BBC response to Ofcom's Call for Inputs

"Spectrum above 6 GHz for future mobile communications"

Overview

The BBC welcomes the opportunity to respond to Ofcom's Call for Input, Spectrum above 6 GHz for future mobile communications. In particular, we welcome an early input into thinking on this issue as UK and international policy makers start to consider how to facilitate future mobile services.

We welcome the ongoing rapid development of mobile services. Our content is delivered over both fixed and mobile networks in increasingly innovative ways. We may have future interests in ensuring robust and high capacity 5G mobile networks which could in certain circumstances offer the potential to deliver connected services to audiences who don't want or can't get fixed broadband.

With that in mind, we have engaged constructively with both Ofcom and the UK government on their policy to clear DTT from the 700 MHz band, enabling enhanced coverage for future mobile deployment.

However, we have some concern with the broader approach that Ofcom is supporting with the issue of identifying spectrum above 6 GHz for mobile services. We set out more fully through Digital UK's response to Ofcom's Call for Inputs on WRC-15 how specific lessons could be learned from the preparations ahead of the World Radiocommunications Conferences (WRC-15). The experience of identifying spectrum for mobile below 6 GHz has convinced us that WRC Agenda Items should be focussed on specific bands. One of the regrettable consequences of looking at broad portions of spectrum as with WRC-15 Agenda Item 1.1 is that a number of services and spectrum users are faced with significant uncertainty over future access to spectrum. Such uncertainty can only hamper the ability to plan for the future, including making necessary investment decisions.

Our concern is that the UK and its international colleagues will be repeating the same mistake with the approach to 6 GHz spectrum and above at WRC-19. Moreover, we are concerned that the starting point for this particular Call for Inputs is that mobile services will need ever greater access to spectrum. This is not an immutable fact. We are still unclear that 4G services will need any more bandwidth in the very long term after existing clearance programmes have been completed. In terms of 5G, Ofcom itself concedes that nobody *really* knows what this term actually means. We therefore caution against policy being devised on the assumption that mobile services must have access to more and more spectrum. More pertinently, we would strongly argue for caution for shorter term policy decisions where the future of existing services would be placed at risk.

This response is designed to achieve two objectives. Firstly, in our responses to Questions 1 to7 we set out our thoughts on what might drive the development of 5G services. Secondly, in our responses to Questions 8 to 14 we give details on those services above 6 GHz where we have an interest and would be concerned if regulatory initiatives were undertaken which would put those services at risk.

Responses to questions

(Q1) 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?

1. The wider bandwidths available for example above 6GHz are in general always going to have significantly greater potential (especially in terms of raw capacity) than significantly lower bands. Much of the lower bands are already allocated to existing uses, so their scope for aggregation to provide ever greater speeds for individual users will be extremely limited. Therefore, much higher frequency bands should certainly be the main place that is considered for such high capacity applications..

2. However it should be noted that the characteristics of the higher bands will tend to mean they are only really applicable for shorter range, line-of-sight applications. Also the use of entirely innovative technologies (such as massive MIMO) to provide higher aggregate capacity from existing mobile allocations should also be taken into account. The best benefit from any such new technologies requires that they should be introduced in a compatible way into existing allocations (i.e. so that the new technology can share an existing allocation with no impact on current mobile devices).

(Q2) 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?

3. The capacity gains of massive MIMO can be traded for robustness gain, and hence can be used to mitigate increased propagation losses to an extent - although not to the point where the required high throughput is compromised. High building penetration losses at higher frequencies will tend to limit their application to small cell applications.

(Q3a) Are there any fundamental/inherent frequency constraints of the 5G technologies currently being investigated with regard to 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?

4. As stated in the CFI, 5G research is still at an early stage, and so there is little that would currently constrain allocations. However it will be ever increasingly important that operators share frequency allocations (either in time and/or geographically), and quite possible radio access infrastructure, especially as the frequencies which are used increase and the cell sizes reduce. This will facilitate the use of contiguous blocks of spectrum for access on a per user basis reducing the need for aggregation across multiple bands and the associated terminal cost. The approach also reduces the signalling and synchronisation overheads, which are required on a per-carrier basis (e.g. the capacity and spectrum efficiency will be higher for 1 x 20MHz block of spectrum compared to 4 x 5MHz blocks of spectrum).

