Intel Response to "Public consultation on the Draft RSPG Opinion on spectrum related aspects for next-generation wireless systems (5G)"

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Date / Revision 31st July 2016 / Final

Section 2

> This roadmap has been developed to facilitate the launch of 5G on a large scale in Europe by 2020. The goal is that the benefits of 5G-based services are available to all European citizens in a timely manner, driving industrial and societal transformation and economic growth in Europe from 2020 and beyond.

Europe needs to take into account international 5G developments: Intel applauds the European Commission proactively progressing opportunities to identify spectrum suitable for 5G. However, given expectations of a 5G launch in Europe in 2020 at the earliest, we note that some Administrations outside Europe are driving more aggressive timescales. There are various cases where access to spectrum suitable for 5G is being progressed expeditiously. In the US, the FCC on 14th July 2016 adopted new rules to enable rapid development and deployment of next generation 5G technologies and services: these new rules open up nearly 11 GHz of high-frequency spectrum for flexible, mobile and fixed use wireless broadband – 3.85 GHz of licensed spectrum (in the 28 GHz, 37 GHz and 39 GHz bands) and 7 GHz of unlicensed spectrum (in the 64-71 GHz band)[1]. Verizon expects to begin commercial deployments in 2017.[2]There are other Administrations aiming for 5G trials and deployments in time for the next Olympic Games[3]. There are also numerous trials underway in leading countries. In addition, the US "incentive auctions" of spectrum within 470-698 MHz are already underway[4].

Intel believes the European Commission needs to take into consideration development outside of Europe in order influence and keep pace with international developments.

Section 2.1

> 1. The RSPG considers the 3400-3800 MHz band to be the primary band suitable for the introduction of 5G use in Europe even before 2020, noting that this band is already harmonised for mobile networks, and consists of up to 400 MHz of continuous spectrum enabling wide channel bandwidth. This band has the possibility to put Europe at the forefront of the 5G deployment.

3.4-3.8 GHz and 3.8-4.2 GHz Important for 5G: Intel supports efforts to introduce 5G at a pan-European level as expeditiously as possible in the 3.4-3.8 GHz band. Other countries are pursuing 5G deployments within this frequency range: for example, the 3.3-3.6 GHz frequency range is one of the frequency ranges that China is pursuing for 5G deployments.[5]

However, this should not reduce other initiatives to secure access to additional bands suitable for 5G in higher bands above 6 GHz and/or bands below 6 GHz. There is no single 5G band solution that will address all 5G service and application bandwidth, latency and coverage requirements.

Intel agrees that the 3.4-3.8 GHz band is regarded as suitable for early deployment of 5G in Europe due to already being harmonised for mobile networks with up to 400 MHz of continuous spectrum. Intel believes that possibilities to open up the adjacent 3.8-4.2 GHz band should also be explored in order to provide greater bandwidth per operator in this frequency range.

Section 2.2

> 2. The RSPG is of the opinion that 5G will need to be deployed also in bands already harmonised below 1 GHz, including particularly the 700 MHz band, in order to enable nationwide and indoor 5G coverage.

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[1] https://www.fcc.gov/document/fcc-adopts-rules-facilitate-next-generation-wireless-technologies
[2] http://www.nasdaq.com/article/verizon-to-commercially-deploy-5g-wireless-networks-in-2017-cm610483
[3] https://www.telegeography.com/products/commsupdate/articles/2016/04/01/sk-telecom-completes-5g-field-trial/, http://www.pcworld.com/article/3053620/koreas-working-on-a-cool-combination-5g-and-the-winter-olympics.html
[4] http://wireless.fcc.gov/auctions/incentive-auctions/broadcast-incentive-auction.html
[5] http://www.mobileworldlive.com/asia/asia-news/china-preps-ground-for-5g/

Existing IMT bands below 1 GHz plus sub-700 MHz important for 5G: In the spirit of technology neutrality and service neutrality, which Intel strongly advocates, we recommend that affording this flexibility to existing bands harmonised below 1 GHz for mobile broadband.

Intel also support initiatives to provide access to spectrum within the 470-694 MHz frequency range for 5G. We note that Pascal Lamy, as Chairman of the high-level group on the future use of the 470-790 MHz frequency band, in his report to the European Commission recommended a "*flexibility option*" involving studying scenarios that allow spectrum in the sub-700 MHz frequency band to be used for downlink-only electronic communications services in cases where there is no or declining demand for DTT at national level. Whilst we recognise the consideration of possible regulatory actions in the frequency band 470-694 MHz in Region 1 will only take place in preparation of WRC-23, the US has taken the lead on this band to enable mobile broadband below 694 MHz through the ongoing incentive auction. Intel supports European consideration of mechanisms to enable new 5G services within the 470-698 MHz frequency band in a timely manner, noting the requirement to take into account protection and coexistence with existing terrestrial broadcasting services.

Section 2.3

3. The RSPG considers that there will be a need to ensure that technical and regulatory conditions for all bands already harmonised for mobile networks are fit for 5G use.

5G deployments in existing IMT bands/ Mobile Operator's Discretion: Intel agrees that it is important for the technical and regulatory conditions for existing bands already harmonised for mobile networks to be suitable for future 5G deployments. In this regard, existing least restrictive technical conditions (channelling arrangements and Block Edge Masks) should be reviewed and revised as required to facilitate 5G usage.

Intel believes Mobile Operators are best positioned to determine when 5G should / could be deployed in existing harmonised frequency bands and that timescales for such a transition should not be mandated at a European level by the European Commission.

