Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title: Spectrum above 6GHz for Future Mobile Communication

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Address (if not received by email):

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Name Daniela Genta Signed (if hard copy)

Summary

Airbus Defence and Space (Airbus DS) is concerned about possible conflicts between users of spectrum allocated for future use by IMT and incumbent users of existing allocations between 6GHz and 100GHz at least, and possibly beyond.

We require that essential aviation services, military and civil, in particular those dependent on satellite communications supporting aviation and other services, are adequately protected from interference from future 5G user terminals, base stations, and backhaul fixed point-to-point links. Experiences of introducing LTE in 800MHz and 700MHz suggest that such protection is necessary.

Therefore any proposals for allocations for future 5G use that may give rise to such conflicts must be based on studies that verify such protection whatever band is proposed. Results from previous studies must be revisited to verify that the eventual 5G waveforms are compatible with other services.se that may give rise to such conflicts must be based on studies that verify such protection.

We are especially concerned about allocations in the band between 6GHz and 30GHz where all spectrum is already allocated, often for multiple purposes. There are also many allocations above 30GHz where study would be required.

It is possible that sufficient spectrum above 43GHz would be available in contiguous blocks that are sufficiently wide to be of interest for future consumer high bit-rate mobile broadband service and we encourage Ofcom to focus its attention on these.

Answers to relevant specific questions in the Consultation are given below.

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?

The technology to implement transceivers that are able to aggregate multiple bands is mature but expensive. Apart from cost, which would come down in a mass market, it will take considerable effort by industry and regulators to find sufficient spectrum to support the high data rates that 5G aspires to achieve, agree that it can be used for 5G. While it may be technically practical, we believe that it is not a highly useful approach.

It is envisaged that 5G will be a platform that unifies all kinds of services, not limited to high bit-rate consumer mobile broadband data. Some services, e.g. smart metering and demand-side management of electricity consumption could be supported by 5G systems. These would not require a high data rate but would benefit from large cells and high availability, which could be achieved better in the lower frequency bands with a modest spectrum demand.
Recent research shows that of the spectrum already available to IMT and actually licensed, at least a third is not used. We strongly advise therefore to achieve higher efficiency in spectrum use by 5G systems in the already allocated bands.

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?

There are several areas where research and innovation is needed to exploit technology advances effectively. As well as massive MIMO, which may give benefits above 30GHz, there is potential for full-duplex links and advanced modulation and coding schemes that are highly immune to interference. They all aim to increase efficient use of spectrum and to maximise capacity. Thus they will tend to increase interference and this interference will be more continuous in time and space. Its intensity will also be less predictable: massive MIMO enables beam forming and tracking, as well as being a means of increasing gain to mitigate propagation losses; dynamic spectrum management may move assigned frequencies into localised hot-spots to meet demand. Therefore the potential to interfere with sensitive receivers, particularly those using satellite communications, is likely to increase.

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?

We do not believe that 5G technologies will be inherently constrained by availability of a minimum contiguous bandwidth. It is more likely that there will be a minimum contiguous bandwidth requirement that will make the delivery of high bit-rate mobile broadband services economically effective for operators.

We do not think that spectrum blocks must be contiguous to support multiple operators and it may facilitate harmonisation if this is not the case.

Operators tend to prefer exclusive access, claiming that they are more spectrum efficient if this is the case, so it is likely that multiple bands will be required. However if they are willing to share then contiguous multiple bands might make this more convenient.

It would also be convenient if the spectrum allocated for future 5G use was placed in a contiguous block away from other spectrum users.

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?

It is not clear if 10-30 GHz is better or worse than 30-50 GHz as far as technology and components are concerned. It is clear that the configuration of user terminals, antennas, and base-stations will be different to enable them to operate efficiently in these two example bands. It is likely that the current trend to integrate components optimised for multiple technologies into these equipments will continue and that it will be driven by the economics of the 5G business. For example, some experts predict that a user handset will combine a short-range high data-rate mm-wave system with a fallback lower data-rate cm-wave system, maybe also short range, such as WiFi.

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?

5G systems could deliver a wide range of services. As well as personal mobile broadband, it is envisaged that professional services, such as those currently supported by TETRA, industrial applications such the smart grid, or public services such as traffic management. Users of these services will be located anywhere nationwide, so nationwide coverage will be needed.

However the envisaged deployment of systems that can manage spectrum dynamically may make the situation more complex. For example, the tendency of consumers to congregate in smaller areas, such as sports grounds, and the general need to provide higher capacity in urban areas, may create small to large hot-spots that require more spectrum, possibly temporarily but also more permanently. The envisaged network "densification" and ability of user handsets and hot-spot base-stations to route traffic within the access network may, on the contrary, require that all spectrum be potentially accessible anywhere and that access be granted dynamically.

