

# Consultation on the Spectrum Outlook 2018 to 2022 (SLPB-006-17)

Comments of  
**Ericsson Canada Inc.**

February 16<sup>th</sup>, 2018

**February 16th, 2018**

**Sent by email to:** ic.spectrumauctions-encheresduspectre.ic@canada.ca

**Cc:**

Director, Spectrum Regulatory Best Practices,  
Innovation, Science and Economic Development Canada,  
235 Queen Street, Ottawa, Ontario K1A 0H5

**RE: Canada Gazette, Part I, October 21, 2017, Notice No. SLPB-006-17—Consultation on the Spectrum Outlook 2018 to 2022**

Please find attached the comments of Ericsson Canada Inc. in response to the above Canada Gazette.

The document was created using Adobe Acrobat X Pro Version 10.0.0, on operating system Microsoft Windows 7.

We appreciate the opportunity to provide comments and as always, we are ready to work with Innovation, Science and Economic Development (ISED) Canada in the future on this very important topic.

Sincerely,

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## EXECUTIVE SUMMARY

In developing policies and licensing frameworks to make additional spectrum available, Ericsson encourages ISED to consider some key aspects as follows:

- Flexibility and technology neutrality in the assignment of spectrum to allow service providers the ability to respond to changing market demands which include public interests: With the fast pace of technology advancements, changing market demands and innovative business cases, it is important that radio spectrum licensing avoid rigid definitions of services and users, leaving spectrum licencees the flexibility to use radio spectrum in an optimal manner fitting their business plans, allowing amazing innovations to spring forward with services that have not even been imagined or thought of yet.
- Ensure services that need spectrum receive the spectrum in a timely fashion, synchronized with viable ecosystems: Spectrum without a supporting equipment ecosystem would be a waste of public resources. With substantial progress in 5G in many parts of the world in the mid-, high- and low-frequency ranges, it is important to have corresponding spectrum bands released in conjunction with the development of the respective ecosystems.
- A balanced distribution of spectrum amongst the different services and spectrum sharing when relocation of incumbents either is impossible or will consume too much time: The current “imbalance” in the distribution of spectrum among various services must take into consideration planning spectrum for the future. When clearing of spectrum is either impossible or will take too much time, various spectrum sharing schemes among services could be considered.

Commercial mobile services will grow fast in terms of devices, subscribership and the traffic which consequently ensues. The demand for mobile data continues to growth exponentially with North America having the highest usage, from 7.1 Gigabytes (GB) per month per smartphone by the end of 2017 to 48 GB by the end of 2023. In terms of subscriptions, North America currently

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has the highest LTE subscriptions at close to 80 percent and is expected to lead 5G uptake – with 5G estimated to account for 37 percent of all mobile subscriptions in the region by the end of 2023.

There are technologies available to address traffic pressures and spectrum demands. However, there are always additional trade-offs when implementing these technologies. Furthermore, many use cases demand very high capacity, near-zero latency, and massive connected devices, which cannot be addressed via technologies alone and additional spectrum is required.

With network densification, small cell deployments, infrastructure deployment is a challenge to network operators. Current local regulations, with strict requirement on siting/location and aesthetics, either hinder or slow down site acquisition and the antenna installation process. To facilitate infrastructure deployment, it is required to have multi-stakeholder strategies to review and revise the current regulatory regime dealing with infrastructure deployment.

In the early stage, with Wi-Fi offloading and IoT, connected devices confined in small areas, licence-exempt spectrum, which can be used as complement due to the lack of licensed spectrum, is important. However, with applications that demand a predictable quality of services, high security, low latencies or wide licensed area coverage, licensed spectrum will be essential.

To provide backhaul services supporting networks with very high capacity, the demand for backhaul spectrum increases. However, the current fee structure, which is based on throughput instead of occupied spectrum bandwidth, has basically halted the E-band usage, even with available spectrum and equipment ecosystems. The fee structure must be based on occupied spectrum instead of throughput so that it will incentivize more efficient use of the spectrum and will not penalize very high throughput backhaul links

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There are a number of bands which are important from now to in the next few years. For commercial mobile services, 5G networks are being deployed in the mid frequency bands (3.5 GHz) and very soon in the high frequency bands (millimetre waves). This wave of 5G deployment will be followed by low frequency bands below 1 GHz. For backhaul services, the E-band is important to provide large capacity with wide channel bandwidths given the appropriate fee structure. The mid frequency bands such 23 GHz and 32 GHz can be addressed immediately to release the pressure on bands between 15-23 GHz.

## INTRODUCTION

Ericsson would like to commend Innovation, Science and Economic Development Canada (ISED) for inviting industry to comment on this important **Consultation on the Spectrum Outlook 2018 to 2022** (“Consultation”), for updating the previous version taking into consideration technology advancements, growth in demand of various services, applications, and international developments.

Ericsson is a global leader in delivering ICT solutions. In fact, 40% of the world's mobile traffic is carried on Ericsson networks in over 180 countries. Over the past 140 years, Ericsson has been at the forefront of communications technology. Today, we are committed to maximizing customer value by continuously evolving our business portfolio and leading the ICT industry’s move to 5G networks<sup>1</sup>.

In Canada, Ericsson has operated since 1953 and serves Canadian customers by providing a wide range of products and solutions such as mobile and fixed network infrastructure, professional services, software, broadband and multimedia solutions. Ericsson in Canada is one of the top ten Research and Development (R&D) investors with nearly CAD\$5 billion invested in Canadian R&D over the last 10 years. Ericsson has over 3,000 employees with offices across Canada, including Toronto, Ottawa, and Montreal, fulfilling worldwide mandates in the development, testing and support of wireless networks and advanced end-user multimedia services.

Ericsson has actively participated in the Radio Advisory Board of Canada’s (RABC) working group on SLPB-006-17. Ericsson supports many of the positions put forward by the mobile industry community. Below are Ericsson’s detailed responses and additional information pertinent to this Consultation.

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<sup>1</sup> <https://www.ericsson.com/en>

## COMMENTS ON SPECIFIC QUESTIONS

### SECTION 4 - A PRINCIPLED APPROACH TO RELEASING SPECTRUM

**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?**

With rapid changes both in technologies and market demands, it is important to consider some key aspects of spectrum management ensuring that the value of spectrum is maximized:

- A. Consider flexibility and technology neutrality to allow service providers the ability to respond to changing market demands which include public interests.
- B. Ensure services that need spectrum receive spectrum in a timely fashion, synchronized with viable ecosystems.
- C. Consider a balance distribution of spectrum among different services and additional spectrum sharing when relocation of incumbents either is impossible or will take a long time.

**A - Consider flexibility and technology neutrality to allow service providers the ability to respond to changing market demands which include public interests**

Ericsson agrees with ISED that “*there will also be a need to make spectrum available for a range of services that are in the public interest but may not be driven by market forces. In particular, spectrum will continue to be made available to meet requirements for sovereignty, security and public safety.*”<sup>2</sup> Therefore, Ericsson supports ISED on its decision concerning the designation of the D Block for public safety broadband use<sup>3</sup>. Ericsson is looking forward to finalizing the decision process and to kick start the deployment of a national Public Safety Broadband Network which will not only help provide first responders access to the latest technologies but will also spur growth in the local Canadian economy and job market.

