025 to satisfy growing Wi-Fi demand, including multi-room coverage in a home, coverage for an office building, outdoor Wi-Fi hotspots, and other use cases.
75. Similarly, in its latest report on licence-exempt spectrum needs,<sup>41</sup> Qualcomm recommended that regulators should plan for around 1280 MHz of licence-exempt spectrum centered around the 5 GHz band to enable future WLAN-type application and usage scenarios. The report also stated that higher throughput coverage scenarios in dense environments require extensive use of 160 MHz channel bandwidth modes and as such, regulators should strive towards making multiple (i.e., three or more) 160 MHz wide channels available for licence-exempt use. IoT and licence-exempt LTE (e.g., LAA,

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<sup>40</sup> Quotient Associates, "Wi-Fi Spectrum Needs Study", February 2017, online: [https://www.wi-fi.org/download.php?file=/sites/default/files/private/Wi-Fi%20Spectrum%20Needs%20Study\\_0.pdf](https://www.wi-fi.org/download.php?file=/sites/default/files/private/Wi-Fi%20Spectrum%20Needs%20Study_0.pdf) (accessed 2 February 2018)

<sup>41</sup> Qualcomm Technologies Inc., "A Quantification of 5 GHz Unlicensed Band Spectrum Needs", July 2016, online: <https://www.qualcomm.com/documents/quantification-5-ghz-unlicensed-band-spectrum-needs> (accessed 2 February 2018)

MuLTEfire) and 5G technologies will only exacerbate the problem. For example, a Gartner report estimated that the IoT installed base will more than double from 8.4B in 2017 to 20.4B in 2020.<sup>42</sup>

**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?**

76. There are various technologies on the horizon that may provide some relief from traffic pressures and address spectrum demand. These include new wireless standards such as 802.11ax and 802.11ay,<sup>43</sup> LAA and Multefire<sup>44</sup> and 5G; and adaptive beam steering technologies. These technologies are being gradually introduced into the industry and we expect that large-scale development will take place over the next 1 to 4 years.
77. Sharing techniques can also assist in aiding to relieve traffic pressures and to meet demand. Such techniques include sharing among licence-exempt users through protocols such as Listen-Before-Talk, as well as sharing between licenced and licence-exempt users, which is important given the high and increasing demand for unlicensed spectrum. Sharing in bands near the current 5 GHz band and in higher bands should be considered on a band-by-band basis, with the adoption of no interference, no protection measures.
78. However, while these technologies may offer some incremental efficiency gains in the short term, they are not expected to keep pace with the traffic growth projections over the long term.

**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?**

<sup>42</sup> Gartner Inc., “Gartner Says 8.4 Billion Connected ‘Things’ Will Be in Use in 2017”, February 2017, online: <https://www.gartner.com/newsroom/id/3598917> (accessed 2 February 2018)

<sup>43</sup> These standards are designed to improve spectral efficiency, reduce congestion and increased throughput by, among other things, using higher-order modulation support.

<sup>44</sup> Multefire operates 4G LTE technology solely in licence-exempt spectrum, rather than requiring an anchor in licensed spectrum.

79. The licence-exempt bands that will likely see the most evolution over the next five years include the 902-928 MHz band, the 5850-5925 MHz band, and the 57-71 GHz band.
80. With the rapid growth of IoT and the Low-Power Wide-Area Network (“LPWAN”) technologies such as LoRa, millions of new devices are expected to be deployed in the 902-928 MHz band. Additionally, as detailed in paragraph 47, there is an opportunity for the Department to proceed with an examination of the 5850-5925 MHz band, which has the potential to evolve considerably, following the direction of the U.S. and Europe. Lastly, the 57-71 GHz<sup>45</sup> band will undergo significant change, with the emergence of millimeter wave 5G technology.
81. The 5.925-7.125 MHz band also has the potential to evolve over the next five years. Although the 5.925-7.125 MHz band is not yet allocated for licence-exempt use, the FCC’s recent Notice of Inquiry<sup>46</sup> indicates that flexible use policies for this band may be on the horizon south of the border. Given its proximity to the licence-exempt 5 GHz bands, it would represent an opportunity to make more mid-band spectrum available for Wi-Fi. As discussed paragraph 47, there is also an opportunity for ISED to examine the restriction on use in the 5600-5650 MHz band, which also has the potential to evolve over the next five years. Shaw would support unlicensed use in these bands, and acknowledges the importance of protecting incumbents should the Department allow such use.

