Nokia response to Wireless Broadband in the 26GHz band

Option Paper

About Nokia

Nokia is a global leader in technologies at the heart of our connected world. From the enabling infrastructure for 5G and the Internet of Things (IoT), to emerging applications in virtual reality (VR) and digital health, we are shaping the future of technology to transform the human experience. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers, with the industry's most complete, end-to-end portfolio of products, services and licensing.

Nokia has established a broad range of innovation partnerships to find a common direction through collaboration in requirement setting, technology research and finally in standardization. Therefore, we are driving collaborative research with customers (AT&T, CMCC, Deutsche Telekom, MTS, NTT DOCOMO, SKT, KT, Verizon, Vodafone…), governmental bodies, regulatory and industry bodies (e.g. GSA, GSMA, NGMN, 5G Americas, 5G IA, 5G AA…), industry & scientific community, 5G labs (e.g. 5G Lab at TU Dresden, 5G Test Network Finland…) and universities (e.g. New York University for channel measurements and characterization or University of Kaiserslautern for 5G architecture).

Nokia was the consortia leader of the METIS- II, 5G NORMA and FANTASTIC 5G research projects inside the 5G PPP, which will deliver input, for example, for the 5G air interface and network architecture work in 3GPP.

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

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Summary

Nokia welcomes the opportunity to respond to Australian Communications and Media Authority Consultation to Wireless Broadband in the 26GHz band Option Paper. As a leading player in the global communications sector, and contributor to the Australian market over many decades, Nokia is well placed to provide insight on market and technology trends, including industry structure and regulatory practice. As a summary:

- The 26 GHz band as a priority band for 5G above 24 GHz and Nokia supports to make this band available for 5G. Nokia emphasizes the availability of 26 GHz for 5G in Australia would benefit from the global eco-system of equipment. Even if some European countries are initially only going for 26.5- 27.5GHz, equipments will likely be available for the entire band. With the 24GHz (24.25-24.45 and 24.75-25.25GHz) auction announced in the US for early 2019, there is a strong traction to cover the whole 24.25-27.5
- Nokia believe that a reasonable limit for unwanted emission the would enable the introduction of 5G in the designated priority band 26GHz, while adequately protecting the EESS in 23.6 to 24.0GHz is -32 dBW/200 MHz for BS and -28 dBW/200 MHz for UE.
- Nationwide exclusive licensed spectrum will continue to be essential for the development of the networks of the future. This regime should be maintained as the main solution for 26 GHz band for 5G. It is the view of Nokia that industries can be served by MNO's networks using network slicing or leasing. ACMA could also reserve a separate sub-band for geographic/local licenses only in restricted geographic locations (ranging in size from local regions to individual premises).

Further comments:

Mmwave (26GHz/28GHz)

The 26 GHz band as a priority band for 5G above 24 GHz and Nokia supports to make this band available for 5G together with the 3400-3800 MHz band. The 26 GHz band offers a tremendous opportunity for the deployment of 5G services in the 2019/early 2020 timeframe and the 5G NR mmWave ecosystem supporting 26 GHz is expected to be ready in 2019. However, there are issues that remain to be resolved regarding protection of EESS(passive) below this 26 GHz band while not introducing unnecessarily stringent unwanted emission requirements for 5G. Undue emission requirements for 5G could have severe adverse impacts for 5G users on the reduced 5G performance and throughput.

This band will be specifically suited to enable multi-gigabit data rates to be delivered within 5G hot spots, with dense spatial re-use and flexible configuration of spectrum, for the existing fixed links the current sharing studies recommends a tool box to manage the coexistence of 5G access and fixed services in 26 GHz thus enabling administrations to take account national circumstances and FS deployment. while providing 5G services.

Large-scale investments by MNOs in 26 GHz is essential for its success and regulators should ensure that MNOs are designated, through the appropriate selection procedures, as the primary stakeholders to provide 5G services in the 26 GHz band.

National governments and regulators are licensing 26 GHz as early as in 2018 to provide sufficient time for trials, for commercial arrangements to be put in place and getting the technology working in a real-world environment. With its global perspective, Nokia emphasizes the availability of 26 GHz for 5G in Australia would benefit from the global eco-system of equipment. In Europe, 5G spectrum consultations are ongoing (or planned) in a number of countries including UK, Spain, Portugal, France, Germany and Finland; and 26 GHz band is expected to be made available for 5G in the near future. Italy concluded auction of the highest 1 GHz range covering 26.5-27.5 GHz in October 2018. USA has announced auction of what it refers to as “24GHz band” covering the 24.25-24.45 and 24.75-25.25GHz ranges immediately after its 28GHz auction which is starting on November 14th, 2018. In addition, FCC has started the study of 25.25-27.5 GHz range which is between its 24GHz and 28GHz bands. 3GPP has also defined 5G band n258 to cover the 24.25-27.5GHz range. There is, therefore, clear momentum to develop an ecosystem for the 26GHz band.

