Nokia response to Radio Spectrum Management Discussion document

On 24 – 30 GHz use

About Nokia

We create the technology to connect the world. We develop and deliver the industry's only end-to-end portfolio of network equipment, software, services and licensing that is available globally. Our customers include communications service providers whose combined networks support 6.1 billion subscriptions, as well as enterprises in the private and public sector that use our network portfolio to increase productivity and enrich lives.

With an end-to-end portfolio that is unique in the industry, Nokia can work in partnership with operators to deliver "real 5G". Nokia's in house 5G mmWave Small Cells and AirScale BTS provide in-building and outdoor coverage, while our Microwave Anyhaul, Cloud native RAN, antennas, and 5G cloud-native core are part of approximately half of our agreements to date. Beyond our mobile networks portfolio, Nokia has excellent FP4 network processor-based IP routers and PSE- 3 chipset powered optical networking - our customers can use the Nokia Network Services Platform to make this into full-5G-strength software defined connectivity 'smart network fabric' secured by Nokia Security Orchestration, Analytics and Response (Nokia SOAR) to ensure resilient 5G.

Nokia is a global leader in 5G standardization and technology innovation with a strategy specifically designed to support the New Zealand market.

Nokia is also a supplier to various enterprises which have deployed private wireless networks. Globally Nokia has been selected by more than 150 operators to supply 5G networks.

Through our research teams, including the world-renowned Nokia Bell Labs, we are leading the world to adopt end-to-end 5G networks that are faster, more secure and capable of revolutionizing lives, economies and societies. Nokia adheres to the highest ethical business standards as we create technology with social purpose, quality and integrity.

For more information: https://www.nokia.com/networks/5g/

Disclaimer: This response is based on Nokia's current understanding of the market dynamics and various standards bodies; these dynamics are changing and hence our views may update with these changes

Nokia welcomes the opportunity to comment the RSM's Consultation on the use of 26 GHz and 28 GHz. Nokia sees digitization as a cornerstone of the economic development and further progress of the society. Access to spectrum resources is expected to become even more relevant for many industries in the upcoming period and its use to achieve the societal value should be the overarching target. As such, any policy decision should be sufficiently forward-looking to encompass ongoing and future technological developments, including for 5G and its evolution and the associated spectrum needs. Nokia is member of GSA and our response should be considered in complement to the GSA submission.

THE TECHNOLOGIES AND APPLICATIONS IN 24 - 30 GHZ

Q1. What are the most likely use cases in New Zealand for mmWave based 5G services?
Q2. What are the likely use cases for Ka band satellite services in New Zealand in the short and long term?
Q3. What are the spectrum requirements for ESIM use in New Zealand?
Q4. Do you think the existing fixed service licenses in 26 GHz can be migrated to the 23 GHz and/or 38 GHz fixed service bands?
Q5. If not, do you think the existing fixed services should be allowed in the 26 GHz?

Worldwide, the 24.25–29.5 GHz range (covering the overlapping Bands n257 (26.5–29.5 GHz), n258 (24.25–27.5 GHz) and n261 (27.5–28.35 GHz)) has been the most-licensed/deployed 5G mmWave spectrum range to date. According to the GSA[1] there are one hundred and thirty-two operators in 43 countries/territories investing in 5G in this frequency range. Also, twenty-three operators are understood to be actively deploying 3GPP-compliant 5G networks in 37 – 40 GHz (n260). Three operators in the USA have launched 5G using this band.

Key to successful deployment of mmWave use cases is ensuring that enough spectrum is available for each operator (at least 800-1000 MHz per network).[2] Also, enough base stations are required at appropriate (hot spot) locations to support the traffic density required.

26 GHz could be deployed also on existing macro sites, for example for FWA, where these are properly located for delivery of service. However, in many cases, small cell technology will be deployed both indoors and outdoors to serve on-spot coverage and capacity requirements. New sites supporting 26 GHz need adequate and robust backhaul to MNO networks and / or potentially to SA networks for industrial / vertical solutions. Key to successful deployment of small cells is simplification of permission and authorization regimes.

[1] mmWave Bands: Global Licensing and Usage for 5G - GSA (gsacom.com) November 2020
[2] There are some spectrum awards that have assigned less than 400 MHz (e.g., in Italy 200 MHz was assigned to each of the five operators with the possibility to access the whole 1GHz of spectrum through a "club" model.)

In the European Union (EU), an Implementing Regulation was issued in July 2020 on small cell wireless access points.[3] Small cells that meet the parameters set out in the Regulation are exempted from any individual town planning permit or other individual prior permits.

