

Before
INNOVATION, SCIENCE AND ECONOMIC DEVELOPMENT CANADA
Ottawa, ON K1A 0H5

In the Matter of)	
)	
Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary)	Canada Gazette, Part I June 16, 2018
Consultation on Changes to the 3800 MHz Band)	Notice No. SLPB-004-18

COMMENTS OF NOKIA

Nokia respectfully submits Comments in response to the above-captioned Consultation from Innovation, Science and Economic Development Canada (“ISED”) on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band.¹

¹ Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band, Notice No. SLPB-004-18, Canada Gazette, Part I, June 16, 2018 (“Consultation”).

Nokia offers unparalleled leadership in the technologies that connect people and things. Nokia is leveraging its strengths to create a new type of network that is intelligent, efficient, and secure, and which will serve as a critical enabler of many capabilities and use cases associated with the Internet of Things (IoT). We are weaving together the networks, data, and device technologies to create the universal fabric of our connected lives. In this new paradigm, new applications and data will flow without constraint, services and industry will automate and run seamlessly, and communities and businesses can rely on privacy, security, and near instant response times by connecting through the cloud. The role of analytics and data science in this world will be a significant contributor to the design of new infrastructure and services supporting the network and creating value to fuel investment and innovation.

Nokia brings together, in one company, mobile broadband with fixed line access, and the underlying IP routing and optical technology that connects

them. Nokia has made pioneering advancements in reducing the footprint of mobile base station infrastructure, from compact yet full power macro sites down to the full range of small cell solutions, which are expected to be critical to enabling 5G deployment and the IoT. Nokia also offers the industry's most comprehensive portfolio of services for integrating heterogeneous networks ("HetNets"), encompassing analysis, optimization, deployment, and management. With approximately 40,000 employees focused exclusively on research and development ("R&D"), including a major R&D center in Ottawa, Nokia is well placed to play a leading role in shaping the new revolution in connectivity.

MOVING EXPEDITIOUSLY ON MID-BAND SPECTRUM FOR TERRESTRIAL MOBILE – INCLUDING AT 3.40-3.7 GHZ AND 3.7-4.2 GHZ – IS CRITICAL TO CANADA'S NEAR-TERM SPECTRUM STRATEGY

Nokia applauds ISED's innovative spectrum policies, moving expeditiously in consultations to bolster the amount of low-band spectrum

available for mobile broadband in the low band spectrum, such as the 600 MHz band, as well as high-band spectrum, demonstrated by the recent proceedings on various mmWave bands and long-term spectrum outlook to ensure a consistent pipeline of spectrum to fuel the 5G revolution. ISED's exploration of the release of mid-band spectrum in the 3 GHz range is a key piece of the connectivity puzzle.

The 3 GHz range has favorable propagation characteristics compared to high-band spectrum, but provides larger bandwidth than is available today in low-band spectrum. Notably, the propagation characteristics in mid-range bands support the existing grid of wireless sites, and thus is perfectly suited to overlay (macro sites) as well as underlay (micro of outdoor small cell) deployment. These deployments would accelerate the mass rollout and adoption of the 5G ecosystem in Canada, supporting the promise of new services and business opportunities for Canadians. The contiguous bandwidth

in the 3 GHz range allows service providers to achieve peak throughput performance and capacity that lives up to the expectations of 5G.

The 3 GHz range is also being considered in other regions and countries for 5G and has a potential to become a globally harmonized range. Based on the demand demonstrated in other regions of the world, Nokia is actively working on launching radio products for this band based on world demand in the late-2018 timeframe. Canada would be well-served to stay on the leading edge with other innovative countries to unlock the promise of mid-band spectrum for 5G.

Nokia agrees with Canada's strategy to "align with international market developments and the continual evolution of wireless technologies around the world."² As the consultation further states:

By ensuring that the spectrum being made available reflects global trends, emerging 5G standards and the equipment

² Consultation, ¶ 7.

ecosystem that is expected to materialize in the coming years, Canada positions itself to benefit from the next generation of smartphones and other advanced wireless devices. Canadian consumers benefit from the economies of scale that come when manufacturers produce equipment for many markets.³

As a leading equipment manufacturer, Nokia has first-hand experience with the economies of scale described above. Beyond reducing equipment costs, spectrum harmonization also enables global roaming, reduces equipment design complexity and improves spectrum efficiency.⁴ All of this ultimately reduces costs for consumers. Harmonization also aids in addressing cross border coordination.