Nokia sees also the 28 GHz band (27.5-29.5 GHz) as a very important band for 5G, especially concerning early deployments of 5G. In USA, 28GHz deployments are already happening using existing 28GHz spectrum assets and FCC is bringing more 28GHz spectrum to the market through an auction starting on November 14th, 2018. Several other countries like Canada, Japan, Korea, Mexico, and Singapore are looking towards opening that 5G Frontier band 5G (http://5g-28frontier.org).

The important achievements in 3GPP with the recent approval of Release 15 on non-Standalone New Radio specifications will facilitate 5G device implementations in the 28 GHz frequency band globally. It will also encourage to harmonize the technical and regulatory conditions in the 28 GHz frequency band to facilitate economies of scale and globally harmonized implementations.

The 5G mobile industry is developing chipsets, devices, and infrastructure equipment based on the approved Release 15 specifications from 3GPP to enable the first deployments of commercial 5G systems in the 28 GHz frequency band. In addition, the numerous 5G trials already ongoing in several countries are based on these industry equipment developments.

Some countries have already made the 28 GHz frequency band available for 5G, in 2016, and other administrations are taking similar steps throughout this year and 2019. This 5G Frontier band initiative has a clear objective to realise the global 5G vision, which will accelerate 5G deployments around the world. For additional information see www.5g-28frontier.org.

Bandwidths requirements:

Large amounts of bandwidth are required in order to reach the low latency and high data rates of up to 20 Gbits/s envisaged in the 5G vision. Table below shows the theoretical data rates that can be achieved for a given bandwidth.

RF channel bandwidth	Peak data rates[1]
200 MHz	6 Gbit/s
400 MHz	12 Gbit/s
800 MHz	24 Gbit/s
1000 MHz	30 Gbit/s

1000 MHz bandwidth would be required to achieve the Peak data rate requirement of 20 Gbit/s in the DL, assuming a 3:1 DL/UL ratio.

The mmWave spectrum, such as the 26 GHz band, which has up to around 3 GHz of spectrum earmarked, provides this large amount of spectrum. There is clearly a trade-off between higher frequencies and reduced range which is why mmWave spectrum is positioned as a hot spot solution to complement 5G networks in other lower frequency bands as well as an FWA enabler. Where possible, 800-1000 MHz bandwidth per network is envisaged although there are trade-offs between the amount of spectrum available, timings for availability and sharing with or clearing existing users, number of networks for competition purposes etc.

[1] Peak spectral efficiency (SE) of 5G New Radio: 30 bit/s/Hz in DL (from ITU-R M2410 “Minimum requirements related to technical performance for IMT-2020 radio interface(s)”).

The large bandwidths available is the key advantage of the 26 GHz (and other mmWave bands) when compared to lower bands and can be leveraged to reach the targeted data rates for 5G. Where possible 800-1000 MHz bandwidth per network, ideally contiguous, in the longer term could provide superior performance and will demonstrate fully the value of mmWave bands for 5G.

Technical Conditions

Nokia welcomes the decision of ACMA to explore alternatives compared to the current European approach related to coexistence with other services such as EESS(p). Even if Europe represents one of the most significant market, it is not the only one. Some other regions are moving forward. For example, the Arab Spectrum Management Group (ASMG) have agreed on a range of −32 to −37 dBW/200 MHz (base stations) and −28 to −30 dBW/200 MHz (terminals) for unwanted emission in the 26 GHz band and recently the African preliminary position for WRC-19 (APM19-3) have adopted the same range. In addition, US will auction the 24GHz (24.25-24.45 & 24.75-25.25 GHz) in Q12019, which goes down to 24.25GHz with same EESS(p) issue and the current limit considered by FCC is -13dBm/1MHz which is 22dB more relaxed than CEPT. So, auction will happen with this relaxed limit. The FCC will later on, if necessary, consider through notice and comment whether any modification of their current out-of-band limits may be needed. As of today, no one has petitioned FCC to change the limits. Even if they change the limit, it may not be as stringent as CEPT. Also in Korea, the limit for 28GHz (26.5-29.5 GHz) is same as in FCC (-13dBm/1MHz).

Although there is clearly a need to protect EESS (passive) operations in 23.6-24 GHz, it is important not to over-protect EESS in such a way that would unnecessarily restrict 5G networks and services and discourage investment in the band. If ACMA has to decide on emission limits now, Nokia recommends to consider the IMT unwanted emission limits for the 23.6 to 24.0 GHz frequency band to protect EESS (passive) within the following ranges

- BS: -32 to -37 dBW/200 MHz
- UE: -28 to -30 dBW/200 MHz

A detailed analyses (leading to that above range) on the different studies conducted in TG5/1 for EESS (passive) service and 5G/IMT-2020 and their assumption is discussed in Annex 1.

