BT's response to:

# Spectrum above 6 GHz for future mobile communications

*(Issued by Ofcom on 16 January 2015*)

**Submitted to Ofcom on 26 February 2015**

## EXECUTIVE SUMMARY

1. BT supports the wider mobile industry request to secure an agenda item for the ITU World Radiocommunication Conference in 2019 (WRC-19) on the spectrum requirements above 6GHz for a future very high speed short range component of the 5G platform. This element of 5G is the subject of ongoing research and investigation and the exact timescales of its commercial implementation cannot be accurately predicted at this stage. Although the timeframe will be sometime beyond 2020, it is necessary to begin the international process to address the identification of suitable spectrum now. In this context we welcome this call for inputs and we hope that it enables Ofcom to prepare and be active in supporting such a proposal for a WRC-19 agenda item.
2. At this early stage it is not possible to be definitive as to the exact spectrum requirements for 5G mobile above 6 GHz, nor the preferred frequency band, as these are matters of ongoing international study. We anticipate that within the timescales of the preparations for the WRC-19, provided the agenda item is sufficiently broad as to cover the range of bands that are already the subject of international research and investigation, it should be possible to converge on a suitable solution.
3. Given the extensive international research and development work already underway, including the work that is summarised within the ITU-R WP5D in a draft Report on "The technical feasibility of IMT in the bands above 6GHz", we have no specific BT perspective to offer on the technology aspects.
4. At this stage we do not single out any particular frequency range or specific frequency band that BT would prefer to be identified as a global band above 6GHz for 5G mobile. However, we support initiation of further studies in all bands within the approximate range 6 GHz to 80 GHz and will contribute to further national and international work to narrow down the candidate bands in the light of the results of sharing studies and applying other relevant filters, such as the amount of contiguous bandwidth that would be available and whether sharing with existing and planned uses would be feasible.

## 1. INTRODUCTION

BT supports the wider mobile industry requests for the ITU to address global identification of additional spectrum for future mobile services in bands above 6 GHz. This is needed to enable a new component of 5G that will provide very high speed short range connectivity. This element of 5G is the subject of ongoing research and investigation and the exact timescales of its commercial implementation cannot be accurately predicted at this stage. Although the timeframe will be sometime beyond 2020, it is necessary to begin the international process to address the identification of suitable spectrum now.

We therefore welcome Ofcom's work to prepare a UK position on this matter and welcome its support to secure agreement at the ITU World Radiocommunication Conference 2015 (WRC-15) on a suitable agenda for the next conference in 2019 (WRC-19).

The detailed spectrum requirements above 6 GHz for 5G mobile and the potential regulatory solutions will require further study. However, the broad requirements can already be anticipated and we provide our preliminary views on this in response to the questions below.

## 2. RESPONSES TO THE QUESTIONS

### Question 1: Are there practical ways of achieving the very high performance that use of wide channels above 6 GHz could offer, for example using carrier aggregation of lower frequency bands?

No. The spectrum requirement to support the peak speeds and capacity that is foreseen for the new very high speed short range mobile connectivity component of 5G is estimated at 500 - 1000 MHz per network. This is consistent with technology that has already been demonstrated which uses 500 MHz and 1 GHz wide carriers. Sub-6 GHz spectrum already available to mobile operators would not match such requirements, even if aggregated. In any case existing spectrum allocations will be required to deliver wide area mobile network capacity and cannot additionally support the new very high speed short range component of 5G mobile.

### Question 2: What recent or emerging advances in technology may provide effective solutions to the challenges in higher frequency bands? For example can increased propagation losses be mitigated by using the high gains available with massive MIMO?

Technology demonstrations by Samsung and others have demonstrated the feasibility of using higher frequency bands such as 28 GHz for fixed and mobile access. For several years millimetre wave bands have been successfully used for very high speed fixed links and more recently 65 GHz, and 70 / 80 GHz products have emerged. There are also wireless LAN standards for the 60 GHz band.

The ITU-R WP5D has an activity looking at the technical issues associated with mobile in bands above 6GHz and is preparing a Report ITU-R M.[IMT.ABOVE 6GHz] on "The technical feasibility of IMT in the bands above 6GHz". That draft report[1] is still in preparation but since Ofcom is an active

[1] At the time of writing the draft report is temporarily available to ITU-R members at https://extranet.itu.int/rsg-meetings/sg5/wp5d/_layouts/15/WopiFrame.aspx?sourcedoc=/rsg-meetings/sg5/wp5d/TEMP/536e.docx&action=default

participant in the ITU-R WP5D it will have access to it and will be familiar with its content. This document already provides a very good summary of the technology issues and propagation considerations of the various bands and we have no additional information to provide.

Practical experience of higher frequency bands demonstrates that non line of sight propagation can benefit from reflections from buildings and other obstacles and the antenna scheme is important in determining the overall path loss. Example link budgets under discussion within the aforementioned draft ITU-R Report give an indication of what coverage may be possible.

**Question 3: Are there any fundamental/inherent frequency constraints of the 5G technologies currently being investigated with regard to:**

**a) minimum contiguous bandwidth per operator? Will the spectrum for multiple operators need to be contiguous (i.e. a single band) or could multiple operators be supported through multiple bands?**

To benefit from economies of scale and to promote global roaming, ideally multiple operators (or networks potentially shared by operators) should be accommodated in the same band. Contiguous spectrum would enable the most efficient use.