Nokia also urges ISED to make the 3.5 GHz band available for terrestrial flexible use by 2019 and notes that the consideration of the 3.8 GHz band, while important, should not slow down progress on the 3.5 GHz band. As

³ *Id.*

⁴ See Document 5D/246-E, Canada's input to ITU-R WP 5D, "Technical perspective on benefits of spectrum harmonization for mobile services and IMT," 23 January 2013.

noted above, there is substantial demand in other regions of the world to deploy in the 3.5 GHz band *this year*. Nokia urges ISED to move expeditiously to allow roll-out of services in the 3.5 GHz band in Canada without delay.

RESPONSES TO SPECIFIC QUESTIONS IN THE CONSULTATION

Q1 — ISED is seeking comments on its assessment of the timelines identified for the development of an equipment ecosystem for 5G technologies in the 3500 MHz and 3800 MHz bands, and whether the timelines will be the same in both bands.

Nokia expects 5G technologies in 3500 MHz (3400–3650 MHz) band using 3GPP TDD band n78 (3300-3800 MHz) to be available in 2019 driven by China, interested in 3.3-3.6 GHz, and South Korea which just auctioned 280 MHz of spectrum in 3420-3700 MHz.

We expect 5G technologies in the 3800 MHz band (3650–4200 MHz) to be available in 2020, driven by the U.S. which has an open proceeding on 3.7-4.2 GHz and Japan which has 3.6–4.2 GHz as one of the candidate bands for 5G. 3GPP TDD Band n77 (3300–4200 MHz) was developed for Japan. It is not clear yet if the U.S. will be able to use band n77 or if a new band specific to the U.S. will be developed in 3GPP based on the rules being developed by the U.S. FCC.

Q2 — ISED is seeking comments on the proposals for:

- **adding a primary mobile allocation to the 3450–3475 MHz band**
- **removing the radiolocation allocation in the 3450–3500 MHz band**
- **making the corresponding changes to the Canadian Table of Frequency Allocations**

Nokia agrees with these proposals.

Q3 — ISED is seeking comments on the proposal to allow flexible use in the 3450–3475 MHz band.

Nokia agrees with ISED's proposal to allow flexible use in the 3450–3475 MHz band in addition to the 3475-3650 MHz band that would enable flexible use across the entire 3450–3650 MHz band in Canada.

Q4 — ISED is seeking comments regarding interest in sharing spectrum between radiolocation and other services in the 3400–3450 MHz band, and options for doing so.

Nokia agrees with ISED that sharing spectrum between radiolocation and other services in the 3400–3450 MHz band would optimize spectrum use in the 3400–3450 MHz band if the radiolocation service is to stay in the band. A database approach could be explored to enable sharing of the terrestrial service with the incumbent radiolocation service.

Q5 & Q6.

Nokia is not providing comments on these topics at this time.

Q7 — ISED is seeking comments on a revised band plan using unpaired blocks of 10 MHz in the frequency range of 3450–3650 MHz.

Nokia agrees with ISED's revised band plan using unpaired blocks of 10 MHz in the 3450-3650 MHz range, which provides a channel spacing size supported by both LTE and 5G New Radio, facilitates the issuance of new licenses to both incumbent and new licensees and does not preclude ISED from licensing blocks as aggregated packages of multiple 10 MHz blocks to facilitate large bandwidth channels for 5G technologies.

Q8 — ISED is seeking comments on whether any additional measures should be taken to limit potential interference issues with the proposed TDD band plan.

Nokia agrees with ISED that there exists a potential for mutual inter-system interference in the case where two or more TDD systems operate in the same or adjacent frequency blocks and in close geographic proximity. Nokia further agrees that this potential interference can be mitigated by measures such as (1) TDD synchronization and alignment of the downlink and uplink splits between the TDD systems; or (2) the implementation of a guard band between

operating frequencies if the operators decide not to synchronize and align their downlink and uplink splits.

However, we do not suggest that ISED should mandate any such specific additional measures. Instead, ISED should turn to the operators to agree on additional measures to mitigate interference, perhaps evidenced by a letter showing that an agreement has been reached. This is the approach taken by the U.S. FCC, which has left it up to the industry to define such mitigation techniques via the Wireless Innovation Forum (WInnForum) and CBRS Alliance for the 3.55-3.7 GHz CBRS band.

Q9, Q10, Q11, & Q12.

Nokia is not providing comments on these topics at this time.

Q13 — ISED is seeking comments on whether the fixed and mobile equipment for LTE and 5G technologies will be able to operate with intermittent interference from radars, including cross-border interference, within the 3450–3650 MHz band and in adjacent bands.