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<sup>2</sup> The Consultation, Paragraph 15

<sup>3</sup> <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11289.html>

In designating spectrum for Public Safety Broadband Network (PSBN), ISED has also recognized the possibility to share extra capacity with other services<sup>4</sup>. This flexible use of available spectrum will allow various services to share and maximize the value of spectrum for users with different requirements.

With 4G/LTE and eventually 5G, sharing of spectrum and radio network resources can be achieved in a number of ways including Multi-Operator Core Network (MOCN)<sup>5</sup> and via network slicing<sup>6</sup> (which enables sharing of end to end network resources). Network slicing provides greater network resource utilization, with each customized network slice, to respond to the complex and different requirements by various services and users. Resources for the network slices can be set up based on different aspects of service characteristics and business models e.g. bandwidth demand, latency demand. In this way, users from different sectors, mass consumers or vertical industries will be able to share the same physical resources including radio spectrum, in a dynamic manner adapting to the needs of each sector. The impact of network slicing on vertical industry is expected to be even more pronounced as these industries *“have addressed their connectivity and communication needs with dedicated or industry specific solutions. 5G will provide a common base to provide a more cost efficient, open, interoperable and large ecosystem enabled solution platform for the various vertical industries”*<sup>7</sup>

Ericsson also commends ISED on the most recent Consultation on Releasing Millimetre Wave Spectrum to Support 5G<sup>8</sup> where ISED recognized the need to be flexible when defining services to be used, either fixed or mobile, leaving the service providers to determine appropriate applications and use cases based on market demands.

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<sup>4</sup> <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11289.html>, Decision D-4

<sup>5</sup> [http://www.etsi.org/deliver/etsi\\_ts/123200\\_123299/123251/06.02.00\\_60/ts\\_123251v060200p.pdf](http://www.etsi.org/deliver/etsi_ts/123200_123299/123251/06.02.00_60/ts_123251v060200p.pdf)

<sup>6</sup> <https://www.ericsson.com/en/networks/topics/network-slicing>

<sup>7</sup> <https://gsacom.com/paper/5g-network-slicing-vertical-industries/>

<sup>8</sup> <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11298.html>



In summary, with the fast pace of technology advancements, changing market demand and innovative business cases, it is important that radio spectrum licensing avoid rigid definitions of services and users, leaving spectrum licencees the flexibility to use radio spectrum in an optimal manner fitting their business plans. This flexibility for services and business models will allow amazing innovations to spring forward with services that have not even been imagined or thought of yet.

**B - Ensure services that need spectrum receive the spectrum in a timely fashion, synchronized with viable ecosystems**

Ericsson supports ISED's view that *"spectrum should be made available in Canada to keep pace with international markets and global technology development. Releasing spectrum when there is an expected radio equipment ecosystem or when it is clear that there will be global standards will allow Canadians to benefit from access to next generation smartphones and devices that are competitively priced due to the economies of scale that are realized when manufacturers make equipment for many markets"*<sup>9</sup>.

For example, with the FCC licensing AWS-4 spectrum and later the PCS-H block as well as the AWS-3 unpaired 1695-1710 MHz block, 3GPP was afforded the opportunity to complete standards for bands 66 and 70. Spectrum licence holders are taking advantage of the available spectrum to develop the necessary equipment ecosystem. It is imperative that Canada be ready for this new ecosystem with timely licensing of the harmonized 3GPP spectrum bands 66 band 70<sup>10</sup>.

With respect to 5G, Ericsson is witnessing many countries testing and deploying the next generation of wireless communications systems in many frequency bands well ahead of

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<sup>9</sup> The Consultation, Paragraph 17

<sup>10</sup> The Consultation, Page 33, Section 6.3.4

WRC-19. For example, in various Asian countries, operators are working on 5G systems in many frequency bands. One such collaborative project between KT (Korea), Ericsson and many other technology partners<sup>11</sup> started in 2015 using the 28 GHz spectrum band and is in its final stage ready to deliver entirely new experiences in the city of PyeongChang – the host of the Winter Olympics in 2018 (currently underway). For the future, Ericsson and KT have agreed to develop jointly additional 5G features such as beam forming and beam tracking technologies and 5G-LTE inter-working functions to optimize capacity and coverage with robust performance. Along with the 28 GHz, other 5G trial systems are exploring the mid frequency range either in the 4.5 GHz band such as the one with Softbank<sup>12</sup> and KDDI<sup>13</sup> in Japan or the 3.5 GHz frequency band such as the one with Intel in China<sup>14</sup>.

In the U.S., two major service providers, AT&T and Verizon, have been collaborating with vendors on 5G trials but using the mmW-band in the 28 GHz<sup>15,16</sup>. These high frequency 5G trial systems are now in a sufficiently advanced stage that Verizon has decided to work with Ericsson to deploy commercial 5G network in select U.S. markets in the second half of 2018<sup>17</sup>.

In addition, T-Mobile has teamed up with vendors to trial 5G systems using the 600 MHz band (acquired from the most recent auction in the U.S.<sup>18</sup>) and has started to deploy 5G ready equipment in that band<sup>19</sup>.

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<sup>11</sup> <https://www.ericsson.com/en/news/2017/5/5g-collaboration-in-lead-up-to-2018-winter-games>

<sup>12</sup> <https://www.ericsson.com/en/news/2017/8/ericsson-and-softbank-trial-5g-in-4.5ghz-band>

<sup>13</sup> <https://www.ericsson.com/en/press-releases/2017/9/ericsson-and-kddi-to-test-5g-on-4.5ghz>

<sup>14</sup> <https://www.ericsson.com/en/press-releases/2017/9/ericsson-showcases-5g-readiness-in-china-with-intel>

<sup>15</sup> <https://www.ericsson.com/en/press-releases/2017/12/verizon-qualcomm-and-ericsson-collaborate-to-trial-latest-massive-mimo-advancements-on-the-path-to-5g>

<sup>16</sup> <https://www.ericsson.com/en/press-releases/2017/1/ericsson-qualcomm-and-att-announce-collaboration-on-5g-new-radio-trials-intended-to-accelerate-wide-scale-5g-deployments>

<sup>17</sup> <https://www.ericsson.com/en/press-releases/2017/12/verizon-awards-5g-contract-to-ericsson>

<sup>18</sup> <https://www.rcrwireless.com/20170503/carriers/ericsson-nokia-t-mobile-5g-tag17>

<sup>19</sup> <https://www.ericsson.com/en/news/2017/8/t-mobile-lays-5g-foundation-with-expanded-600-mhz-rollout>

Based on current global activities, one can confidently foresee 5G ecosystems being developed for the mid-band (3.5 GHz range), high-band (mmW- range) and low-band (bands below 1 GHz).

With substantial progress in 5G in many parts of the world, Canada cannot afford to fall behind. Therefore, Ericsson recommends that Canada have in place a plan for the timely release of spectrum in the frequency bands mentioned above, noting the sequence of mid-, high- and low-frequency ranges, in synchronization with the development of respective ecosystems. Ultimately, not only will Canadian consumers benefit from 5G; Canada will be able to keep pace with other countries both in the development and deployment of 5G.

