Response to Ofcom's call for input on:

5G spectrum access at 26 GHz and update on bands above 30GHz

(Issued by Ofcom on 28 July 2017)

BT plc and EE Ltd
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Executive Summary

1. BT/EE welcomes Ofcom's leadership in promoting international harmonisation of the 26 GHz band for 5G. Noting the good progress being made in standards development, and the prospect of equipment becoming available even before the band has been identified for IMT-2020 (5G) at the ITU at the World Radiocommunication Conference in 2019, we consider that early availability of this spectrum in the UK will bring important benefits to consumers and should become a priority in Ofcom's work.
2. We request Ofcom to move to prepare to award the 26GHz spectrum, by 2019 if it is confirmed that devices will be available by 2020, to promote innovation and competition in provision of 5G mobile services. A standalone award is satisfactory to us, unless it is convenient to combine it with other awards, given that the spectrum has different technical properties to other sub-6 GHz bands and is more complementary than substitutional to these. We would not wish to see award of 26 GHz delay other awards that should be completed first (i.e. 2.3 GHz, 3.4-3.6 GHz, 3.6-3.8 GHz and 700 MHz).
3. We urge Ofcom to not over complicate the licensing of 26 GHz spectrum and to award exclusive national licences, with the ability to trade the spectrum, including leasing it on a local basis to other parties that may require access to the spectrum in any specific locations where the main licensee does not deploy network. This would enable national operators to commit the necessary investments to deploy the spectrum at scale and in the locations where it will be of greatest benefit to customers.
4. The national licences should be indefinite duration, giving priority to the licensee to use the spectrum in all locations (the ecosystem will take time to evolve and the substantial investment in network deployment will necessarily occur progressively over time). Ofcom could however intervene if commercial leasing arrangements are not successfully concluded in areas where there are no credible plans to use the spectrum.
5. Our preference would be to award all of the 26GHz band at once, with clear plans for transitioning existing fixed links. However, we are happy to discuss this further and could support a separate award of the cleared 1GHz of spectrum at the top of the band if award of the whole band would lead to delays and could not be completed in time for when devices become available.
6. Whilst the 26 GHz band is likely to be one of the earliest mmWave bands[1] for which standardised equipment is available and economies of scale may develop, it is important that Ofcom does not promote 26 GHz to the exclusion of other very promising bands that we expect may be confirmed within the ITU and included in standards. In particular we request Ofcom to support identification of the 32 GHz band for 5G in ITU and in Europe, especially given that the RSPG has identified it in its Opinion issued last year as a promising 5G band.
7. We welcome the roadmap for further bands for 5G and note that, in addition to 26 GHz, Ofcom is now promoting 66-71 GHz is a priority band for 5G and considers that the full range of 37 – 43.5 GHz should be considered for 5G. We ask that Ofcom continues to promote 32 GHz alongside these other bands.

[1] Ofcom refers to 26GHz as mmWave and so we follow that convention.

1. Introduction

BT/EE welcomes this call for input on making available the 26 GHz band in the UK. We also appreciate the leadership that Ofcom is providing internationally to promote the harmonisation of this frequency band for 5G in Europe and on a wider global basis.

International regulatory and standardisation support is building for 5G mobile at 26 GHz, with very good prospects of the band being included in equipment and devices, even ahead of the ITU WRC-19 conference where global 5G spectrum harmonisation will be decided. This suggests that Ofcom should get this spectrum, much of which is unused, into the market at the earliest opportunity. We suggest that this should be achievable and is necessary by 2019 at the latest given current expectations on device availability.

We request Ofcom to commence preparation of concrete plans to award the 26 GHz band as soon as possible and ahead of when devices will be available but without delaying other important spectrum awards (2.3 GHz, 3.4 – 3.6 GHz, 3.6 – 3.8 GHz and 700 MHz). A standalone award of 26 GHz would be satisfactory to us, unless it is convenient to combine it with other awards, given that it has quite different technical properties to sub-6 GHz spectrum and is therefore more of a complement than a substitute to these.

Whilst the 26 GHz band is clearly important as it shows promise to become one of the very first global mmWave 5G bands, we emphasize that promotion of this band should not be at the exclusion of other additional candidate 5G bands, such as 32 GHz - which we consider to also be a very promising candidate - and the 40 GHz band.

The “roadmap” for 5G mmWave spectrum that Ofcom has set out within the document is helpful and we have provided our comments on it, as well as answering Ofcom’s specific consultation questions on the 26 GHz band.