In the EU, the 26 GHz band is one of the 5G pioneer bands and at least 1 GHz of spectrum in this band should have been allocated prior to 21 December 2020 for 5G deployments to MNOs. To date, five countries have auctioned spectrum in this band and some three more make the spectrum available according to market demands. Licensing models are somewhat mixed between nation-wide MNO licenses and local licenses for private or public use. Additionally, we expect around 15 European countries to open up the band in 2021-2022 timeframe.

Regarding the HAPS, the use of the band 26/28 GHz has been regulated within the fixed service only and does not allow the use of HIBS. Therefore, it is limited to backhauling or fixed wireless access between the fixed ground stations in the area covered by the HAPS or between these stations and a gateway. HIBS (HAPS IMT Base Stations) are currently under study for WRC-23 (agenda item 1.4), only for IMT bands below 2.7 GHz and not within the millimetric range.

The use of mmWave frequency bands for 5G:

5G initial use cases using mmWave bands are likely focusing on the enhanced Mobile Broadband (eMBB), mainly for end-users. Additionally, an important differentiator in 5G is linked to the industrial uses - the Ultra Reliable Low Latency Communications (URLLC) usage scenarios for indoor hotspots in enterprises and factories. Additional cases cover outdoor mobile broadband in dense urban and urban areas as well as Fixed Wireless Access (FWA) in suburban and rural macro scenarios.

The multi-gigabit data rates possible with mmWave technology and the wide bandwidths available in 26 GHz will likely enable new use cases benefiting from high instantaneous data rates.

The high date rates can enable end users to download large amounts of data very fast while allowing the network to serve simultaneously more highly demanding end points; the high instantaneous peak rates combined with Massive MIMO will dramatically increase network capacity and hence facilitate traffic offload to the existing 4G networks. mmWave technology brings the benefits of Massive MIMO down to a small-cell scale, hence maximizing small cell capacity and hotspot deployments addressing on-spot events and venues (e.g., stadiums) and crowded locations within city centres.

Applications such as Mobile Virtual/Augmented Reality and Ultra High Definition Video, 5G fixed wireless access services and smart home, smart manufacturing, health care will all benefit from 5G deployments.

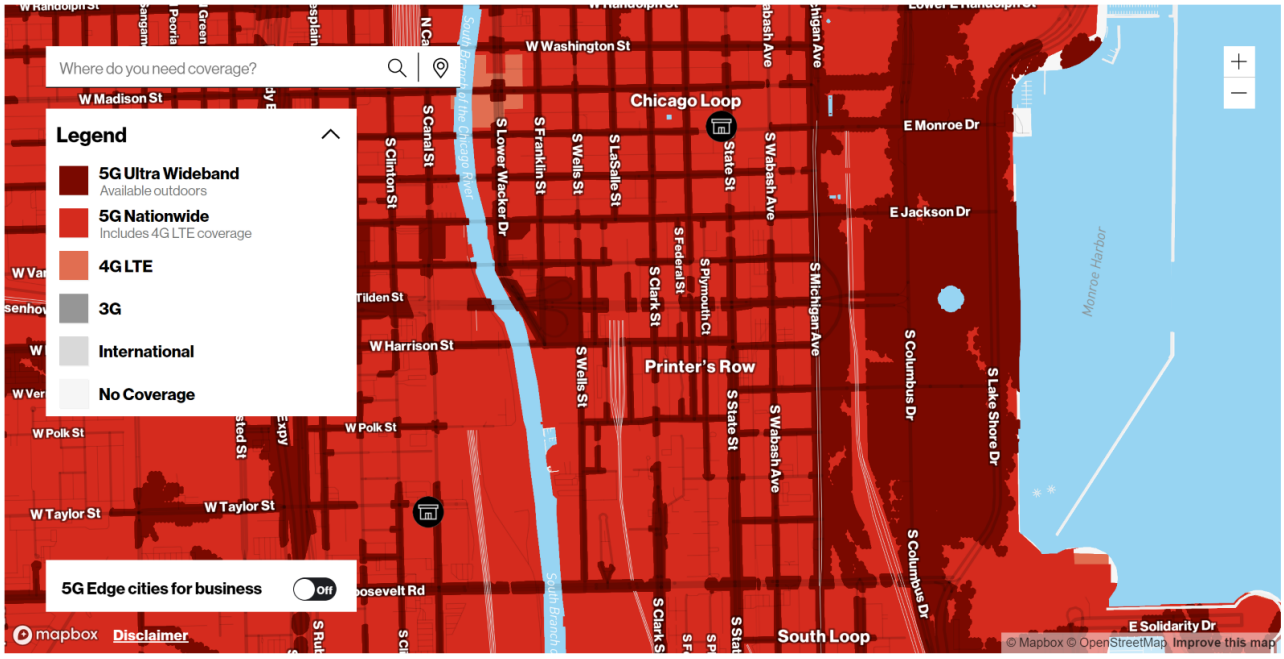
[3] COMMISSION IMPLEMENTING REGULATION (EU) 2020/1070 of 20 July 2020.