**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?**

82. Shaw expects the trend for offering carrier-grade and managed Wi-Fi networks to increase over the next five years as service providers come to see these networks as an increasingly attractive offload tool, and business customers come to see managed Wi-Fi services as an appealing value-add for their employees and customers. Indeed, in specific

<sup>45</sup> We note that the 64-71 GHz range was the subject of the Department’s *Consultation on Releasing mmWave Spectrum to Support 5G*, which contemplates future unlicensed use of that band, and the adjacent 57-64 GHz range is already available for unlicensed use.

<sup>46</sup> *Supra*, note 19.

market verticals such as retail, hospitality and professional services, Wi-Fi availability is a base requirement for daily business activities.

83. Shaw was one of the first providers in the country to offer a carrier-grade Wi-Fi network; our public Wi-Fi network alone has grown to over 100,000 Wi-Fi hotspots in the past six years. In addition, Shaw continues to add new managed Wi-Fi service locations each month. Shaw's public Wi-Fi network's subscriber and traffic growth have both been steady since its launch.
84. Clearly, this continued growth will have an impact on congestion in Wi-Fi bands. Congestion in the 2.4 GHz band has become critical in Canada, rendering this spectrum virtually unusable for popular applications such as video streaming and conferencing. As a result, usage is now growing rapidly in the 5 GHz band. Shaw's Go WiFi network is a case in point, with 5 GHz traffic now surpassing 2.4 GHz traffic – a trend that is likely to accelerate due to limited capacity and congestion on 2.4 GHz networks.

#### **Satellite**

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

85. Shaw has no comment at this time.

**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**

86. The C-band continues to be important for the operation of FSS in Canada. For example, Shaw uses this spectrum to deliver Standard Definition (SD) and High Definition (HD) video services to consumers, particularly in underserved areas. Satellite remains the most efficient method to reach many of these areas (particularly northern communities). C-

band spectrum is also critical to Shaw for the reception of foreign and American video programming; the U.S. continues to use C-band FSS for video distribution.

87. Shaw is not currently aware of any commercially available technology that will eliminate interference if C-band spectrum is shared with MSS or mobile services, but these technologies and other mitigation techniques should continue to be explored and developed with a view to exploiting the spectrum as fully and efficiently as possible.
88. Shaw agrees with the assessment of the Ku-Band in Canada. It is critical to the DTH industry in Canada that the Ku and Extend Ku Bands remain protected and interference free. Shaw has no comments on the Ka-Band.

**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?**

89. To aid in relieving traffic pressures and addressing spectrum demand for satellite services, Shaw is using advanced modulation systems and deploying increasingly more advanced technological compression solutions on our DTH networks. However, high-quality video and audio will require more efficient solutions. With the consumer-led conversion from SD to HD, and the future of 4K or Ultra HD on the horizon, compression technology will be key to being able to offer these bandwidth-intensive products within the current licensed satellite spectrum. Technology advancements in this area are grouped into categories:
- (a) Compression MPEG4, AVC (H.264), HEVC (H.265)
  - (b) Modulation Techniques 8PSK with Turbo Coding, DVB-S2 and DVB-S2X(future)
  - (c) Satellite ALC (Automatic Level Control) providing best case scenario availability in the DTH Links during rain fade. ALC also allows us to improve our bits/hertz over a non ALC link.
90. These technologies are available today and being deployed. However, we expect that demand will continue to outpace technology solutions.

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

91. In Shaw's view, all of these services are important. As trends continue toward increased use of OTT, IPTV, IoT, and connected cars, broadband may become more popular than traditional services. However, we must ensure these traditional services are supported to ensure all Canadians has access to services, with priority to underserved areas.