**C - Consider a balanced distribution of spectrum among different services and additional spectrum sharing when relocation of incumbents either is impossible or will take a long time**

The pie-chart in Figure 1 illustrates the amount of spectrum made available to the different services in Canada as per Table 1 through Table 4 in the consultation. From the chart, compared to the other services, the mobile service appears to have what is a “sliver” of spectrum allocated to it. It would improve the “sliver” somewhat if even all the spectrum bands in Table 6 (“Ongoing and planned spectrum releases”) are considered, including the amounts from the Millimetre Wave consultation<sup>20</sup>: 3.85 GHz for licensed spectrum and 7 GHz for licence-exempt. But even there, the skewing away from the mobile service is brought to light and this is the “balance” that Ericsson urges ISED to address in its 2018 Spectrum Outlook consultation. Further, it is worth noting that this 3.85 GHz of spectrum is to be shared between the mobile and fixed satellite services and is not meant for exclusive mobile use, though agenda item 1.13 of WRC-19 calls for the “identification of spectrum for IMT.”

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<sup>20</sup> <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11298.html>

Notwithstanding this observation, Ericsson supports ISED's view on spectrum sharing, since freeing up of spectrum for new services will not always be possible given the extent to which spectrum is already being used<sup>21</sup>.

Currently there are technologies that facilitate the sharing of spectrum bands. For example, LTE-U/ LAA can co-exist in licence-exempt spectrum with IEEE 802.11 based technologies. In the future, Multefire<sup>22</sup> will be available for sharing of licence-exempt spectrum without the use of a primary channel in licensed spectrum. In the case of the 3.5 GHz band in the U.S., due to heavy incumbent use, the FCC adopted "Citizens Broadband Radio Service (CBRS)" as a sharing technology. Besides the examples discussed here, other forms of sharing such as geographic and dynamic sharing, can also be used to increase the amount of spectrum accessible to new services<sup>23</sup>. If interference mitigation can be achieved (by using less expensive static methods such as shielding and advanced antenna configurations), the probability of sharing increases.

To facilitate sharing, it is important to have a detailed and accurate understanding of incumbency so that interference mitigation strategies can be devised with optimal cost and the least effect on services that share the same spectrum. Ericsson commends ISED's effort to modernize its Spectrum Management System Information (SAM-CSI). However, continuous improvement will still be required. For example, a user-based reporting mechanism that is transparent and open to users, could be implemented to help rectify incomplete and/or inaccurate information. In addition, quicker response time and less down time are also required to make the system more useable.

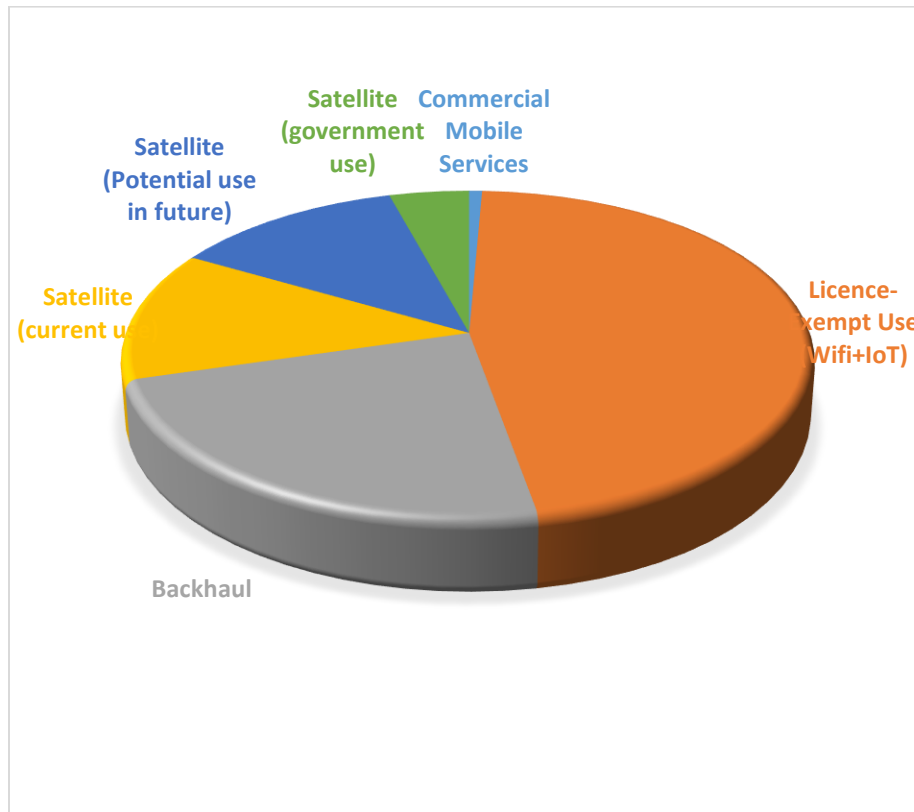
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<sup>21</sup> The Consultation, Paragraph 20

<sup>22</sup> <https://www.qualcomm.com/news/onq/2016/02/25/lte-unlicensed-spectrum-innovation-prevailing>

<sup>23</sup> [http://www.5gamericas.org/files/2414/1323/5229/4G\\_Americas\\_Spectrum\\_Sharing\\_-\\_FINAL\\_Oct\\_2014.pdf](http://www.5gamericas.org/files/2414/1323/5229/4G_Americas_Spectrum_Sharing_-_FINAL_Oct_2014.pdf)

**FIGURE 1: AMOUNT OF SPECTRUM FOR VARIOUS SERVICES (DATA TAKEN FROM THE CONSULTATION)**



In summary, Ericsson believes that there is an “imbalance” in the distribution of spectrum among various services and future spectrum planning must take this into consideration. Ericsson supports spectrum sharing when the clearing of spectrum is either impossible or will take a long time. However, it is important to recognize that there is always a cost associated with deploying new technologies and techniques be it smart antennas, radio resource management, dynamic spectrum access etc. to facilitate the sharing of spectrum. The additional cost could make sharing impractical or prevent a business case becoming viable.

## SECTION 5.2 - 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.**

Ericsson generally agrees with ISED’s assessment on demand for commercial mobile services in the next few years as commercial mobile services “*are becoming the preferred communications for many Canadians*”<sup>24</sup> and in addition to consumers, “*other sectors have begun to rely on commercial mobile services*”<sup>25</sup>. However, more recent studies and reports show that the growth in mobile traffic and subscriptions is even more astonishing.

In the latest version of the Mobility Report issued by Ericsson in November 2017, it is shown that the monthly mobile traffic per smartphone continues to increase worldwide. North America has the highest usage, and traffic is expected to reach 7.1 Gigabytes (GB) per month per smartphone by the end of 2017 and increasing to 48 GB by the end of 2023<sup>26</sup>. In addition, North America currently has the highest penetration of LTE subscriptions at close to 80 percent. The region will also lead 5G uptake, with major operators stating their intentions to deploy 5G early. 5G subscriptions are expected to account for 37 percent of all mobile subscriptions in the region by the end of 2023<sup>27</sup>. This is very much in line with the GSMA report which states that 5G adoption in North America will also occur faster than in any other region in the world with about 50% of connections being on 5G networks in both the U.S. and Canada by 2025<sup>28</sup>.