Below a selection of use cases are described for the 26 GHz/28GHz bands:

Enhanced Mobile Broadband (eMBB)

It is likely that eMBB and backhaul will be the first services to be deployed with progressive rollout over the next few years. Use cases that require standalone mmWave capability are likely to follow as SA 5G implementations come to market. eMBB is likely to comprise several variants including static semi-static / nomadic consumption (e.g. seated at a venue or in a restaurant and occasionally moving around), mobility (e.g. connection while on transport or driving). An example of eMBB provision by Verizon in Chicago, "5G Ultra-Wideband", is shown below and denotes 28 GHz mmWave on-spot coverage which reaches street level outdoor and open areas but cannot easily reach indoors and far-behind corners.

5G coverage by Verizon in Chicago (Source https://www.verizon.com/coverage-map)



A major railway station provides equally a good example of 26 GHz eMBB use, where mmWaves can offer improved network data speed and low latency, improved business processes (e.g. selling and changing train tickets), better user experience, increased mobility, and reduced travel times. Examples are:

- Personalized travel support services:
  - Real time video with an agent (ticket purchase and exchange).
  - Navigation support service for disabled travelers (low latency).
  - 26 GHz hotspots for travelers in the station (content download before travelling).
- Augmented Reality for emergencies:
  - Assistance to a person in danger (first aid assistance).

- Direct immersion in non-attack crisis situations via an 8k 360° camera.

FWA

FWA delivers broadband connections to residential and business premises without the need for a fixed copper or fiber connection. It would also substantially increase the data rates in case only copper connection is available. It avoids civil works and other costs that would be required to deliver fiber upgrade. Today FWA is targeted at homes, buildings and offices, with the objective to deliver very high-capacity connections, enable new applications and improve user experience.

5G allows FWA to be delivered in mid-band but also mmWave spectrum. While mid-band spectrum will deliver a good service and may be well suited to longer range rural FWA use, 26 GHz is also an option for deployment of FWA in some locations in rural or suburban settings lacking fiber. 5G FWA can provide 1 Gbps download speeds and upload speeds in the 100s of Mbps are routinely possible.

At 26 GHz, FWA requires line of sight or near line of site transmission and it works best with an externally mounted antenna at the customer premises. Topology could dictate many cell sites, which could influence the scaling and economics of delivery. Moreover, for localised fill-in or provision to small groups of rural premises, or where there are other constraints on provision of fixed infrastructure, it may well be an advantageous option as FWA and eMBB could share the same spectrum and base station infrastructure and thus optimize the associated cost e.g. in sub-urban areas.

FWA solutions allow cable / fiber broadband capability to be offered in many places where it is extremely costly and / or complex to deploy fixed fiber solutions. Even in situations where there is a good fixed broadband capability, 5G FWA may be an economic means for facilitating interim connectivity upgrades and dealing with hard to reach premises.

Hot spot high-capacity locations (sports arena and connected venues)

26 GHz is an attractive band for high capacity, low latency connectivity over a limited on-spot coverage area. The main advantages are improved broadband access (high speed and low latency) for audiences at indoor and outdoor venues with savings on infrastructure, greater deployment flexibility and the means to deliver a richer content proposition.

Applications could include:

- Transmission of ultra-high-definition video streams for broadcast on giant screens at venues.
- Delivery of 360° 4K immersive video streams for broadcasting to the devices of venue audiences.
- Feedback and monitoring of data generated by sports participants or other performers at the venue.
- Further solutions that enhance the immersion and experience of the audience.

- Seamless access to business video calls / conferencing, presentations and data at major trade shows and events (e.g. MWC, IFA).

Industrial use cases and connected enterprise

Use of spectrum for industrial applications presents a wide range of opportunities. By its nature this is likely to apply to countries with a strong industrial strategy and those with a political will toward industrialization. It could help to kick start new advanced industrial activity and increase international competitiveness.