***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.***

92. Shaw generally agrees with the assessment of demand for backhaul in the next five years and that one of the drivers of this demand will be the increased use of small cells in both the sub-6 GHz and millimetre wave bands. As discussed in Part II above, backhaul spectrum is extremely important to the ability of new competitors in the mobile wireless to compete effectively, particularly in regions where those new competitors do not have wireline infrastructure to compliment their mobile wireless presence. Backhaul spectrum will become even more important in the era of 5G, as 5G networks will require higher capacity backhaul links per cell site.
93. Shaw notes that providers' ability to utilize technologies that promote efficient use of backhaul spectrum is hampered by the Department's severely outdated licensing regime and fee calculation methodology for backhaul spectrum. The current methodology, which utilizes DS0 or 64kbps capacity increments, results in enormous licence fees, especially for high capacity links, even when these links are very short. Modern capacity links are many thousands of time higher than 64kbps (1Gbps = 15,625 DS0 or 64kbs links). A licence fee approach that is based on per installed capacity, rather than utilized spectrum, is counterproductive, as it results in more capacity for the same amount of spectrum, thereby penalizing those who use spectrum efficient technologies.



94. An Ericsson Microwave report recently emphasized the critical importance of licence fees to the level of adoption of microwave transport links, especially in high frequency bands.<sup>47</sup> In over 20 countries, licences for a 250 MHz microwave hop is below 250 euros/year, while the typical cost in Canada for a 1Gbps link costs \$13,280.00/year. In the E-band, links can be capable of 4 Gbps, which would cost up to \$53,120.00/year in Canada. Today, advanced microwave links support up to 10Gbps speeds, making a linear pricing model no longer financially feasible. In fact, in some cases, the cost of the licence for just one year exceeds the entire cost of infrastructure.
95. The spectrum fee proportion of the total cost of microwave links is constantly rising, and is currently the dominant factor for high capacity links. If this trend continues, deployment of high capacity microwave links will become even more cost prohibitive and the contribution of microwave links in backhaul solutions in Canada will deteriorate even further. Shaw therefore urges the Department to update its fee calculation methodology
96. Updating the severely outdated licensing regime and fee calculation methodology for backhaul spectrum would greatly benefit consumers. For example, it would reduce barriers to network expansion, particularly with respect to areas outside of densely populated urban areas. In order to expand coverage in some of these areas, providers are either faced with the choice of building fibre, which is often impractical, or utilizing microwave links. Encouraging providers to utilize microwave links would result in faster, more cost-effective network expansion, the use of less infrastructure, and less risk that infrastructure would be damaged by natural disasters. Addressing this issue would also result in less costs being passed on to consumers and would therefore have the potential to result in lower prices for Canadians.

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

<sup>47</sup> Ericsson, "Ericsson Microwave Outlook: Trends and Needs in the Microwave Industry", October 2016, online: <https://www.ericsson.com/assets/local/microwave-outlook/documents/ericsson-microwave-outlook-report-2016.pdf> (accessed 2 February 2018)

97. At the present time, in regions where the exclusive use of fiber facilities is infeasible, Shaw employs a mix of fiber and wireless microwave solutions for its medium and long-haul networks supporting the distribution of broadcasting, Internet and phone services. We expect this to continue. Microwave links deliver benefits to consumers and are considered a strategic asset by providers. They frequently provide redundant links for fixed networks for critical communication such as voice. In some situations, fiber optic links are exposed to natural disasters, and the existence of microwave links provides the necessary backup solution for essential communication needs. For mobile backhaul, microwave radio links are often the most practicable backhaul solution.
98. As infrared communication (i.e., free space optic) develops, it may replace some of the fiber and microwave connectivity, largely because it will be capable of providing large bandwidth, especially in shorter distances for 5G. This technology is still in nascent stages, however, and further development is required to ensure proper functioning.