It is expected 5G will bring new business opportunities, new use cases and new applications in the areas of IoT, broadband everywhere and anytime, critical control of remote devices, smart vehicles, transportation infrastructure, and media everywhere<sup>29</sup>. For example, with near-zero

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<sup>24</sup> The Consultation, paragraph 26

<sup>25</sup> The Consultation, paragraph 32

<sup>26</sup> <https://www.ericsson.com/en/mobility-report/reports/november-2017>, Page 12

<sup>27</sup> <https://www.ericsson.com/en/mobility-report/reports/november-2017>, Page 8

<sup>28</sup> <https://www.gsmaintelligence.com/research/?file=b0cf4f71cb2d035f429d9de8ca4fc72e&download>, Page 19

<sup>29</sup> <https://newsroom.t-mobile.com/news-and-blogs/narrowband-iot.htm>

latency, 5G is expected to spark new applications that rely on accurate and instant haptic feedbacks. Operating an excavator remotely, performing a surgery remotely etc., will be done accurately, precisely, and safely.

On the other hand, with very large bandwidths combined with very low latencies, applications based on Augmented Reality (AR) and/or Virtual Reality (VR) can be implemented successfully<sup>30</sup> - it is projected that VR/AR applications require a capacity of over 100 Mbps with latencies less than 10 ms (Figure 2)<sup>31</sup>. Once AR/VR are usable, one of the key findings of the Ericsson Mobility report, issued November 2017, is that *“7 out of 10 early adopters expect VR/AR to change everyday life fundamentally in six domains: media, education, work, social interaction, travel and retail. Media is already being transformed and consumers expect virtual screens to start replacing televisions and theaters in less than a year”*<sup>32</sup>.

These new technologies and use cases will exacerbate the demand for more 5G spectrum in various frequency ranges.

**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?**

Standards development organizations like IEEE and 3GPP continue to develop technologies to address traffic pressures and spectrum demands for commercial mobile services. Examples of these technologies include massive multiple input, multiple output (MIMO) technology, full-duplex, carrier aggregation (CA), LTE-U, LAA, and beamforming techniques. But development of technologies is not always enough as the industry is approaching the limit of Shannon’s law and such developments need to go hand in hand with the availability of new spectrum.

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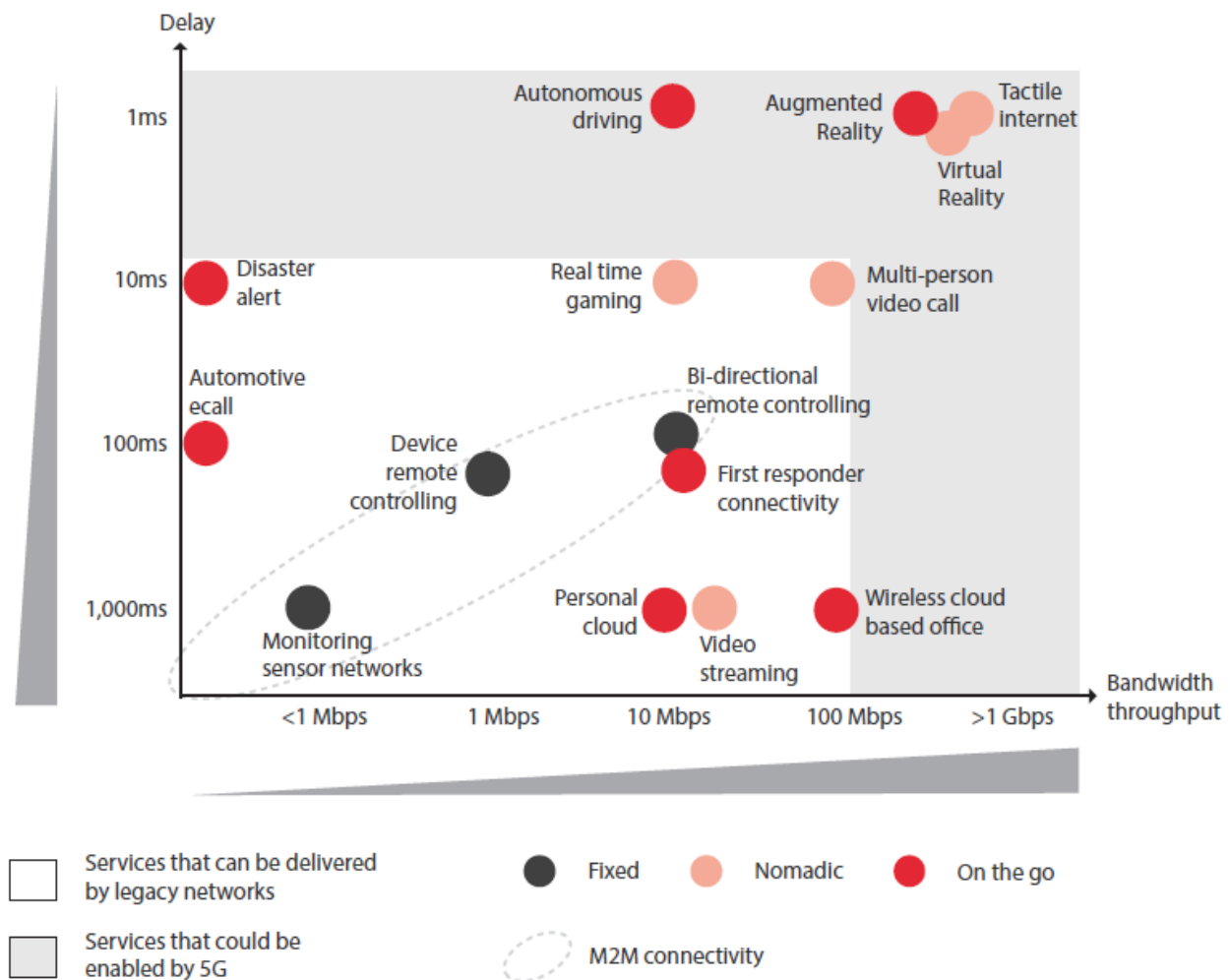
<sup>30</sup> <https://www.digitaltrends.com/virtual-reality/winter-olympics-virtual-reality/>

<sup>31</sup> <https://www.gsmaintelligence.com/research/?file=141208-5g.pdf&download>

<sup>32</sup> <https://www.ericsson.com/en/press-releases/2017/6/consumers-expect-ar-and-vr-to-merge-with-reality>

Ericsson would like to re-iterate the point that there are always additional trade-offs when implementing these technologies. Furthermore, many use cases demand very high capacity, near-zero latency, and massive connected devices, which cannot be addressed via technology alone. Ericsson agrees with ISED that “*the continued growth in data traffic generated by an increasing number of users in various sectors and the data-intensive applications running on mobile networks may not be sustainable with the use of existing mobile spectrum only*”<sup>33</sup>.

**FIGURE 2: BANDWIDTH AND LATENCY REQUIREMENTS OF POTENTIAL 5G USE CASES**



<sup>33</sup> The Consultation, Paragraph 42



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**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?**

Along with more advanced technologies to maximize the value of available spectrum, additional operational measures such as densification, small cells and advance traffic management will help to address (the increased) traffic pressures. To enhance indoor coverage and/or to help relief capacity demands on the macro network, indoor solutions such as Distributed Antenna Systems (DAS) and Ericsson's Dot systems can be used<sup>34</sup>. These operational measures also encounter limits and trade-off in terms of cost and complexity which would make certain configurations impractical or commercially non-viable.

Besides the technical limits of these operational measures, deployment of 5G networks with very a large number of small cells is also challenged by municipal legal and regulatory frameworks. Site acquisition, antenna installment, etc., are under strict requirements in terms of location and aesthetics.