There are many ways in which wireless might be used to drive transformation in an industrial setting and enhance delivery and competitiveness. It can assist with cost reduction, improving operational efficiency and significantly increasing the flexibility with the way in which an industrial installation is configured. Wireless could be actively deployed for machine control, maintenance management, quality assurance, stock control, safety management and incident response. 5G wireless solutions will deliver the secure radio environments necessary for industrial use. While 5G integration is at an early stage in industrial environments there are clear advantages 5G mmWave brings with quality, channel bandwidth and flexibility.

Implementation will be via many sorts of sensors, control devices, video and VR/AR capability needing the resources of large scale IoT, high bandwidth (potentially uplink as well as downlink) and ultra-reliable and low latency communications for mission critical applications (i.e. the full suite of 5G capability). Bandwidths required and the relatively short-range propagation make 26 GHz an ideal spectrum choice for many industry use cases. Metallic and other surfaces act as reflectors allowing for indirect signal paths. Where physical constraints exist, 26 GHz (e.g. building fabric, extensive metallic obstructions) 26 GHz can be used in combination with other spectrum choices (e.g. low- and/or mid-band).

The deployment of wireless solutions is ideal for greenfield industrial sites but 26 GHz small cells can also improve and replace legacy installations at brownfield sites to meet an increasing number of interconnected machines and devices, and deliver benefits of higher reliability, productivity and energy savings by enhancing the ability to reconfigure and removal of operation and maintenance issues associated with fiber or Ethernet connections to equipment on production floors.

The spectrum and core network / RAN aspects of industrial use cases could potentially be provided by MNOs but they could equally well be provided in SA mode by specialist providers.

PMSE

PMSE (Programme Making and Special Events) covers radio applications used with real-time presentation of audio-visual information, including the transmission of audio, video and data signals[4].

Visual PMSE in a 4K-8K multi-camera production environment requires very high bandwidth connections if done wirelessly. Vendors in the field can clearly see the case for 26 GHz connectivity (and this is also being explored in the 5GPPP 5G Records project) but are unable to decisively move forward without access to the 26 GHz ecosystem (5G mmWave modules needs to be integrated into the equipment). Access to spectrum is required on a localised basis, especially if PMSE is operating in a mobile production unit, which changes location day by day.

Using wireless systems eases the requirement for a significant amount of cabling and assists with rapid deployment and / or reconfiguration and thereby increases efficiency and reduces operating costs. The spectrum and core network / RAN aspects of the use case could potentially be provided by MNOs but this is a service that could equally well be provided in SA mode by specialist providers.

Spectrum Allocations

Q6. Do you agree New Zealand should allocate 24.25 - 27.5 GHz primarily for IMT use?
Q7. How should RSM accommodate other use in this band such as space services?
Q8. How do you see our proposal of the 28 GHz band allocation?
Q9. Which option do you prefer for allocating 28 GHz band? Or is there any other option for managing the shared use of IMT, ESIMs and FSS in the 28 GHz band?
Q10. If you prefer option 1, do you agree with the proposed sharing mechanism (defining satellite coordination zones) between IMT use and FSS ground stations?
Q11. If you prefer option 2, how much spectrum do you think RSM should allocate to ESIM, IMT private network/FWA? And what's the preferred spectrum placement?
Q12. Are there any other issues of sharing use between satellite earth stations and ESIMs that you would like to bring to our attention?
Q13. Do you agree that the current satellite allocation and licensing regime for 29.5 - 30 GHz should remain?
Q14. What's your preferred licensing option in 26/28 GHz spectrum?
Q15. Do you see any need for general user licence spectrum for IMT? If so, what use case might there be?
Q16. If there is a need for general use spectrum for IMT and ESIM, how much spectrum should we set aside for it? Should RSM mandate technical conditions on the general use licence?

On 26 GHz, Nokia welcomes the decision of RSM to make the whole band 24.25-27.5 GHz available for IMT, preferably on an exclusive basis.

[4] Source : European Commission

In order to show full 5G capabilities in mmWave range it is recommended to allocate 1GHz of nationwide contiguous spectrum per network. However, large amount of spectrum bandwidth cannot be accommodated, other smaller bandwidth allocations per operator can also be considered.

Regarding the licensing model, Nokia is of view that exclusive nationwide licensing of sufficient amount of spectrum per mobile operators should be the preferred option. This regime should be maintained as the main solution for 26 GHz band for 5G.