Nokia believe that a reasonable limit for unwanted emission the would enable the introduction of 5G in the designated priority band 26GHz, while adequately protecting the EESS in 23.6 to 24.0GHz is -32 dBW/200 MHz for BS and -28 dBW/200 MHz for UE.

The other option would be to wait and see what FCC decides in USA in 2019. Unfortunately, there is no clear certainty regarding FCC's action. FCC could even decide not to take any action and keep the current -13dBm/1MHz emission limit that it is using for the upcoming auction. If FCC takes any action, it would likely happen in Q22019 or beyond.

Nokia believes that the proposed imposition by some countries like Russia of a strict "EIRP mask" or "in-band power limit" for transmissions from 5G base stations would be over-restrictive, impractical and unnecessary, and would further restrict the development and implementation of 5G in the 26

GHz band. In an 5G/IMT-2020 network in this band, beamforming will be used to direct the main beam from a base station in the direction of each user equipment (UE) to be served, and a restriction on emissions at positive elevation angles is likely to be impractical to implement. The vast majority of UEs will anyhow be located below the height of the base station to which they are connected, and hence elevation angles greater than 0° will be atypical and are unlikely to have significant impact on interference into other services. Imposition of an EIRP mask would place unnecessary constraints on a 5G network operator's ability to provide 5G services in an efficient and effective manner.

Therefore, we also recommend to ACMA to avoid any stringent and impractical conditions that could hamper the deployment of 5G network

Licensing

Nationwide exclusive licensed spectrum has been a key underpinning of the phenomenal success of mobile services. This regime should be maintained as the main solution for 26 GHz band for 5G. A different approach for this 5G band could disrupt a well-established regulatory framework and delay the take up of 5G services.

A very efficient way to address vertical markets is to have the service offered by MNOs through the network slicing functions. 5G networks are being defined to have the capability to serve different usage needs in terms of data rate, reliability, latency, number of devices, etc. MNOs can define slices that respond to the needs of specific vertical markets, and these slices could run over different frequency bands. For instance, a smart grid network would require ubiquitous coverage to be offered by low frequencies, but a smart factory might require very high data rates at a localised facility and hence mmW bands above 6 GHz could be used.

Another approach is one where the vertical user leases spectrum from the MNOs and deploys its own network at its premises. In order to respond to vertical market's needs, it would be wise to remove all regulatory barriers from leasing/secondary markets in mmW spectrum like 26 GHz.

If the regulator determines that leasing is not happening in an effective and efficient manner (i.e. MNOs might not engage in leasing) and at fair and reasonable conditions, then it could consider "use-it-or-lease-it" conditions or indicating upfront that it will take action ex-post if there is evidence that MNOs are not responding to leasing requests.

Finally, another approach could be to reserve a separate sub-band for geographic/local licences. Such authorisation would suit the requirements of verticals who wish to use the spectrum only in restricted geographic locations (ranging in size from local regions to individual premises).

It is the view of Nokia that verticals, such as factories, stadiums, etc., can be served by MNO's networks using network slicing, sub-leasing and use-it-or-lease-it conditions within this spectrum. Once a competitive 5G market has developed and, at that point in time, if network slicing, leasing and use-it-or-lease-it conditions do not allow vertical markets to grow, only then regulators could

consider making dedicated spectrum available. This could strike a reasonable balance between establishing stable and early 5G market with MNO's and providing a pragmatic solution for verticals.

Licenses should therefore allow leasing. In addition, use-it-or-lease-it clauses attached to licensing conditions could be considered by regulators. These regulatory tools coupled with network slicing and other similar solutions can enable efficient spectrum utilization for both MNOs and verticals.

Annex 1

Co-existence between IMT and EESS in 26 GHz range

Different studies in ITU-R TG5/1 were received in relation to compatibility between 5G/IMT-2020 in the 24.25-27.5 GHz band and EESS passive in the band 23.6-24.0 GHz, leading to a range of unwanted emission levels that would be necessary to protect the EESS (passive). While some of the studies were performed on all sensors in Rec. ITU-R RS.1861 operating in the 23.6-24.0 GHz frequency band, the results summary in Draft CPM text (Temp/146, section 2/1.13/3) are based on the most restrictive Sensor F3.

The differences in the results are due to differences in the assumptions used by the sharing studies. It is to be noted that the protection required shows a range of 10-12 dB difference due to several reasons including:

- ✓ Assumptions used in the study
- ✓ Application of the EESS (p) sensor
- ✓ Sensitivity of the EESS(p) sensor

In order to compare the compatibility study results, the different parameters and models that led to the varying results need to be analyzed and discussed:

- ✓ Interference apportionment or not (0 to 3 dB used in studies)
- ✓ Antenna normalization or not (~2dB difference for beamforming antennas)
- ✓ Multi-operator factor or not (0 or 2 dB)
- ✓ LOS (Line of Sight) probability between BS and UE
- ✓ Urban deployment only or urban + sub-urban deployment (difference ~0.7 dB)
- ✓ Production and other margins.