**b) frequency range over which the technologies are expected to be able to operate, for example due to propagation, availability of electronic components, antenna designs and costs of deployment? For example, is 10-30 GHz better or worse than 30-50 GHz and why?**

The choice of band will need to balance many factors including the total bandwidth that needs to be accommodated, the generally propagation losses as frequency increases and the cost of components to deliver a given power level. On balance we consider that all frequencies between about 6 GHz and 80 GHz would be potentially of interest for evaluation.

**Question 4: Will 5G systems in higher frequency bands be deployed, and hence need access to spectrum, on a nationwide basis or will they be limited to smaller coverage areas? And if so, what sort of geographic areas will be targeted?**

We consider that 5G systems in high frequency bands, when eventually commercialised, are likely to be targeted in limited locations in urban areas and possibly indoors given the indicative cell ranges of up to c. 200m that have been reported in some early trials. On this basis there might be scope for geographic sharing with other services to some extent.

**Question 5:**

**a) To what extent will 5G systems in higher frequency bands need dedicated spectrum on a geographical and/or time basis or can they share?**

Geographic sharing may be possible to a limited extent as very high speed short range systems are not likely to be deployed ubiquitously.

**b) If they can share, what other types of services are they likely to be most compatible with?**

5G mobile services in bands above 6 GHz might be able to share with terrestrial services or satellite services (downlink) only if these are not likely to have systems deployed and operating in the same

geographic area. It may be possible to share the band for fixed backhaul, as per our response to Question 6a.

**c) What technical characteristics and mitigation techniques of 5G technologies could facilitate sharing and compatibility with existing services?**

The relatively short coverage range of 5G mobile applications in high frequency bands, and hence short frequency re-use distances, could facilitate geographic sharing if necessary.

**d) Could spectrum channels be technically shared between operators?**

In principle the same spectrum channels could be technically shared between operators if they are not both operating in the same area. However it seems likely that operators may want to operate in the same area and this would mean that the spectrum would need to be partitioned, or else interference or reduction in capacity would occur. Sharing spectrum in the same area (either by each operator using a fraction of the total or by transmitting multiple operators' traffic on a single carrier as is possible with 4G) the total bandwidth requirements may simply increase accordingly to deliver the increased capacity of multiple operators.

In some circumstances it may be cost effective and practical to share mobile network infrastructure between two or more mobile operators for high speed mobile coverage in bands above 6GHz, but this is to be studied further and the spectrum requirements in this case will anyway still reflect the need to accommodate multiple operators' traffic and will increase accordingly.

**Question 6:**

**a) Given the capacity and latency targets currently being discussed for 5G how do you anticipate backhaul will be provided to radio base stations? Are flexible solutions available where the spectrum can be shared between mobile access and wireless backhaul?**

We expect a mix of fixed and wireless backhaul solutions. It is possible, and might even be advantageous in some circumstances, if backhaul and mobile access could use the same spectrum band; this could be achieved through careful co-ordination and planning by an MNO, to maximise their use of the available spectrum.

**b) What, if any, spectrum will be required? What channel sizes will be needed? Will the bands used be similar to those currently used for wireless backhaul?**

Wireless backhaul may require a similar amount of spectrum as the mobile access, i.e. 500-1000 MHz per network. Existing fixed links bands may be suitable. There may be some cost advantages if the backhaul could be accommodated in the same band as the mobile access.

**Question 7: Should we expand the scope of bands being reviewed beyond the 6-100 GHz range?**

No, bands above 100 GHz would be technically unsuitable.

**Question 8: Do you agree that it is likely to be necessary for bands to have an existing allocation to the mobile service? Does this need to be a primary allocation?**

No we don't think this is necessary, but existing mobile bands (especially primary allocations) might

be expected to represent the best possibilities for sharing with other allocated services.

**Question 9: Do you agree with the criteria we have used for our initial filter of bands, and are there other criteria that could also be used?**

The approach taken seems reasonable as a first step. But another analysis that includes bands not already having a primary mobile allocation is necessary (for example there may be lightly used bands that could be technically suitable and which, unlike other bands in the current analysis, are not already assigned to operators).

**Question 10: Of the spectrum bands/ranges mentioned in this section, are there any that should be prioritised for further investigation?**

At this early stage we have not decided on any specific priority bands from BT's perspective.

**Question 11: Are there any bands/ranges not mentioned in this section that should be prioritised for further investigation? If so, please provide details, including why they are of particular interest.**

We have no additional suggestions at this stage.

**Questions 12: Are there any particular bands/ranges that would not be suitable for use by future mobile services? If so, please provide details.**

In the absence of sharing studies, at this stage we don't have any suggestions of bands above 6 GHz that are not suitable for 5G mobile.

**Question 13: What additional information, beyond that given in Annex 5 would be useful to allow stakeholders to develop their own thinking around spectrum options?**

Additional analysis of bands not already having primary mobile allocations would be useful.

**Question 14: What are the most important criteria for prioritising bands going forward?**

Technical suitability for high speed short range mobile connectivity (available bandwidth, likelihood of technology availability at realistic costs, propagation characteristics that enable coverage on 100-200m outdoors and within rooms), good potential to share with existing uses/users and good prospects for global harmonisation.

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