On 28 GHz, Nokia considers that the whole band 27.5-29.5 GHz should be allocated for IMT use without any (indoor/outdoor) restrictions. On the two options proposed, while the range 27.5-29.5 GHz has not identified by ITU for IMT, it has mobile service allocation in ITU Radio Regulations on primary basis and is standardized by 3GPP under the band n257 (26.5-29.5 GHz). Countries like Japan, USA, Korea who have opted for the whole band range 26.5-29.5 GHz, have conducted 5G specific co-existing studies, and found possible co-existence of 5G and satellite services in band between 26.5 and 29.5 GHz. Moreover, the band n257 benefits of a robust ecosystem.

A combination of exclusive nationwide licenses to MNOs in the 26 GHz band and local licenses for industries, FWA, and other usages in the 28 GHz should be the main option to be considered by RSM. Allowance to accommodate primary FWA, private IMT networks and/or indoor eMBB in a portion of the 28 GHz band should be made aligned with the premise that approximately 1000 MHz is recommended per 5G operator.

Where local area spectrum licensing is considered, balanced local-national licensing approach is essential, and usage of the lower portion of the band for local licensing is preferred (e.g. the Finnish, Danish models that set up the lower part for local licensing).

In general Nokia considered that:

- If nationwide licenses are not available, a minimum of city/suburban wide licences where MNOs ends up with the same spectrum across all cities/suburban areas is recommended;
- Ideally ~1000 MHz of contiguous spectrum per operator/network is preferred;
- Spectrum bandwidth availability should be balanced with the amount of spectrum available, number of operators and the possible availability of local area licences;
- When spectrum supply is limited, “club licensing” may help maximising overall spectrum use;
- Where MNOs may not consider deployments in mmWave outside of the city/suburban areas, unused spectrum outside these areas can be subject to a “use-it-or-lease/lose-it” approach to enable other entities to use these resources.

The amount of spectrum that RSM intend to allocate to ESIMs and FSS is roughly 2 GHz. Nevertheless, based on New Zealand population base and potential future applications, the proposed amount of spectrum for these services may be over-estimated and IMT should be the priority.

Q17. Do you agree RSM should adopt 3GPP NR FR2 based channel bandwidth to design a channel plan in the radio licence regime for IMT services?

3GPP technical specifications such as 38.101 and 38.104 are important to implement 5G. Therefore, Nokia recommends that RSM adopt 3GPP NR FR2 based channel bandwidth for 5G, taking into account global harmonization and interoperability.

TECHNICAL CONSIDERATIONS

5G technical standards

Q18. Do you agree RSM should refer 3GPP standards to set the regulatory requirements for spectrum allocated to IMT?

Nokia recommends RSM to follow 3GPP approach on its regulatory decision to ensure that New Zealand will benefit the economy of scale of global products for network and end-user equipment.

Regulatory regime for equipment

Q19. Should we introduce a break point for MR technical conditions mid-way through the duration of the MR? Or is it sufficient to set AFELs based on current technology and standards only?

Recognizing the fast pace of technology evolution compared with typical duration of MRs and the good practice of RSM normally requiring that equipment comply with a relevant standard in the Radio Standard Notice, it is important to assure that regulatory technical conditions give certainty to all stakeholders. Therefore, in case RSM decides for introducing a break point for MR technical conditions mid-way through the duration of the MR, this should not affect previously deployed equipment.

Q20. Do you agree RSM should mandate equivalent ETSI harmonised standards for radio licences in Radio Standards Notices and review these standards regularly?

Industry is generally supporting the 3GPP and ETSI standard. If ETSI harmonised standards are to be considered, RSM should take into account that sometimes they contain additional requirements that might be justified by the CEPT situation, and not necessarily outside CEPT. Therefore, to avoid unnecessary, RSM should consult the industry prior to any mandatory decision.

Use TRP to set the unwanted emission limits

Q21. Which option do you prefer to set the unwanted emissions?

TRP is the preferred option for systems with AAS antennas. There is no access to the conducted power.

Q22. If we use a TRP option for setting AFEL and UEL, do you have any recommended solutions on TRP measurement in field?

Currently solutions are under study in 3GPP and ITU-R.

3GPP Unwanted Emissions Limits

Q23. Do you agree that RSM should set unwanted emissions limits (in UELs and AFELs) base on 3GPP category B requirements? If no, please explain the reasons and provide your suggestions?