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?

Some users, e.g. emergency services, require dedicated spectrum. In other cases it is convenient to have spectrum that is dedicated to a specific use, or uses, in time or space. The ability to share depends on the locality of the service and whether the spectrum can be reused efficiently in time and space, such as is done now by PMSE users. As noted above in our answer to Q.4, we believe that most services will require nationwide coverage that is continuous in space and time.

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

Because the 5G waveforms and air-interfaces are not yet known, it is difficult to provide an answer at this time. We believe that this can only be answered properly after careful study of the interactions between the services once 5G specifications have been agreed. Significant incompatibilities were revealed when LTE was introduced in, or near, spectrum allocated for use by other services where devices were not sufficiently robust.

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

The allocation of spectrum to LTE in the 700 MHz and 800 MHz bands revealed a high potential to interfere with equipment using existing services. While it could be argued that the problems are partly attributable to unanticipated vulnerabilities of that equipment, e.g. lack of effective filtering, the design of 5G air-interfaces and waveforms and eventual deployment of 5G services should be done with due care and attention paid to compatibility with existing users. Detailed studies will be required.

d) Could spectrum channels be technically shared between operators?

There is no doubt that there are technical means to enable sharing even if they are not fully mature or understood in operational terms. However the unwillingness of operators to share may be a more significant barrier.

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 that existing backhaul solutions and spectrum allocated for such purposes will continue to be used and that the number of such links will increase to provide more user capacity incrementally. The use of satellite systems in providing this capacity should be considered. Additional spectrum will undoubtedly be needed.

5G latency targets are very demanding and, given the parallel increase in demand, it is not certain that a simplistic approach that overprovides the backhaul networks and core network components will reduce latency significantly. It is unlikely that satellite systems will play a role in this.

It is highly probable that mm-wave spectrum will be shared between the access network and the backhaul. However flexible solutions are not yet available with the necessary technology maturity and their feasibility is still be studied.

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?

We expect the mobile operators to defend existing fixed link allocations very strongly and also to demand more spectrum. We recommend that this be included in any proposed new IMT allocations and that it be above 30 GHz. As the required data-rates are not fully known and the propagation characteristics in higher bands may be poor, the channel sizes could also be large. Any new allocations should be used for both access and backhaul.

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

Yes. We recommend consideration of spectrum up to 250 GHz. The reason to suggest this is that we expect 5G to be highly successful and that the generation after will benefit from its experiences and related technology improvements that will make these bands more feasible for use by future IMT services.

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?

The criterion to define the most suitable bands should not be that there is an existing allocation to the mobile service. This criterion should take primarily into account the sharing conditions with other services using the band. The most favourable sharing condition might occur in frequency bands not yet allocated to the MOBILE service.

It should also be noted that mobile systems using currently the bands above 6 GHz could have characteristics completely different than those expected for 5G systems. The sharing conditions between incumbent services and current mobile systems can therefore be completely different from the sharing conditions between those incumbent services and 5G systems.

The sharing condition will mainly depend on the technical and operational parameters of 5G systems (size of the cells, EIRP level, terminal density, indoor/outdoor usage, etc) and also on those of the incumbent services.

Finally, the spectrum requirement for 5G system is also an important criterion.

We therefore recommend that the following element should be more take into account than the fact that the band should already be allocated to MOBILE services:

- The initial 5G systems technical and operational characteristics;
- The existing and future usage/characteristics of incumbent services;
- The initial estimations for spectrum requirements for systems above 6 GHz;
- Limit the bands that should be investigated.

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?

We agree with the criteria that were used and do not propose others.

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

We do not propose other prioritisations of spectrum bands. However users' priority should be considered in more detail.

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 do not identify any priorities for investigation of other bands but we do recommend a longer term view of future requirements as indicated in our response to Q.7.

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

We defend existing allocations to military services, to fixed and mobile satellite services, to space exploration services very strongly in the 6-30 GHz range. There are also significant uses of spectrum up to 60 GHz, e.g. by satellite communications gateways.

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?

The information given in Annex 5 is entirely adequate.

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

The number of existing allocations in the 6-30 GHz band gives a strong indication of the importance of this spectrum to operators and consumers/users of fixed and wireless communications, including space services.

Airbus DS recommends the implementation of the following criteria for prioritising bands for 5G/IMT 2020 identification going forward:

- Existing and future usage of incumbent services needs are adequately considered and protected from interferences;
- Technical and operational characteristics of the IMT devices for the various frequency ranges are known;
- UK present and future investments, industrial interests in the aerospace and defence sectors , including the inherent societal benefits are not put at risk or jeopardized.