2. Our vision for 5G mmWave component

We consider that a millimetre Wave component of 5G will be important to provide the very best customer experiences and deliver important services that lower frequency spectrum cannot properly support. It would initially be deployed in specific locations and over time extended wider to benefit increasing numbers of customers in more and more places.

If we are to commit investment in 5G mmWave networks it is extremely important that the spectrum is made available in a timely manner, with appropriate terms and conditions attached and with a guarantee of quality in terms of permissible interference. The 26 GHz spectrum needs to be made available in large block sizes that can support 5G New Radio channels that deliver substantially better experience to customers than can be achieved in lower frequency spectrum. We expect that the first 3GPP specifications are expected to support individual carrier bandwidths of up to 400 MHz.

As a national mobile network operator it is important in planning network architectures and investments that the spectrum is available to us anywhere in the UK, so that wherever there is a business case to deploy mmWave capability we can be confident that we will be able to

do so. That implies availability of some national exclusive licences, albeit with the possibility for licensees to lease such spectrum to other parties, under commercial arrangements, where and while it would otherwise be unused.

With many of the bands considered for 5G in ITU or elsewhere already assigned (auctioned) in the UK (i.e. 28 GHz, 32 GHz, 42 GHz), the 26 GHz band has some advantage in that all MNOs could potentially secure access to it if they wished and at least part of the band is relatively unconstrained by existing use (i.e. effectively cleared).

We consider that an early award of 26 GHz (by 2019 given current expectations of device availability) is important to enable early operator investments in its use for 5G and would promote competition and innovation. Other mmWave bands that have already been awarded and may become suitable for 5G are not a sufficient solution to deliver early benefits of 5G to customers.

3. Response to the consultation questions

Question 2.1: What are your planned timelines for commercial availability of network equipment and devices for the 26 GHz band? When will equipment for testing and trials be available? Please specify the specific mmWave tuning ranges supported and their timing.

No comments (this question is for equipment vendors)

Question 2.2: Given the 3GPP studies into NR-based operations in licence-exempt spectrum, when (if ever) do you expect to support licence exempt operation and/or coordinated sharing in the 26 GHz band in your products?

No comments (this question is for equipment vendors)

Question 2.3: When do you expect to support standalone New Radio in the 26 GHz band in your products?

No comments (this question is for equipment vendors)

Question 3.1: Are there any other aspects related to the existing use of 26 GHz not covered in this CFI that you believe need to be considered?

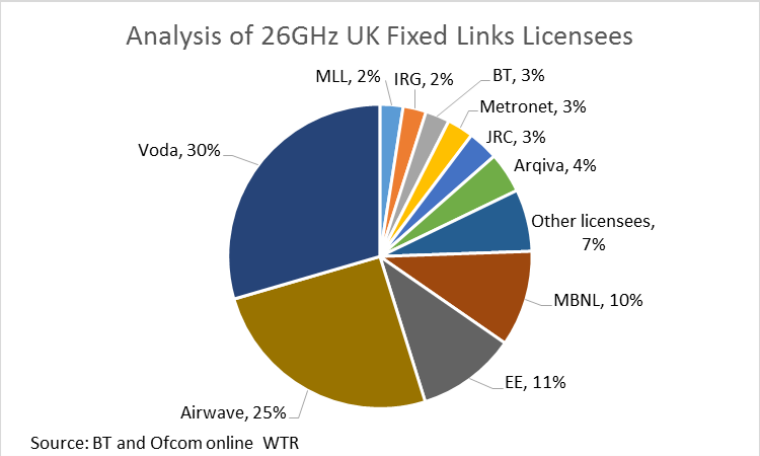
We support technology and service neutral award of the 26 GHz spectrum, but optimised for 5G mobile use. The possibility of fixed wireless access and backhaul applications should also be borne in mind as both these applications may be relevant in future wireless broadband networks and as part of 5G. We note that the existing fixed links deployments use paired (FDD) spectrum whereas the new 5G use would require unpaired (TDD) spectrum, meaning that existing fixed links would likely be incompatible with the auction spectrum packages and spectrum arrangements and would therefore need to migrate from the band.

Question 3.2: What options for the existing services in the 26 GHz band do you believe need to be considered to allow for the introduction of new 5G services? Please give as detailed a response as possible along with all relevant information and explain how you would see any potential option you provide working in practice.