Nokia is of the view that the unwanted emission limits should refer to the limits in 3GPP Release 15 and beyond specifications. Category B defined in 3GPP technical specification 38.104 could be a basis for this matter.

Sharing and compatibility considerations

Sharing and compatibility with Earth Exploration Satellite (Passive) Service in 23.6 - 24 GHz

Q24. Do you agree that we should we implement (e.g. through UELs and AFELs) the ITU Radio Regulations, Resolution 750 limits, including the 1 September 2027 transition date and grandfathering clause for the protection of the EESS (Passive) Band? If not, please explain what limits and transition dates you consider to be more appropriate.
Q25. Do you have any insights on equipment availability at, or close to, the edge of 24.25 GHz that can meet both pre-1 September 2027 and post-1 September 2027 unwanted emission limits? Is there any additional technical solution such as frequency separation or filtering required for some equipment types?

Nokia supports a global adoption of the values defined and agreed at WRC-19 in order to preserve a global market for the 26 GHz frequency band. Any deviation from these values would result in market fragmentation for the for n258 equipment.

Our opinion is that there is a need to align with the limits defined at WRC-19 for the protection of passive sensors in the band 23.6-24 GHz, noting that:

- WRC-19 has defined a two phases approach, with, for the base stations, a value of -33 dBW/200 MHz applicable from now up to 1st September 2027; and a value of -39 dBW/200 MHz for equipment delivered after 1st September 2027.
- Nokia is of the view that the limit of -33 dBW/200 MHz can be reached by base stations manufactured from now, while – taking into account technology improvements in the upcoming period – products manufactured after 1st Sept 2027 will be able to implement the more restrictive value of -39 dBW/200 MHz;

- We also point out that the values defined at WRC-19 already represent a compromise, as the value stated by 3GPP for spurious emissions, -13 dBm/MHz corresponds to -20 dBW/200 MHz.
- Nokia does not support values which would be more stringent than those decided at WRC-19. Nokia also does not support the starting of the phase 2 before 1st September 2027.

More stringent conditions from an individual country will impose additional requirements on the equipment used in the respective country and eventually, will be translated into equipment specifically design and manufactured for it. As such, the advantages of using a global ecosystem will be limited, including the benefits of having access to the innovation that it brings. Consequently, Nokia recommends New Zealand to consider aligning to the regulations agreed at WRC-19.

Similarly, Nokia considers that outside of the band 23.6-24 GHz the spurious emission limits shall be those defined by the 3 GPP.

Nokia equipment complies with 3GPP specifications and will follow any evolution of the evolution of specifications accordingly. Nokia will also work with its customers to ensure that adjacent systems co existence is met.

Sharing and compatibility with the Radio Astronomy Service in 23.6 - 24 GHz

Q26. Do you agree with RSM's position to not establish a framework for coordination zones for RAS?

We are supportive of RSM position not to establish a framework for coordination zones for RAS.

Sharing and compatibility with Earth Exploration Satellite and the Space Research Services (space to Earth) in 25.25 - 27 GHz

Q27. Do you see a need for RSM to allow EESS and SRS earth stations to operate in the band?

As indicated, RSM is not aware of any current, planned or future operations of EESS or SRS in this band in New Zealand. Moreover, if any future licence, it will be in rural areas and approved radio engineers will need to consider this. Therefore, no further actions from RSM is needed to avoid over-protection.

Synchronisation options for IMT network

Q28. Do you agree a semi-synchronised or unsynchronised network should be used in 5G high band deployment?

From a technical perspective, semi-synchronised networks would be possible in isolated settings at 26 GHz. Please see Nokia's response to Q30

Q29. If the network is unsynchronised, what is the best way to manage the interference between unsynchronised operators?

Q30. If your preference is a semi-synchronised network, what is your suggestion on setting the synchronized parameter?

Regarding the most appropriate synchronization framework for 5G mmWave TDD bands:

- It is widely recognised that mmWave propagation is affected by much higher losses compared to sub-6 GHz frequencies;
- Beamforming at both the transmitter and receiver side will limit the amount of interference that a given transmission will cause on nearby users and base stations;
- mmWave frequencies enjoy a very good indoor/outdoor isolation thanks to the high building entry/exit losses.

These imply that outdoor and indoor networks might operate independently.

In general, compared to typical sub-6 GHz deployments, where synchronization or semi-synchronization is preferable across TDD networks, mmWave asynchronous deployments might be considered with adequate network planning. In most challenging scenarios, semi-synchronization might help to mitigate the interference between networks adjacent in frequency and space.