In a recent industry event in Ottawa, hosted by the CWTA 5G Council<sup>35</sup>, carriers and municipalities alike recognized the challenge in dealing with infrastructure deployment as current regulatory and legal regimes are not equipped to deal with the expected massive small cell installation to support 5G services and applications. Proposals that were discussed at the event mostly involved collaborative efforts among multiple interested parties including different levels of government<sup>36</sup>.

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<sup>34</sup> <https://www.ericsson.com/assets/local/narratives/networks/documents/radio-dot-system-brochure.pdf>

<sup>35</sup> <https://www.cwta.ca/5gcc/>

<sup>36</sup> <https://mobilesyrup.com/2018/02/07/canadian-municipalities-infrastructure-partner-rogers-executive/>

In the U.S., FCC has started a process to “*review of the legal framework for infrastructure deployment reviews, to identify regulatory barriers and examine how the Commission could act to remove or reduce these barriers*”<sup>37</sup>. More recently, in a speech at a conference in Brussels about promoting 5G, FCC Commissioner Brendan Carr spoke about the need to modernize cellular infrastructure deployment rules as one of the three key steps to advance 5G deployment besides spectrum and light touch regulations. According to Carr, with 5G, the number of cell sites may increase 10- to 100-fold and the “*permitting, siting, and review processes that applied during the transition to 4G is not going to work for 5G given the massive number*”<sup>38</sup>.

From a product and solution point of view, many vendors have come up with ways to mitigate the challenge of deployment infrastructure when densifying the network. For example, Ericsson has a series of products and solutions under the umbrella of “invisible sites” which enable the reuse of existing infrastructure for new small cell sites. This include light poles, bus stops, buildings, infrastructures, etc.<sup>39</sup>. One of the most innovative solutions is to have radio and antenna components hidden under street manholes, keeping these components completely concealed<sup>40</sup>. These solutions speed up site acquisition process and deployment, while ensuring no or minimum visual impact in street environment.

However, Ericsson believes that even with technology advancements, and operational improvements, the large number of sites required by 5G networks will demand a multi stakeholder strategy to review and revise current regulatory regime dealing with infrastructure deployment.

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<sup>37</sup> [https://transition.fcc.gov/Daily\\_Releases/Daily\\_Business/2017/db0330/DOC-344160A1.pdf](https://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0330/DOC-344160A1.pdf)

<sup>38</sup> [https://transition.fcc.gov/Daily\\_Releases/Daily\\_Business/2018/db0131/DOC-348968A1.pdf](https://transition.fcc.gov/Daily_Releases/Daily_Business/2018/db0131/DOC-348968A1.pdf) - Page 2

<sup>39</sup> <https://www.ericsson.com/en/networks/topics/invisible-sites>

<sup>40</sup> <https://www.ericsson.com/en/news/2016/3/swisscom-and-ericsson-plant-lte-small-cells-underground>

## SECTION 5.3 - 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.**

Ericsson and its partners provide equipment and solutions using both licensed and licence-exempt spectrum<sup>41</sup>. In addition, Ericsson is an active member of associations and organizations promoting technologies based on both licensed and licence-exempt spectrum such as 3GPP, IEEE, LTE-U forum<sup>42</sup> to name a few.

Ericsson maintains the view that for service providers to ensure connectivity - with predictable levels of quality, reliability, and most importantly security, dedicated and licensed spectrum, or shared spectrum, is a crucial component of the network. This continues to be true in the future with 5G networks.

Public Wi-Fi is often found in public spaces such as airports, hotels, and coffee shops. Public Wi-Fi access may be free or have associated charges. In different scenarios, private and secured Wi-Fi can also be used by enterprises to provide local wireless connections. However, Ericsson supports RABC's position that the needs to use licence-exempt spectrum for mobile connectivity mainly stems from the lack of licensed spectrum and therefore licence-exempt spectrum is used either to complement licensed spectrum or to provide "best effort" connections<sup>43</sup>.

Additional licence-exempt spectrum should not be at the expense of licensed spectrum. Licensed spectrum is still needed. As discussed earlier in Question 1, Part C, based on the amount of spectrum already available, it is not clear that the additional licence-exempt spectrum in the

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<sup>41</sup> <https://www.ericsson.com/en/press-releases/2017/1/ericsson-and-cisco-extend-strategic-partnership-to-include-new-wi-fi-solutions>

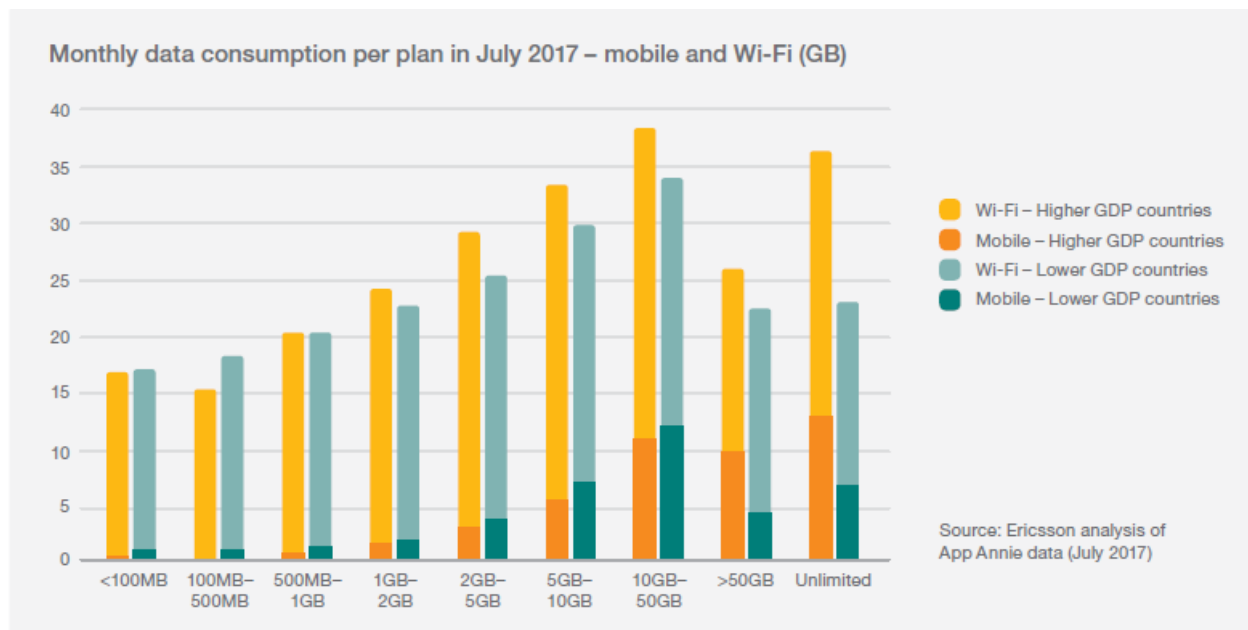
<sup>42</sup> <http://www.lteuforum.org/>

<sup>43</sup> RABC response to this Consultation, paragraph 20

bands 64-71 GHz as discussed in the Milimetre Wave Consultation<sup>44</sup>. A further detailed assessment must be performed later when the policy of this band is up for discussion.