***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?***

99. Shaw is continually deploying more advanced technological solutions to address spectrum demand for backhaul services. High traffic growth requires rapid deployment of high capacity backhaul solutions in a cost-efficient manner. The technological advancements in this area can be grouped into the following categories:
- Higher capacity through higher order of modulation, including 256, 512, 1024, and 2048 QAM;
  - Adaptive technologies that effectively manage traffic variations to maximize capacity of the link by efficiently using main and diversity branches of the link; and,
  - Support of Software Defined Networking (SDN) and Network Virtualization Functions (NFV). SDN will enable some advanced traffic management and optimization

techniques, such as: (i) flow-based traffic shaping;<sup>48</sup> (ii) flow/traffic re-routing;<sup>49</sup> and, (iii) dynamic frequency allocation.<sup>50</sup>

100. Moreover, industry groups are actively pursuing Full Duplex Microwave technologies that will allow the existing Frequency Division Duplex (“FDD”) systems to almost double the throughput of the radios. However, this is a challenging task. Frequencies would be transmitting in both directions, and interference studies would be necessary. As such, several issues may need to be resolved before this becomes a viable solution. New Air interface and modulation technologies are also being researched, such as the use of spiral modulation, which greatly increases spectral efficiency through the transition from periodic to non-periodic signal modulation.
101. These technologies are being gradually introduced and we expect that large-scale development will take place over the next 1 to 4 years.

**Q16 – Will the demand for commercial mobile, license-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?**

102. The increasing demand for the above services will indeed impact the demand for backhaul spectrum, especially where millimetre wave frequencies are used in urban and other high-density areas (e.g., train stations, airports, stadiums, etc.). Mobile broadband and its rapid technological evolution towards 5G, with significant technical requirements for reduced latency and increased capacity in these areas, will be a dominant driver of backhaul spectrum demand. Additionally, fixed wireless service, as a stand-alone service, or combined with 5G, will require very high capacity for residential and enterprise users.
103. The allocation of backhaul spectrum for 5G access could create significant hardship for incumbent grid-cell licensees in 38 GHz band. This band has a significant amount of

<sup>48</sup> This is a methodology that provides dynamical adaptation of traffic flows to the part of the network where transport capacity is currently available - by utilizing this methodology, the Hierarchical Quality of Service (HQoS) will provide overall network-level service quality.

<sup>49</sup> This SDN-based solution allows maximization of network capacity at the time of peak demand by dynamic re-routing of traffic to spare, redundant or underutilized links.

<sup>50</sup> An emerging technology that can optimize utilization of hybrid licensed and licence-exempt technologies for backhaul, by applying SDN capabilities in minimization of interference and re-programming of microwave nodes dynamically.

spectrum, which is very usable in urban areas for mobile backhaul. As detailed in Shaw's initial comments in the Department's mmW Consultation, Shaw has invested significantly in developing valuable, innovative, high-quality wireless connectivity experiences for Canadians, in part using grid cell licenses.<sup>51</sup> Shaw must retain the ability to continue to meet the needs of its customers and enhance its network in these areas during this pendency of this proceeding. Otherwise, Shaw's customers may not be able to obtain the types of services they require as their needs evolve. Relocation of equipment to other bands would be very costly, time consuming and service-impacting for end customers.

**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?***

104. We expect that, in Canada, millimeter wave spectrum will experience high demand. Channel aggregation techniques, such as combination of 18GHz and 80GHz frequencies, will also create high demand for E-band spectrum. However, due to the channel sizes and bandwidth available, combined with the outdated licensing regime as alluded to above in Shaw's response to Question 13, use of this spectrum is becoming even more prohibitive. As mentioned, the cost of a licensed microwave link is still based on 64 kbps voice channels. Radios using the E-band can provide up to 10 Gbps of data traffic, and the cost for just one licence for such use would cost over \$131,000 annually, making it financially infeasible to operate multiple links. We also anticipate high demand for the V-band in the coming years, as it will be widely used for small cell backhaul.

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

105. Although Shaw is generally supportive of flexible use licensing for mobile and fixed access, co-existence of mobile services with point-to-point microwave backhaul services in the same territory and same frequencies can result in detrimental levels of interference.

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<sup>51</sup> Citation to specific paragraphs in submission.

106. Accordingly, caution must be exercised in territories where flexible use is contemplated in a band in which there are incumbent fixed point-to-point microwave backhaul services. In those territories, microwave services should be allocated to a specific frequency block within that band (with flexible use being allowed in the remaining frequency blocks within the band), allowing for continued operation of those microwave services and minimizing interference.