As such, in the case of mmWave networks, in addition to synchronization and semi-synchronization, an additional option is to allow asynchronous deployments whenever there is no reason to expect excessive interference.

The UL/DL ratio and other parameters related to the synchronization and/or semi-synchronization frameworks should be defined in coordination with the license-holders in order to meet their specific deployments needs.

In our view, it will often be quite realistic for mmWave networks to operate in at least partially unsynchronized and independent manner. Moreover, even within the network of a single operator, it is possible to envision different mmWave clusters using different TDD configurations, and possibly adapting such configuration dynamically, depending on the time-variant DL/UL load ratio. Such arrangements could be of pivotal importance to exploit the increase in UL capacity and peak bit-rates.

Sharing and compatibility with the fixed satellite and inter-satellite service space station receivers in 24.25 - 27.5 GHz

Q31. Do you agree that think RSM should implement ITU Radio Regulations, Resolution 242, resolves 2.1 in the management rights and licences conditions? If not please explain why or propose an alternative?

ITU Radio Regulations, Resolution 242, resolves 2.1 should be implemented, i.e., the mechanical pointing of outdoor base station transmitting antennas should be at or below horizon. Nokia will work with our customers to ensure co-existence with FSS and ISS in New Zealand.

Sharing and compatibility between FSS transmitting earth stations and IMT/FWA

Q32. Do you see a need for RSM to allow continued FSS gateway access to 27.0 - 27.5 GHz on a case by case basis? If so, how should we coordinate FSS Earth stations and IMT?

24.25 - 27.5 GHz

RSM should allocate 24.65 - 25.25 GHz for IMT exclusive use and notes that there are no licences for FSS earth stations in the band and this should continue. For the in the 27.0 - 27.5 GHz band, RSM should not renew the three licences to IPSTAR at Albany SES in the RRF beyond 31 January 2022.

27.5 - 29.5 GHz

Q33. Do you have any comments regarding the spectrum sharing approach proposed by RSM between FSS and IMT FWA in the 28 GHz band?

We agree with specific proposals of RSM regarding:

- the obligation for all FSS earth stations and FWA base stations to be licensed for specific locations;
- the FWA service areas to be recorded in the licence;
- establish certain geographic areas where existing FSS has priority over FWA, as well as possibility for RSM to define certain geographic areas in sparsely populated rural zones where existing FSS stations may be licensed and have primary status. However, existing IMT FWA should also have priority over new FSS earth stations in those specific areas.

Q34. If RSM were to apply an EIRP limit on horizontal plane for FSS, what is the maximum EIRP value we should assume?

The definition of an EIRP limit on horizontal plane for FSS to protect IMT receivers would require a detailed study considering system and deployment characteristics of both systems. A pdf limit derived only based on IMT receiver characteristics preferred.

Sharing with the existing fixed service

Q35. Which option do you prefer for arranging the existing fixed service in the 26 GHz band?

Nokia supports option 1. There is limited use as fixed service and this option allow to have a date of migration. While private arrangement is always welcomed, having a deadline allow to move faster.

As alternative bands, 23 GHz seems better fitted for refarming than the 38 GHz band. The largest hop lengths at 26 GHz could probably not be managed at 38 GHz.

ESIM shares with other services

Q36. Do you think RSM should mandate the regulatory requirements as laid out in Resolution 169 (WRC-19) for ESIM use if a shared use between 27.5 – 28.35 GHz?

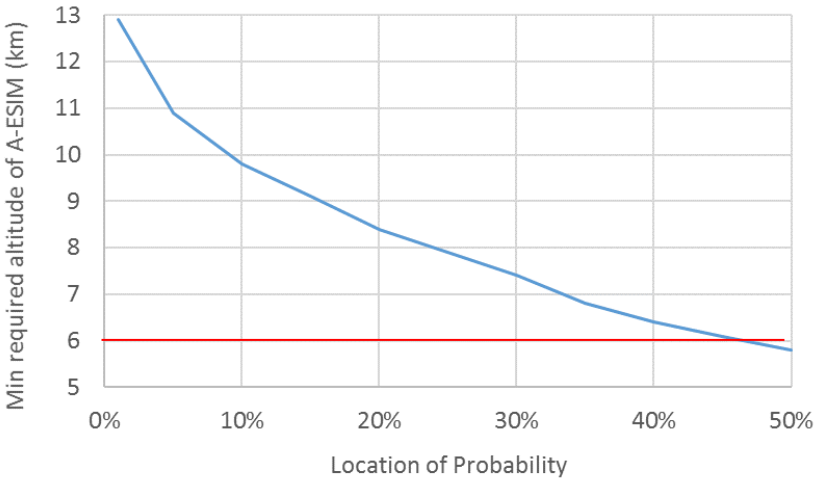
Nokia is of the view that ESIM operations must protect 5G stations operating in 28 GHz. Protections of 5G services should be guided by national regulation within territory of an administration (no co-channel operation) and guided by Resolution 169 (WRC-19) for cross-border situations. Resolution 169 has been approved at the WRC-19 and, as any global decision, should be respected. Several studies have analysed the coordination with different services including ESIM.