In the recent November 2017 issue of Ericsson's Mobility Report, regardless of the country's GDP and mobile data plans, total data consumption is quite the same, only 2.5 times different between users of the highest and the lowest data plans. However, when looking at mobile data consumption only, the mobile data consumption is 24 times different between users of the highest and the lowest data plans (Figure 3). This fact clearly indicates that users prefer to use their own mobile data if their data plan is large enough to satisfy their data needs<sup>45</sup>. This preference of using mobile over Wi-Fi data is indicative of the higher demand of licensed over licence-exempt spectrum.

**FIGURE 3: MONTHLY DATA CONSUMPTION PER PLAN – MOBILE AND WI-FI (GB)**



<sup>44</sup> <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11298.html>

<sup>45</sup> <https://www.ericsson.com/en/mobility-report/reports/november-2017>, Page 20

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**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?**

Mobile operators may choose different methods to off-load traffic from licensed spectrum to licence-exempt spectrum using different technologies such as public Wi-Fi, carrier-grade Wi-Fi and LTE based technologies (LTE-U, LAA) etc. Today's regulations permit the use of LTE-U and LAA in licence-exempt spectrum, even though some licence-exempt spectrum was initially intended for specific services. Given the advancement of technologies, it is important that all uses of licence-exempt continue to be granted as long as the associated technical requirements such as emission, interference avoidance, and sharing criteria are met.

**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?**

Ericsson supports ISSED's view that even though IoT is in its early stage, it will be growing quickly. Ericsson also believes, as does ISSED, that in this early stage, the majority of IoT devices will rely on licence-exempt spectrum for short range connectivity<sup>46</sup>. However, Ericsson does not believe that IoT devices relying on licence-exempt spectrum will grow as fast as IoT devices using licensed spectrum. The reason for a much faster growth of IoT devices using licensed spectrum because IoT applications relying on wide area networks (Narrowband Internet of Things or NB-IoT and CAT-M devices) can only be implemented using licensed spectrum.

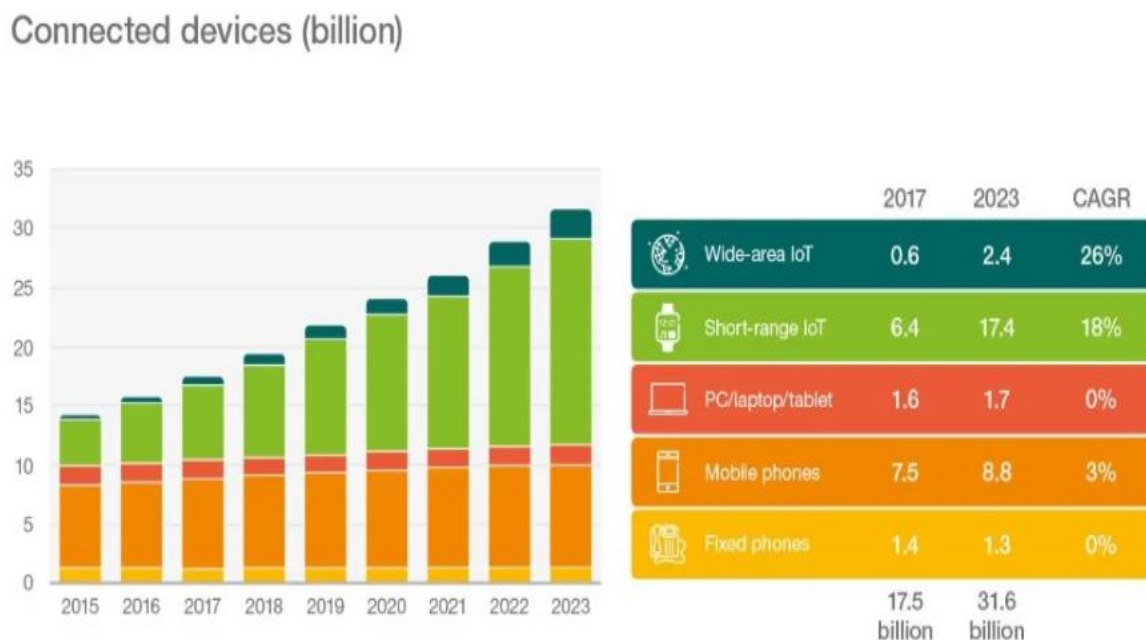
While CAT-M is targeting a wide range of applications for business customers such as wearables, fleet management and asset management, NB-IoT provides scale, coverage and security for customers seeking scalable and cost-effective wireless access solutions for IoT.

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<sup>46</sup> The Consultation, Paragraph 46

In the November 2007 issue of the Ericsson Mobility report, between 2017 to 2023, it is estimated that the number of short range IoT devices will grow from 6.4 to 17.4 billion for a compound annual growth rate (CAGR) of 18%. For the same period, the number of wide-area IoT devices will grow much faster from 0.6 to 2.4 billion devices for a CAGR of 26% (Figure 4)<sup>47</sup>.

**FIGURE 4: CONNECTED DEVICES (BILLION)**



Recently Verizon and Ericsson have successfully conducted a trial with NB-IoT focusing on applications needing data rates below 100 kbps and using licensed spectrum with 180 kHz bandwidth designated for IoT applications not sharing with commercial smartphone traffic<sup>48</sup>. In addition, T-Mobile also announced their IoT strategy using their licensed spectrum<sup>49</sup>.

<sup>47</sup> <https://www.ericsson.com/en/mobility-report/reports/november-2017>, Page 14

<sup>48</sup> <https://www.ericsson.com/cn/en/news/2018/1/verizon-nb-iot-guard-band-network>

<sup>49</sup> <https://newsroom.t-mobile.com/news-and-blogs/narrowband-iot.htm>

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Besides use cases which are built on data capability, with Voice over LTE (VoLTE) supported in Cat-M1-capable IoT devices over wide area networks, new use cases are being explored. *“Many IoT use cases could benefit by incorporating basic voice calling functionality. One example is in assistance situations, such as using an alarm panel in an elevator, or calling the owner of a lost dog via its IoT-connected collar. The technology could also be used to improve business performance, for example, enabling faster repair of vending machines by providing a button to call a service center easily”*<sup>50</sup>.

In summary, Ericsson believes over the period between 2017 to 2023, the number of wide-area IoT devices relying on licensed spectrum will grow much faster than short range IoT devices with the CAGR of 26% and 18% respectively. Considering the current imbalanced spectrum distribution, it is important that future spectrum plans take this imbalance into consideration striving for a fairer distribution of spectrum among services.

**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?**

Ericsson does not have any comment on this question.

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<sup>50</sup> <https://www.ericsson.com/en/mobility-report/reports/november-2017>, Page 9

## SECTION 5.5 - 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.**

Ericsson supports ISSED's view that *"the demand for backhaul capacity is linked to the demand for other service, including commercial mobile, licence-exempt and satellite systems"*<sup>51</sup>.

Particularly, based on the December 2017 issue of Ericsson Microwave Outlook, with 5G on the horizon, *"we can now expect that growth to continue. By 2022, the typical backhaul capacity for a high-capacity radio site will be in the 1Gbps range, rising to 3–5Gbps towards 2025"*<sup>52</sup>.

Increased use of wider channels, initially in the E-band and soon in new bands around and beyond 100 GHz, will be necessary to meet the need of data demand for backhaul.

