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Re: Improving consumer access to mobile services at 3.6 GHz to 3.8 GHz

Please find attached the Institution of Engineering and Technology's written response submision to the above consultation. Although we have also submitted answers online, we have also provided this version because it contains more detailed answers to questions 8 and 9 than the character count of the submission form would allow.

About the IET

The IET is one of the world's leading professional societies for the engineering and technology community, with more than 167,000 members in 150 countries and offices in Europe, North America and Asia-Pacific. The IET provides a global knowledge network to facilitate the exchange of ideas and promote the positive role of science, engineering and technology in the world.

This submission has been approved on behalf of the IET's Board of Trustees, and takes into account the views of IET Members under the guidance of the IET's Communications Policy Panel and should not be taken as representing in any way the individual views of the organisations for which the panel members work.

The IET is happy to discuss these points with the Ministers or Officials.

Yours sincerely,

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Question 1: Do you have any comments on the use of the 3.6 to 3.8 GHz band by existing services?

The threat of harmful interference from the existing services to the new 5G enhanced Mobile Broadband Services needs to be made more explicit in the analysis. For this purpose, Ofcom needs "a reference model" for the likely 5G enhanced Mobile Broad Band networks. Such a model would not just illuminate where the threat of harmful interference was more likely but also deliver confidence to incumbent users where mutual harmful interference issues were less likely.

Question 2: Do you agree with our identification of a trend towards the use of mobile in the 3.6 to 3.8 GHz band?

The RSPG has identified three 5G pioneer bands and each uniquely fit for purpose. One of the three is the range 3.4 – 3.8 GHz (within which the band in question sits) is essential for the success of a 5G high capacity "mobile" services with dense small cell clusters across urban areas.

Question 3: Do you agree with our high level proposal to make 116 MHz within the 3.6 to 3.8 GHz band available for mobile and 5G services, bearing in mind our statutory duties and the high level trends we have identified?

Yes.

Question 4: Do you agree with our general approach regarding spectrum currently licensed to UK Broadband?

It is very difficult for those likely to invest in 5G networks and UK Broadband to assess the potential for harmful interference to each other's services when there is currently no reference model of a 5G network in this band, there is no delineation of where coverages will ultimately reach out to (on either side) and no idea how UK Broadband's network architecture and technical characteristics might evolve in the future. For example, UK Broadband itself may want to adopt 5G technology and this might ease compatibility issues. The price of holding all options open on all sides might be the exclusion of one or the other to avoid a myriad of theoretical harmful interference situations that might never happen in practice.

Question 5: Do you agree with our assumptions, methodology, and conclusions with regards to potential coexistence between mobile and existing fixed links and satellite earth stations? Please refer to annex 5 for further details.

The assessment of harmful interference from new 5G mobile services *is based on theoretical modelling*. As a general rule theoretical models tends to seriously over-estimate the threat of harmful interference. There can be no doubt of the potential of harmful interference but the margin of error is likely to be on the side of significantly over estimating its impact.

Question 6: Do you have a view on any of the two options we identified?

In principle we think the right option is (b). It delivers a rare opportunity to optimise the use of the spectrum across the 3.4 – 3.8 GHz band identified by the RSPG as giving the UK and Europe the opportunity of being a leader in 5G. However, the approach should be taken on the basis of why this band is particularly needed for new 5G networks and its consequential natural geographic limits rather than falling back on how 4G national networks have evolved. In particular dense small cell network clusters delivering contiguous coverage of Gb/s data

speeds for those on the move are unlikely to be located beyond urban areas and certainly there will never be national wide area coverage.

Question 7: Do you have any quantitative evidence on the costs and benefits associated with the options? This include costs for existing users and/or consumers of existing services associated with potential changes, and benefits to UK consumers in gaining access to mobile services in this band.

The value of the UK mobile market is of the order of £15 billion per year and the fixed telecoms market around £13 billion per year. 5G will bring a tighter coupling between these two markets. Many fixed links have a short wireless tail and as mobile networks move towards clusters of dense small cells it will drive the reach of fixed networks much closer to the end mobile customer. Therefore, 5G at the very least will be pivotal in sustaining this £28 billion a year market over the next 10-15 years, even before accounting for any new services the enhanced 5G networks will enable.