5. This will require a new approach to spectrum allocation for mobile services, compared to the current one where entire bands are auctioned to single operators, and become unavailable to other users/operators in areas and/or at times they are not being used by the auction winner.

(Q3b) Are there any fundamental/inherent frequency constraints of the 5G technologies currently being investigated with regard to 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?

6. As a rule costs go up with frequency, and component performance goes down, but manufacturing in large quantities can more than offset this. Test equipment costs (hence manufacturing costs) can however rise significantly at high frequencies.

(Q4) 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?

7. The answer to this question will depend significantly on what is the final offering provided by 5G. However, given the sorts of visions outlined in the CFI, it would seem likely that this will be something of interest to all citizens, not just to those, for example, in current capacity constrained areas such as city hotspots. This requirement for universal access could easily conflict with the technical limitations likely to exist for such high frequency/small cell implementations, where universal provision in rural areas could become prohibitively expensive.

8. Perhaps initially 5G will be used primarily in dense urban areas to provide congestion relief with 4G as the fall-back outside served areas. Spectrum above 6GHz is not suited to large cell coverage typically required for rural broadband where population is sparse.

(Q5) 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?

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

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

d) Could spectrum channels be technically shared between operators?

9. As mentioned in the answer to Q3 (a), it seems that the technical constraints will increasingly demand sharing amongst operators, and therefore standards should be constructed to allow this. Ofcom should make it clear that this sort of approach will be necessary to obtain any access to such spectrum, otherwise severely inefficient use of spectrum will result, along with a poor experience for consumers. If it turns out that 5G is only deployed in, for example, limited geographic areas, sharing with other uses should be required (for example by allowing for this at the time spectrum is allocated)..

10. There may be some scope for PMSE and self-provide, rural broadband to share with IMT at higher frequencies. Such arrangements could be critical, for example, in augmenting existing national allocations of spectrum for wireless cameras in the 2 GHz and 7 GHz ranges. If 5G is deployed for small cells, it will tend to provide islands of hot-spot coverage, similar to 5 GHz Wi-Fi, but potentially even more localised. This would be helpful for events, lecture theatres and business campuses, but a blanket allocation would effectively prevent access to spectrum for other users.

11. It is likely that 5G equipment will be very cost effective due to economies of scale and the spectrum could be shared to allow programme making if this was permitted using a geolocation approach. Indeed, a similar sharing opportunity exists with mobile spectrum at 2.1 and 2,6GHz spectrum which lays fallow over much of the country.

(Q6)

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?

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?

12. Using MUMIMO/Massive MIMO to obtain high throughput per user relies on antenna spatial distribution so may not be directly applicable to a backhaul link (i.e. dish-to-dish). Here, a more conventional approach may be needed albeit with higher centre frequency/ bandwidth to support the payload. It is anticipated that fibre networks will become increasingly essential for providing the necessary backhaul capacity and coordination between base stations.

13. Some point to point backhaul links may be necessary for connecting remote base stations, but many of the benefits of 5G will require very high capacity backhaul circuits which should use fibre wherever possible.

(Q7) Should we expand the scope of bands being reviewed beyond the 6-100 GHz range?

14. These bands may prove useful for high capacity small cell solutions using beam steering but are unlikely to be a focus for 5G research for some time.

(Q8) 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??

15. We agree that it is likely that band would need to have an existing allocation to the mobile service before mobile services could be deployed. The Radio Regulations are designed, in part, to send signals to spectrum users as to where investments are best made in terms of frequencies. This is particularly the case, given the importance of regional or global economies of scale. Mobile services, as with any other service, would

likely require the certainty conferred by a formal allocation before investment decisions could be made.

16. This need not be a primary allocation. The experience with the 800 MHz and 700 MHz bands are that an additional mobile allocation to the existing (in these cases, broadcasting) allocation provide sufficient signal for the mobile sector to deploy services. Within the EU, this would likely be supported by a political Decision to release spectrum for stipulated uses.

17. Ofcom will be aware that our views on the significance of co-primary allocations for mobile have underpinned our arguments over the past 3 years on the importance of avoiding such an arrangement in the 470-694 MHz band.

(Q9) 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?