Nokia is of the view that LTE and 5G technologies will be able to operate with intermittent interference from radars within the 3450–3650 MHz band and in adjacent bands. With these Comments, Nokia submits a paper on “Radar

interference into LTE base stations in the 3.5 GHz band” for ISED’s consideration.⁵ Nokia will continue to provide technical inputs on this issue.

Q14 — ISED is seeking preliminary comments on how to optimize the use of the 3650–3700 MHz band, including the potential use of a database access model.

As ISED noted, the U.S. FCC decided to optimize the use of the 3650-3700 MHz band as part of their Citizen Broadband Radio Service (CBRS) Part 96 rules. We agree with ISED that a similar database approach could be considered in Canada to optimize the use of this band.

Q15 — ISED is seeking comments on the importance of the 3700–4200 MHz band to future FSS operations.

While Nokia has not analyzed the importance of 3700-4200 MHz for Fixed Satellite Service (FSS) use in Canada, Nokia has thoroughly analyzed the satellite Fixed Earth Stations (FESs) that have been registered in the FCC’s International Bureau Filing System (IBFS) database. Our analysis has revealed that both the number of existing FESs and the number of grants obtained to install new ones have been constantly declining over time. See Figure 1.

⁵ “Radar interference into LTE base stations in the 3.5 GHz band,” Mo Ghorbanzadeh, Eugene Visotsky, Prakash Moorut, Charles Clancy, Physical Communication, Volume 20, September 2016, Pages 33-47. ,

<https://www.sciencedirect.com/science/article/pii/S1874490716300088?via%3Dihub>.

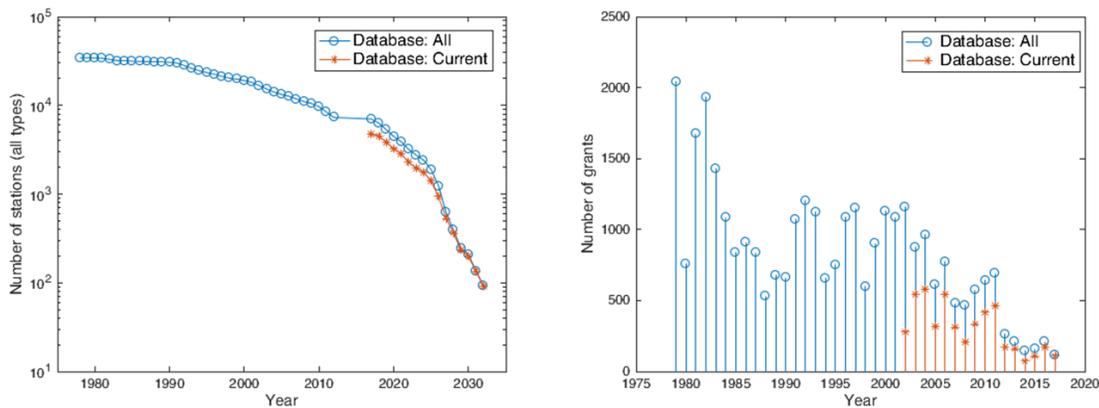


Figure 1. The number of earth stations of different types has significantly decreased since the 1980s (left). Similarly, the number of new grants is also falling (right), showing overall that the mid-band 3.7-4.2 GHz is likely underutilized currently.⁶

Nokia understands that the trend away from the 3.7 GHz band can be attributed in large part to migration to other spectrum bands as well as a trend away from wireless altogether onto increasingly ubiquitous fiber technologies. For example, many licensees are moving to higher frequency bands, e.g., Ku-band, as more bandwidth is available to support high-resolution content distribution, and dishes are cheaper due to their smaller antenna size. For this reason, the mid-band spectrum between 3.7 GHz and 4.2 GHz appears to be underutilized with decreasing usage by incumbent FSS operators in USA, further making the case to allow cellular services to exploit this spectrum and enable next-generation 5G networks for additional much needed network coverage and capacity in U.S. and worldwide.

⁶ The FCC’s database includes two ways to view the data: “All” and “Current.” The “Current” view appears to be more accurate, but we included the “All” view as well to provide a larger dataset going back further in time before the “Current” view is available. In either view, the downward trend is clear.