Question 8: Do you have any other suggestions that would allow widespread 5G availability using the 3.6 to 3.8 GHz band across the UK while allowing certainty for at least some existing users to continue to provide the benefits currently provided by use of the 3.6 to 3.8 GHz band?

All that we need to know for spectrum planning purposes about the earth stations and fixed links is known. This is not the case for 5G where relatively little has been defined. This leads to worst case assumptions having to be made. Were a "reference model" of a 5G network to be agreed with the industry – the interference issues could be much more tightly defined…both geographically and with time. What is a likely scenario for the roll out of 5G networks? Below is a strawman:

- Around 1.5% of the UK land mass has high enough footfall for multiple operators all to want to co-locate their small cells. This will account for the first 100,000 or so small cells to be rolled out, it defines where the most likely initial deployment will take place and where all the available spectrum will be deployed.
- The UK National Ecosystem Assessment (2012) identifies 6.8% of the UK land mass as urban. Using this figure, some 500,000 cells in total are required to provide 5G coverage of all urban areas. However, beyond the first 100,000 or so cell sites the traffic will not exist to support multiple operators at each cell site. The first operator to a cell site removes the already marginal business case for other operators to subsequently co-locate. Where there is only one operator it opens up a greater potential for channel switching to solve harmful interference to incumbent services (assuming there to be more than one 100 MHz wide 5G RF channel that is accessible).
- Over the remaining 93.2% of the UK land mass and outside of buildings there is likely to be no commercial interest in locating 5G small cells as the business case falls below viability even for a single operator.
- Towards the periphery of 5G dense cell network coverage the cell sizes will increase to sustain viability (less dense networks).
- The signals at 3.6 GHz will not penetrate buildings very reliably so the emergence of indoor 5G cells are likely and numbers will grow into the millions. It is technically feasible to remotely control harmful interference to outside public 5G cells.

The numbers are purely illustrative but the strawman may help to dimension a reference model to provide a much greater level of certainty in over 93.2% of the UK land mass for non-5G services. The IET is willing to assist Ofcom develop the 5G Reference Model through suggesting appropriate values for key parameters needed for spectrum sharing calculations.

It is also essential for assessing harmful interference and spectrum planning more generally to standardise the minimum width of a 5G radio channel. The 5G PPP Infrastructure Association has stated that this needs to be at least 100 MHz wide to achieve the objectives of 5G.
For existing satellite earth stations, the emphasis should be on improving site shielding where feasible to reduce exclusion zones to the absolute minimum.

Question 9: Do you have any comments in relation to these proposals?

The award of spectrum in the band 3.4 – 3.6 GHz is expected by an Auction process that has not been designed to ensure the delivery 5G RF channels (which need to be at least 100 MHz wide). Therefore, one possible (indeed likely) outcome of the 3.4-3.6 GHz auction is that the band fragments *and no 5G RF channels* emerge. This throws the entire weight of the new 5G network opportunity onto the 3.6 – 3.8 GHz band. This serves to emphasise the vital importance of the entire band 3.6-3.8 GHz (the full 200 MHz) being clear in the areas where 5G is to be rolled out and why this should be the main priority. Only in this way will the UK market have access to 5G RF channels that need to be at least 100 MHz wide. Structurally that could be difficult if Ofcom auction 3.4-3.6 GHz next year, and then 3.6-3.8 GHz later which does not allow for any of the necessary wide RF channels to emerge. We suggest that Ofcom to do some thinking about what it can do to facilitate a "re-ordering" of the 3.4-3.8 band after the first or both auctions in order to move from a fragmented band to contiguous large blocks.

Finally, the release of the 3.6-3.8 GHz band, clearing out of incumbent services to the extent necessary and re-ordering of the band to deliver contiguous blocks must be time-tabled to allow:

- research Test Beds to function now,
- early pre-operation trials before 2020
- and the full roll out of 5G dense small networks and indoor use by 2020.