***Potential Frequency Bands for Future Release***

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

***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***

107. Shaw generally agrees with the assessments provided in the Consultation Document. There is clearly a need for significantly more, and highly diverse spectrum, including low, mid-, and high-band spectrum over the next few years. In Shaw's view, it is clear that mobile services will experience the fastest growth and highest demand for additional spectrum allocations. The low frequency 600 MHz band, which is critical for new competitors like Shaw to achieve optimal network coverage roll-outs and deliver a quality consumer experience, should be released first. It is therefore crucial that the Department continue to move forward with making 600 MHz spectrum available for commercial mobile use as expeditiously as possible. Network grid design is based on the lowest available frequency band, and delays in licensing low bands, such as 600 MHz, could create sub-optimal network rollouts. New competitors specifically have an urgent need to obtain low-frequency spectrum in order to further-drive competition, given the national incumbents' significant low-frequency spectrum advantage. Additionally, there is already an established ecosystem for 600 MHz spectrum, and these devices are already available in the Canadian market.

108. 3500 MHz spectrum should also be made available for mobile use as soon as possible. As the Department acknowledges in its assessment, there is significant international interest in the 3500 MHz band, especially given its instrumentality to 5G. We urge the Department to proceed with its 3500 MHz consultation with priority and urgency, as detailed in paragraphs 27 to 42.
109. The Department must also prioritize enhanced access to licence-exempt spectrum, in order to keep pace with Wi-Fi and mobile broadband data growth and to enable the ultra-connected IoT era. Specifically, as detailed in paragraphs 45 to 48, the Department should examine the restriction on use in the 5600-5650 MHz portion of the band and should consider sharing the 5850-5925 MHz band.
110. The 24.5-27.5 GHz band should also be prioritized for release for mobile use. This band has the potential to drive the development of 5G, along with the bands that the Department considered in its millimetre wave consultation. This band also represents an opportunity for the Department to harmonize with international developments. The U.S. has already decided to make this band available for mobile use<sup>52</sup> and the European Union has flagged it as its top priority band in its 5G roadmap.<sup>53</sup>
111. Shaw also acknowledges that Table 7 includes the 800 MHz and 900 MHz bands. Although these bands have been standardized in the 3GPP, the prospective use of these bands is unclear. The U.S. has experienced some challenges with the 800 MHz and 900 MHz bands, including, among other things, interference issues with adjacent bands and uncertainty as to whether equipment ecosystems will emerge. In Shaw's view, it is a much higher priority to release 600 MHz, 3500 MHz and millimetre wave spectrum, given the importance and urgency related to these bands for mobile use.

**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.**

<sup>52</sup> *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, FCC 17-152, Second Report and Order, Further Notice of Proposed Rulemaking, Memorandum Opinion and Order at para 22 (Nov. 2017).

<sup>53</sup> Ministerial Declaration, "Making 5G a success for Europe", July 2017, online: [https://www.eu2017.ee/sites/default/files/inline-files/Ministerial%20declaration%205G\\_final\\_0.pdf](https://www.eu2017.ee/sites/default/files/inline-files/Ministerial%20declaration%205G_final_0.pdf) (accessed 2 Feb 2018).

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

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

112. In Shaw's view, the Department could consider the 37-43.5 GHz band for release in the next five years. While a portion of this band was covered in the Department's millimetre wave Consultation, as we alluded to in our reply comments in that proceeding, the Department should ensure that sufficient spectrum is available in this band for commercial mobile use, together with appropriate technical and operational requirements for both commercial mobile and FSS to share. Similarly, the Department could consider the 47.2-48.2 GHz band in order to harmonize with the FCC's recent decision.<sup>54</sup>
113. The Department could also consider allowing for backhaul use in the 71 GHz and 81 GHz bands. Equipment has started to become available in these bands, and these bands are well-suited for small cell and 5G backhaul purposes.
114. Moreover, as alluded to in our response to Question 7, Shaw notes that there could be an opportunity for the Department to allow for unlicensed use in the 5.925-7.125 MHz band and the 5600-5650 MHz band, and acknowledges the importance of protecting incumbents should the Department allow such use.

\*\*\* End of Document \*\*\*

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<sup>54</sup> *Supra*, note 39 at paras 43-59.