Section 2.4

4. The RSPG stresses that there are many frequency bands above 24 GHz which are of potential interest for 5G in Europe:

- To give sufficient guidance to industry, the RSPG will aim to identify at the earliest opportunity a suitable band to be made available in Europe. In order to do this RSPG members will prioritize the necessary work to assess what would be involved in enabling access to each candidate band in their country.
- In this regard the RSPG believes that global harmonisation will be essential for developing 5G.
- The RSPG will define the timeline for availability of other bands taking into account sharing and transition challenges, for example for mobile access and fixed services (including backhauling).

Importance of "Tuning Ranges": Intel supports in principle an early focus on identifying possible frequency bands to be considered but we have some concerns if "*aim to identify at the earliest opportunity a suitable band to be made available in Europe*" means the RSPG will try and determine the band(s) without necessarily taking into account factors such as 5G progress being made in other frequency bands outside the ITU processes, i.e. 28 GHz band in US and Korea (with similar considerations taking place in Japan), tuning ranges, and other impacts on device availability.

With respect to the RSPG statement regarding the importance of global harmonization, it is critical to understand the concept of "tuning ranges". Simplistically, frequencies that are adjacent to one another can be leveraged for inclusion in a single product design even if they are not all available in a single geography. Finding frequency ranges which are available in major markets, or where the available frequency bands are close enough to be supported within a single radio, i.e. "widely harmonised over major markets" is critical to achieving the economies of scale necessary to support the business case for both manufacturers and operators. This type of harmonisation- widely harmonized over major markets-creates commonalities in regulatory requirements and technical specifications—reducing the cost and complexity of implementing and enabling 5G technologies.

As Europe aims to achieve leadership in 5G, it is of utmost importance to take into account and try to align with these early adopter developments in the 28 GHz band outside of Europe. This is particularly important as one of the candidates for an early European priority band (24.25-27.5 GHz)

is directly adjacent to the 28 GHz band (and even overlaps by 1 GHz with the band that Korea considers for early 5G deployments (26.5-29.5 GHz)) which will enable a tuning-range for widely harmonised equipment, whereas another candidate band (31.8-33.4 GHz) is a smaller band, is not adjacent to the 28 GHz and faces 800 MHz of passive service spectrum with stringent protection requirements in-between, thus significantly limiting tuning-range possibilities.

In addition, when considering frequency bands for ITU deliberations within the scope of the WRC-19 Work Item 1.13, it is recommended that consideration to realistic tuning ranges and adjacent frequency bands are also taking into account.

Section 2.5

> 5. The RSPG believes that considerations of bands above 6 GHz for 5G shall be limited to the bands listed by WRC-15 in order to strengthen the global harmonisation opportunities. This work should focus on the frequency bands proposed by Europe, in particular the bands 24.5-27.5 GHz, 31.8-33.4 GHz and 40.5-43.5 GHz. The RSPG intends to identify which one of these could be harmonised in Europe for early implementation.

Don't Limit Consideration to Only WRC-15 Listed Bands: We do not necessarily agree that one should limit studies to only bands that are listed by WRC-15. In particular, we are concerned that the 28 GHz band is not being considered since some of the first 5G trials and initial deployments by countries outside of Europe that aim to be technology leaders in 5G will take place in this band in the near future. We note the existing allocation to the mobile service on a primary basis in the 27.5-29.5 GHz frequency band. Studies submitted to the FCC process for designation of "5G" bands above 24 GHz led the FCC to conclude that interference from terrestrial 5G services into FSS space stations "are not likely"[6]. We, therefore, strongly urge the RSPG to consider possibilities of utilizing the 28 GHz band for 5G in Europe to the maximum extent, with other leading 5G markets.

With respect to consideration of the 24.5-27.5 GHz, 31.8-33.4 GHz and 40.5-43.5 GHz bands, Intel believes the concept of "tuning range" is critical. It is important to ensure access to frequency bands for 5G can be supported within a single radio for widespread usage and economies of scale, starting with key markets. Countries outside of Europe, that are early adopters and technology leaders, are currently progressing their plans for 5G in the 28 GHz band. This is especially relevant in relation to "tuning ranges" with a view to implementing harmonisation via a single radio spanning multiple bands to drive down economies of scale as explained in our comments to Section 2.4. Therefore, the most interesting band from within this list is the 24.25-27.5 GHz band.

With respect to the 40.5-43.5 GHz band, we note that the FCC has made the 37-40 GHz bands available for "5G" use. Therefore, we request that the RSPG expand the focus to include the 37-43.5 GHz frequency range.

Section 2.6

> 6. The RSPG will keep under review whether there is any requirement for European harmonisation measures in bands above 24 GHz before WRC-19.

Intel supports the objective of identifying frequency bands which are widely harmonized in major markets for 5G. There are existing allocations on a primary basis to the mobile service in many of the bands above 24 GHz. Given the FCC's conclusion that interference from terrestrial 5G services into FSS space stations "are not likely"[7], we strongly urge the RSPG to review the possibility of using the 28 GHz band for 5G in Europe.

The benefits of achieving worldwide interoperability via functional harmonisation where one radio with a sufficiently wide tuning range may be able to cover two Regional bands (or between different countries) should also be taken into account.

Section 2.7

> 7. The RSPG will prepare a supplementary opinion elaborating on the implementation of this opinion taking also into account the wider RSPG work programme, in particular the working groups on IoT and ITS.

Intel notes the RSPG consideration of vertical markets. We welcome further opportunities to contribute to the development of the supplementary RSPG opinion.

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[6] https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-89A1.pdf
[7] https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-89A1.pdf