**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?**

In general, the choice between different backhaul solutions is mainly based on two key factors:

- Cost (all capital expenses and operational expenses including licencing fees) and
- The increased traffic demand vs the ability of available technologies to meet that demand

According to the December 2017 issue of Ericsson Microwave Outlook *"For operators evolving their LTE Networks, the focus will be on improving total cost of ownership and time-to-market in order to outperform competitors. In mature mobile broadband regions such as Western Europe, there are examples of large operators using up to 80 percent microwave that now plan for 5G introduction using existing microwave networks"*<sup>53</sup>.

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<sup>51</sup> The Consultation, Paragraph 96

<sup>52</sup> <https://www.ericsson.com/en/microwave-outlook>, Page 3

<sup>53</sup> <https://www.ericsson.com/en/microwave-outlook>, Page 4



With North America being one of the mature regions in LTE mobile broadband deployment and one of the leading regions heading towards 5G, one can expect a similar trend of relying on microwave to backhaul traffic.

The introduction of high capacity band such as the E-band (70/80 GHz) and future higher frequency bands (W- and D-bands) will make it possible to support higher data throughput giving operators more options in backhaul solutions. In the case of the E-band, Ericsson has seen it used in “more than 85 countries, growth has accelerated in 2017 and a significant further growth is expected in the next 5 years. The main drivers for E-band are high capacities and low spectrum fees”<sup>54</sup>. This trend is also applicable to the US market. Unfortunately, in Canada, even with spectrum available to be licensed and the equipment ecosystem being ready, the licencing fee based on throughput rather than occupied bandwidth has halted the deployment of the E-band.

**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?**

In the effort to achieve high throughput for microwave backhaul links to satisfy the continuously increased in data traffic, besides using higher frequency bands with larger bandwidth (today’s V and E bands and tomorrow’s W and D bands), technology advancement in different disciplines from antenna design to radio design have been and are being considered (Figure 5)<sup>55</sup>.

Among the above techniques such as MIMO, cross-polarization interference canceller (XPIC), radio link bonding etc., multi-band booster<sup>56,57</sup> will dramatically increase the use of the E-band

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<sup>54</sup> <https://www.ericsson.com/en/microwave-outlook>, Page 6

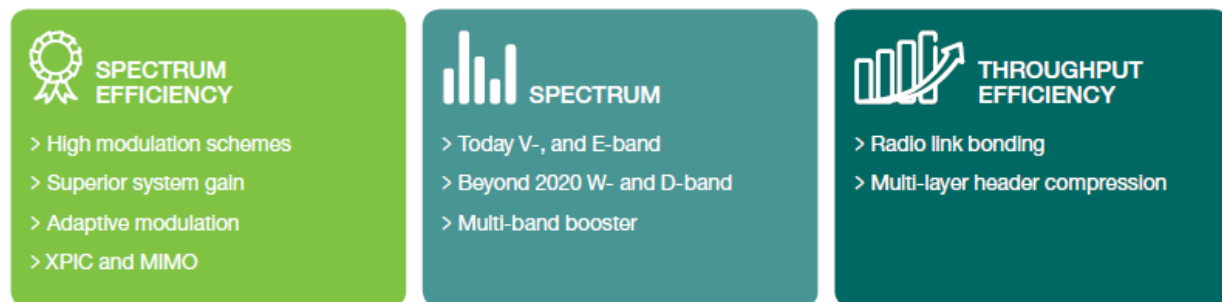
<sup>55</sup> <https://www.ericsson.com/en/microwave-outlook>, Page 12

<sup>56</sup> The Consultation, Paragraph 102

<sup>57</sup> <https://www.ericsson.com/assets/local/publications/ericsson-technology-review/docs/2016/etr-multiband-booster-backhaul.pdf>

and those in the 15-23 GHz range. The reason is that to reduce the load and rental cost of tower space using two antennas, *“there is a clear need for dual-band antennas. The global high-volume bands 15, 18 and 23GHz are the most relevant for dual-band antennas, for combined use with 70/80GHz”*<sup>58</sup>. These bands (E-band and 15-23 GHz bands) are not only valuable as a stand-alone band for backhaul spectrum but also are critical components in scenarios where multi-band booster is used.

**FIGURE 5: IMPROVING MICROWAVE BACKHAUL LINKS**



In Canada, it is recognized that operators *“are primarily encountering difficulties within the 6 GHz bands in rural areas and within the 11 GHz, 15 GHz, 18 GHz and 23 GHz bands in urban and surrounding centres”*<sup>59</sup>. The 32 GHz band – with a large European ecosystem, will be a good candidate band to release the shortage of spectrum in the band 15 – 23 GHz in as a stand-alone band or to be used in multi-band booster combining with E-band.

**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?**

Any increased demand for much larger data traffic and demand for much shorter latency will have an impact on backhaul traffic therefore an impact on backhaul spectrum. For example, as discussed in question 3 above, applications such as VR/AR which require bandwidths at least 100 Mbps and latencies less than 10 ms will certainly have an impact on backhaul spectrum.

<sup>58</sup> <https://www.ericsson.com/en/microwave-outlook>, Page 7

<sup>59</sup> The Consultation, Paragraph 99

**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?**

To support very high demand in traffic as the result of 5G deployment and to support small cells deployment, one of the most urgent needs for backhaul is in the 70/80 GHz (E-band). In many countries, other higher frequency bands such as the W- (92-114.25 GHz) and D-bands (130-174.8 GHz) are being considered. The total amount of spectrum in W- and D-band is almost 50 GHz, five times more than in the E-band – therefore these are important assets for the future.

However, as discussed earlier, the current issue with the E-band is not spectrum availability but licence fee structure that penalizes very high capacity links – and very high capacity is the main driver for this band. With the current fee structure, any future high capacity bands will face the same challenge.

Ericsson notes that FCC also recognized the importance of E-band in backhauling 5G traffic and has decided not to authorize flexible usage (UMFUS) at this time citing that this band “*can play an important role in 5G development by facilitating backhaul and other fixed uses. It is important not only to protect existing links but also to provide an opportunity for future growth of fixed service in these bands as demand for backhaul and other related services increases*”<sup>60</sup>

Mid frequency bands in the range from 15-23 GHz are also important in the next five years for mid-range links. In addition, these bands can be used in together with E-band in multi-band booster deployments. However, due to current congestion in the bands between 15 -23 GHz, Ericsson urges ISED to add more spectrum to the 23 GHz as recommended in the past by RABC, adding the unused sub-bands 21.6-21.8 GHz and 22.8-23.0 and to re-purpose the vacant MCS bands 21.2 GHz-21.6 GHz and 22.4-22.8 GHz for backhaul applications<sup>61</sup>.

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<sup>60</sup> <https://ecfsapi.fcc.gov/file/11222494324943/FCC-17-152A1.pdf>, Paragraph 200 page 67

<sup>61</sup> [https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SMSE-018-12-RABC-Comments.pdf/\\$FILE/SMSE-018-12-RABC-Comments.pdf](https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SMSE-018-12-RABC-Comments.pdf/$FILE/SMSE-018-12-RABC-Comments.pdf)

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Furthermore, in the mid frequency range, the 32 GHz band will be a good candidate band to complement the 15 – 23 GHz bands. Internationally, there have been some discussion about using the band 32 GHz for commercial mobile 5G services. However, more recently, this level of interest has been diminished and this band will likely remain as a fixed service for backhaul applications for a near future<sup>62, 63</sup>.