18. We broadly agree with the criteria used.

Q10) Of the spectrum bands/ranges mentioned in this section, are there any that should be prioritised for further investigation?

19. We do not comment on this.

(Q11) 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.

20. We do not comment on this.

Q12) Are there any particular bands/ranges that would not be suitable for use by future mobile services? If so, please provide details.

21. The BBC has a number of interests in bands above 6 GHz and we consider that the use of those bands would need to be assessed before any initiatives were undertaken to promote mobile use in those frequencies. Those interests are:

    - International satellite news broadcasting and newsgathering;
    - UKdirect to home satellite broadcasting; and
    - Wireless camera programme and special event use.

We set out our concerns on these in turn below.

<u>International satellite news broadcasting and newsgathering</u>

22. Ka band 19.7–20.2GHz and 29.5-30GHz – The BBC's global news, production and distribution operation is reliant on this band for global connectivity between its

international bureaux network, Satellite Newsgathering, outside broadcast and remote Telemetry and control of its relay network. Given the ad-hoc nature of the use of this band and the recent relocation of some services to this band internationally the BBC believes that this band would not be suitable for future deployment of mobile service as it would be impossible to maintain the required separation distances for sharing between the Mobile Service and the Fixed Satellite Service.

23. Ku Band 10-12.75 GHz - The BBC is heavily reliant on the Ku satellite band for international distribution of television and radio programmes. The BBC primarily uses the Ku satellite band for the Direct to Home (DTH) broadcasting of television and radio to its international audiences. The BBC's international divisions are also reliant on this band for distribution of radio and television programmes to relay stations and syndicated distribution partners. Due to the ubiquitous deployment of TVRO (Television Receive Only) earth stations it is not feasible to share this band between the fixed satellite service and mobile services operating on the same or adjacent frequencies.

24. Moreover, the Ku band is crucial both to the BBC's Newsgathering operation and to its live outside broadcast operation via third party outside broadcast facility providers.

UK Direct to Home satellite broadcasting

25. UK broadcasting is a huge success story, underpinned in no small part by the vibrant platform competition that exists between DTT, satellite, cable and (increasingly) IP. BBC services are delivered on all platforms and are crucial to their appeal, accounting for a significant proportion of viewing time in each case.

26. Clearly, Ofcom will need to consider this when assessing use of the spectrum in Ku band (10.7 – 12.7 GHz) currently assigned/allocated for use by direct to home satellite broadcasting.

Wireless camera programme making and special events (PMSE)

27. Wireless cameras sustain high quality broadcasting output including news gathering and special events coverage. They do this by allowing crucial camera access which is unconstrained by cables. The spectrum between 2 and 3 GHz is favourable for this particular type of use because of the specific propagation characteristics it offers. For many years this spectrum has been available to PMSE in sufficient quantity to fulfil its role successfully.

28. However, as a result of the 4G awards in 2013 (releasing the 2.6 GHz band for mobile use) and the UK government spectrum release programme (which will make the 3.4 GHz band available for mobile use) there has been a significant reduction in spectrum allocated for PMSE use. In response to this, Ofcom has worked constructively with the BBC and the wider PMSE sector in identifying alternative spectrum which might complement the remaining spectrum available for wireless camera use.

29. Accordingly, frequencies in the 7 GHz band (7110-7250 MHz and 7300-7425 MHz) have provisionally been identified by Ofcom and stakeholders as being central for securing a long term future for the PMSE sector.

30. A number of investment decisions are now faced by the PMSE sector in terms of its long term planning. Ofcom, together with the Ministry of Defence, has recognised this by establishing security of tenure provisions in those bands which are still available for PMSE use. However, any signals now that these frequencies would be earmarked for future mobile use may have a chilling effect on any of those necessary investment decisions. We would therefore urge Ofcom to clarify its commitment to ensuring wireless camera access to these bands in the context of this international policy work.

Q13) What additional information, beyond that given in Annex 5 would be useful to allow stakeholders to develop their own thinking around spectrum options?

31. We do not require additional information at this stage.

Q14) What are the most important criteria for prioritising bands going forward?

32. We repeat the observation of above. That Ofcom needs to take into account the uncertainty created which will affect incumbent users and their ability to invest in services.