Nokia would like to mention 2 submissions[5] [6] made by GSA to the FCC in the United States where "GSA [highlighted to] remain concerned about the potential for unacceptable adjacent-band interference for certain airborne and maritime deployment scenarios in proximity cases. Land-based ESIM pose even greater concerns due to the high likelihood for extensive and prolonged operation in close proximity to 5G systems. As stated in our filings in 2017, GSA is of the view that mobile systems in the 27.5-28.35 GHz band are entitled to protection from adjacent channel ESIM emissions."

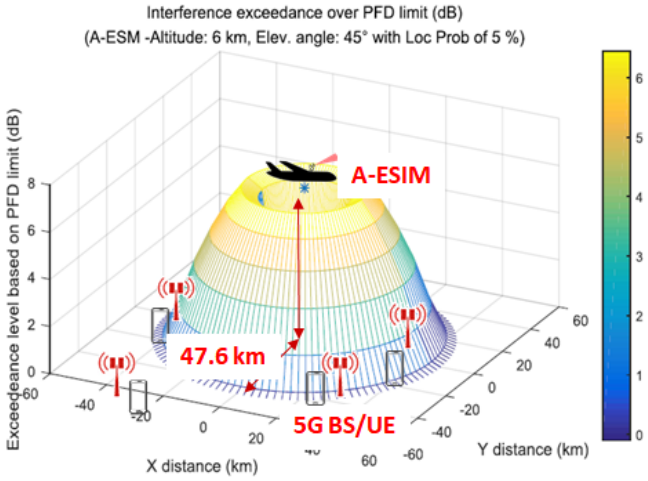
As another example, to assist successful 28GHz commercialization, the Republic of Korea conducted the study how to coordinate with other services in 28GHz. 28GHz (27.5 – 29.5 GHz) is identified as global bands for ESIM usages at WRC-19. In the other hands, administrations are getting interested in using 28GHz for 5G services since the 28GHz 5G ecosystem is already available. Therefore, to coordinate between especially Aeronautical-ESIM services and 5G, the Republic of Korea conducted the study to investigate the applicable direction to implement A-ESIM and 5G simultaneously by assessing interference exceedance from A-ESIM to 5G as Mobile services.

The study intends to protect all types of 5G systems which are defined in Recommendation ITU-R M.2134. The study evaluates, in a given altitude of A-ESIM, how much interference exceedance at which location from BS A-ESIM causes to protect all 5G system in 50% and 5% location probability of clutter environment. The study results in the 6 km altitude at which A-ESIM does not cause unacceptable interference from -6dB I/N of all 5G systems based on medium (50%) location probability of clutter environment. It is shown in the Figure below:

[5] https://ecfsapi.fcc.gov/file/1092396291633/GSA_NGSO_ESIM_Reply_Comments.pdf
[6] https://gsacom.com/paper/gsa-filing-fcc-esim-nprm/



Furthermore, the study results in within 47.6 km ground distance from A-ESIM where BS receives exceedance interference under 5% location probability of clutter environment, as shown in the Figure below:



With those results, as the main purpose of study, 6 km of ESIM altitude is an appropriate altitude above which A-ESIM service could be allowed without any restriction to 5G services. It means normally to ensure the protection of terrestrial 5G services from A-ESIM below the altitude of 6 km. In addition, it could be also learned that neighboring countries located less than 147.6 km far from an international airport could receive unacceptable interference of A-ESIM with 5% probability of location. This is due to the fact that an international takeoff flight could move at least 100 km[7] at ground level to reach 6 km altitude.

[7] This distance was estimated from www.flightstats.com

Finally, as mentioned before, the amount of spectrum that RSM intend to allocate to ESIMs and FSS is roughly 2 GHz. Nevertheless, based on New Zealand population base and potential future applications, the proposed amount of spectrum for these services may be over-estimated and IMT should be the priority.