Nokia also noticed that even these declining numbers found in the FCC's licensing database overstate the actual number of earth stations in operation in these frequencies. The record in prior FCC's proceedings demonstrates that about 30 percent of FSS earth stations licensed in the IBFS database simply do not exist.⁷ On behalf of FWCC, Nokia conducted a random sampling of 300 C-band earth stations and found that 27 percent did not exist.⁸ These earth stations may never have been built or, in several cases, we found photographic evidence on Google Earth that the earth stations were built, but were later dismantled (even the buildings on which they were mounted no longer exist) but left on the books. It appears some earth station licenses were renewed despite having previously been dismantled. In a much larger sample, the Broadband Access Coalition presented similar results in reviewing FCC records versus visual evidence, finding that no satellite facility matched the licensed coordinates in many cases.⁹

In sum, FSS use of the 3.7-4.2 GHz band has been in steady decline and is over-represented in the FCC's database. This decline in use, and the availability of alternative transmission options for FSS systems, make the band a great candidate for re-allocation for terrestrial 5G use. We expect a similar analysis for Canada.

⁷ See Broadband Access Coalition, Petition for Rulemaking, RM-11791, at 23 (filed June 21, 2017) ("BAC Petition"); FWCC Letter to FCC, Request for Audit of Licensed Satellite Earth Stations in Bands Shared with the Terrestrial Fixed Service, at 23 (filed Sept. 30, 2016) ("FWCC 2016 Audit Request").

⁸ See FWCC 2016 Audit Request at 3.

⁹ BAC Petition at 23.

Q16 — ISED is seeking comments on whether unlicensed operators in the 3700–4200 MHz band should be required to submit their technical parameters to ISED to assist in frequency management.

Nokia agrees with ISED that unlicensed FSS operators in the 3700–4200 MHz band should be required to submit their technical parameters to ISED to assist in frequency management by registering their earth stations if they want to claim protection from potential 5G interference.

Q17 — ISED is seeking comments on which steps Canada should take to optimize the use of the 3700–4200 MHz band in consideration of the current services being provided and the developing technologies that would permit the use of new services in this band (e.g. exclusion zones).

Nokia studied the interference from 5G systems into FSS earth station receivers and concluded that the required exclusion zones around FESs could be a limiting factor for 5G deployments when the 5G and FSS systems are deployed co-channel, especially in dense urban environments where FESs are present.¹⁰ Indeed, if the earth stations are located in areas where 5G will likely be deployed, then a larger percentage of useful locations may be unavailable for 5G systems if exclusion zones are used.

¹⁰ Comments of Nokia, Docket No. 17-183, at 10-13 (filed Oct. 2, 2017); Letter from Jeffrey Marks, Nokia, to Marlene Dortch, FCC, GN Docket No. 17-183 (filed Jan. 22, 2018).

Therefore, ISED should consider relocating as many FSS operations as possible out of the band to other bands or other substituting services (e.g. fiber) via market-based mechanisms or auction mechanisms, and repack any remaining FSS at one end of the band to make the remaining spectrum available for 5G with perhaps a guard band between the 5G and the FSS segments. As a first step, ISED should collect additional information about earth stations operating in the band to obtain a better understanding of the technical characteristics and locations of existing FSS operations.

Q18 – ISED is seeking comments on the challenges and considerations related to the coexistence of other services, such as mobile and/or fixed wireless access, in the 3700–4200 MHz band.

The speed of deployment in mid bands such as 3.7-4.2 GHz can be significantly faster than in mmWave (due to reuse of the existing macro site grid), and the capacities significantly higher than on lower frequency bands (achieved using mMIMO beamforming, for which antenna sizes are reasonable at this frequency). Nokia therefore expects the 3.7-4.2 GHz range to be an important 5G mobile band for North America within the next couple of years. As such, coordination of these 5G mobile systems with any fixed wireless access systems may prove to be a challenge if there are many fixed wireless systems also deployed. This issue requires further study and consideration by ISED.

CONCLUSION

Nokia appreciates ISED's efforts to ensure that Canadian consumers, businesses and public institutions continue to benefit from the latest wireless telecommunications services across the country. Nokia stands ready to work with ISED to meet this goal and urges ISED to unlock the promise of the 3 GHz range of spectrum as discussed in these Comments.

Respectfully submitted,

Nokia

/s/Richard T. Herald

Richard T. Herald

Country Senior Officer

Nokia

1380 Rodick Road

Markham, ON, L3R 4G5

July 12, 2018

ATTACHMENT

"Radar interference into LTE base stations in the 3.5 GHz band," Mo Ghorbanzadeh, Eugene Visotsky, Prakash Moorut, Charles Clancy, Physical Communication, Volume 20, September 2016, Pages 33-47.