For long hops, the band in the ranges 6–13GHz will also remain important. Due to their good propagation properties, these low frequencies are fundamental to building transport networks in certain regions. Ericsson commends ISED on its works to increase channel bandwidth in the 6 GHz and 11 GHz and to opening the 13 GHz band for fixed services.

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

Ericsson has no comments.

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<sup>62</sup> [https://circabc.europa.eu/d/a/workspace/SpacesStore/fdf96fcf-16c5-4492-babd-a92eabecdef4/RSPG17-034final\\_2nd\\_draft\\_opinion\\_on\\_5G.pdf](https://circabc.europa.eu/d/a/workspace/SpacesStore/fdf96fcf-16c5-4492-babd-a92eabecdef4/RSPG17-034final_2nd_draft_opinion_on_5G.pdf) - in this draft report by the Radio Spectrum Policy Group (European Commission) on 5G spectrum:” this frequency band should not anymore be considered as a priority for studies”

<sup>63</sup> <https://cept.org/ecc/topics/spectrum-for-wireless-broadband-5g> - in this CEPT report, 32GHz is no longer a priority band in the roadmap for 5G

## SECTION 6 - 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.**

Ericsson has participated in RABC's working group and supports many of the positions put forward by the mobile industry community. Below is Ericsson's additional comments on a number of bands which are of importance.

### L-band (1427 – 1518 MHz):

Ericsson agrees with ISED's assessments: that this band has been identified for IMT at WRC-15, is expected to be globally harmonized, there is little current use of this band in Canada and 3GPP-based equipment ecosystem is expected. Therefore, Ericsson agrees with ISED's consideration of the L-band or a portion thereof for fixed and mobile use<sup>64</sup>.

### 3400 – 4200 MHz:

As discussed at length in previous sections of this document, we are witnessing the deployment of 5G systems in the mid frequency range. In the U.S., the FCC has recognized the importance of this band for 5G services and therefore has modified its rules to "*facilitate the implementation of 5G networks in this band and accelerate deployment of a promising new generation of wireless technologies for all Americans*"<sup>65</sup>.

Therefore, Ericsson strongly supports ISED's plan to release the consultation on 3500 MHz which includes a review of 3400 – 4200 MHz<sup>66</sup>. Future policy review could consider this band for different services, applications based on geographical zones, user density and traffic requirements by taking advantage of the various wireless access technologies' properties. It is technologically possible to mix and match wireless access technologies to optimize the coverage

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<sup>64</sup> The Consultation, section 6.3.3, paragraph 132.

<sup>65</sup> [https://apps.fcc.gov/edocs\\_public/attachmatch/DOC-347378A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/DOC-347378A1.pdf)

<sup>66</sup> The Consultation, section 6.3.5, paragraph 142

in urban, sub-urban, rural, and remote areas; this should be explored further to optimize the use of the spectrum.

#### 23 GHz:

Due to heavy usage and congestion in the backhaul spectrum in the range 15-23 GHz, Ericsson urges ISED to add more spectrum to the 23 GHz band as recommended in the past by RABC, adding the unused sub-bands 21.6-21.8 GHz and 22.8-23.0 GHz and to re-purpose the vacant MCS bands 21.2 GHz-21.6 GHz and 22.4-22.8 GHz for backhaul applications<sup>67</sup>. This action can be taken immediately as equipment ecosystem is readily available.

#### 32 GHz (31.8-33.4 GHz):

Even though this band is part of the WRC-19 agenda item 1.13 IMT bands being considered, as discussed earlier, the level of interest to have this band for mobile service has declined due to:

- The passive services right below, and radiolocation service right above, the band and both of those services must be protected
- The bandwidth of this 32 GHz is relatively small (1.6 GHz) and might need to be further reduced to protect the services in the adjacent bands

Both the Radio Spectrum Policy Group (European Commission)<sup>68</sup> and CEPT<sup>69</sup> have already decided not to prioritize this band for 5G.

In addition, with the existing fixed services ecosystems, this band will remain as a fixed service band for a near future. In Canada, this band should be a good band for fixed services to complement lower bands in the range 15-23 GHz.

#### E band (71-76 GHz, 81-86 GHz):

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<sup>67</sup> [https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SMSE-018-12-RABC-Comments.pdf/\\$FILE/SMSE-018-12-RABC-Comments.pdf](https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/SMSE-018-12-RABC-Comments.pdf/$FILE/SMSE-018-12-RABC-Comments.pdf)

<sup>68</sup> [https://circabc.europa.eu/d/a/workspace/SpacesStore/fdf96fcf-16c5-4492-babd-a92eabecdef4/RSPG17-034final\\_2nd\\_draft\\_opinion\\_on\\_5G.pdf](https://circabc.europa.eu/d/a/workspace/SpacesStore/fdf96fcf-16c5-4492-babd-a92eabecdef4/RSPG17-034final_2nd_draft_opinion_on_5G.pdf)

<sup>69</sup> <https://cept.org/ecc/topics/spectrum-for-wireless-broadband-5g>

Currently, this is the only high-frequency band for very short, high-capacity backhaul applications, supporting upwards of 10 Gbps. This makes E-band critical for small cells and 5G deployments. The FCC recognized the importance of E-band in backhauling 5G traffic and has decided not to authorize flexible usage (UMFUS) at this time citing that this band “*can play an important role in 5G development by facilitating backhaul and other fixed uses. It is important not only to protect existing links but also to provide an opportunity for future growth of fixed service in these bands as demand for backhaul and other related services increases*”<sup>70</sup>. With a stable equipment ecosystem, it is expected that E-band will serve Canadian markets well for the next 5 years and beyond.

#### Above 95 GHz:

In the U.S., the FCC has recently issued a draft Notice of Proposed Rulemaking (NPRM)<sup>71</sup> considering licensed and licence-exempt spectrum in the 95 GHz to 275 GHz range which includes seeking comments on:

- Adopting rules for fixed point-to-point use of up to 102.2 gigahertz of spectrum in various bands, based on the rules in the existing 70/80/90 GHz bands.
- The deployment of point-to-multipoint systems and mobile services in this spectrum.
- Making up to 15.2 Gigahertz of licence-exempt spectrum in several band segments, based on the of the existing unlicensed use of the 57-71 GHz band.
- Creating a new category of experimental licences for the 95 GHz to 3 THz range.

Ericsson believes that Canada would need to closely follow the developments in the U.S. as well as in Europe and when possible promote harmonization so that Canada will also benefit.

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<sup>70</sup> <https://ecfsapi.fcc.gov/file/11222494324943/FCC-17-152A1.pdf>, Paragraph 200 page 67

<sup>71</sup> [https://transition.fcc.gov/Daily\\_Releases/Daily\\_Business/2018/db0201/DOC-348982A1.pdf](https://transition.fcc.gov/Daily_Releases/Daily_Business/2018/db0201/DOC-348982A1.pdf)

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

**the proposed services and/or applications for each frequency band**  
**the potential timing of releasing for each frequency band**  
**the priority of the release of the frequency bands**  
**Provide supporting rationale for your responses.**

Please refer to question 19.

**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.**

Ericsson has no comments.

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

Ericsson has no comments.

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

Ericsson has no comments.

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