We don't consider that sharing between new 5G mobile use and existing fixed links use will be feasible. Ofcom should therefore consider how compensation to existing users (e.g. fixed links) could be used to accelerate clearance of 26 GHz spectrum for 5G.

It will be important to develop an overall fixed links strategy that takes into account how 26 GHz fixed links will need to be migrated and how the future needs of 5G wireless backhaul can be accommodated. The future fees structure for links re-planned in other bands should encourage migration of links from the 26 GHz band and could potentially link to any compensation arrangements that may be devised to accelerate clearance of the 26 GHz spectrum for auction.

We have looked at the online WTR and see that there are a number of 26 GHz fixed links licensees (see figure below). It appears that most links are operated by a small number of companies and Ofcom should perhaps discuss with them what possibilities may exist to accelerate clearance of the band over the coming years, for example with grants for promoting spectrum efficiency as provided for in the WT Act.



Question 3.3: Should a moratorium be placed on issuing new licences in the 26 GHz band for existing services? E.g. to ensure that the 26 GHz band is not unnecessarily encumbered prior to the development of a new authorisation / licensing approach for 5G services?

Yes we agree that further licensing of new 26 GHz fixed links should cease within a reasonable notice period that takes account of procurement commitments and equipment stocks (e.g. 6-12 months). This is necessary because simultaneous use of this band for existing fixed links and new 5G mobile applications is not expected to be compatible according to the results of studies, such as those discussed within CEPT in recent months.

It is important that other alternative spectrum options for existing 26GHz fixed links applications are identified and, as mentioned above, possible compensation arrangements and an appropriate future fees structure that promotes efficient use are considered.

Question 4.1: What service would be delivered and to which consumer and/or organisations?

A number of services are initially contemplated and others will emerge over the coming years. The much wider bandwidth available with mmWave 5G spectrum compared to sub-6 GHz bands means that it is particularly useful for supporting many customers in dense environments. We therefore expect that one of the main uses for the 26 GHz spectrum is the provision of very high speed broadband in urban hotspots and specific locations where very high densities of users occur. Another potential application is fixed broadband access in locations not served by fixed fibre broadband.

Question 4.2: Where in the UK would the 26 GHz spectrum be used to deliver services? For example, will deployments be focussed on:
a) Areas of existing high mobile broadband demand?
b) Rural areas?
c) Rail and road corridors?
d) Specific types of enterprise or industrial sites?
e) Indoors or outdoors?
f) Specific nations or regions of the UK?

We anticipate that 26 GHz spectrum may support the following deployment scenarios:

- Urban hotspots outdoors
- Stadiums/arenas and other indoor venues with ultra high density of users
- Rural areas for fixed broadband
- Railway stations and other transport hubs with very high user concentrations
- Enterprise and industrial sites.

Deployments would generally not aim to provide contiguous 26 GHz coverage but would be in specific locations (e.g. places, transport hubs) nationwide where ultra high area capacity density is required to deliver very high performance in areas of significant end customer concentration.

Question 4.3: Where 5G cells are deployed, are they expected to be individual cells or as clusters of cells required to give wider areas of contiguous coverage? What would be the area of a typical contiguous coverage cell cluster?

Initially mostly individual cells would be in key hotspots, but then expanding over time to give wider areas of 26 GHz coverage as demand grows.

26 GHz is unlikely to be used standalone but used to boost speeds and capacity in key locations, in aggregation with other bands delivering ubiquitous connectivity.

The propagation characteristics and available range are key drivers in determining where 26 GHz will be deployed. We expect mobile coverage to typically be in cells of the order of 100m radius, but it depends very much on the local environment.

Question 4.4: What capacity and bandwidth (i.e. Channel Bandwidth in MHz) would be required at each cell to meet initial capacity requirements? How will this change over time?

In emerging 3GPP standards the supported equipment channel bandwidths for bands above 6 GHz are expected to be initially up to 400 MHz. Draft standards also have 50/100/200 MHz in discussion. Carrier aggregation is contemplated and is under study.

Given the likely high costs of base station equipment it will be important that sufficient spectrum is available to deliver sufficient capacity to make investment in 26 GHz base stations viable and for users to experience much greater speeds than can be delivered using sub 6 GHz bands alone. We advocate initially at least 200 MHz per operator if the whole band is not released, increasing to at least 500 MHz when and where more of the 26GHz band becomes available.

The ability to achieve the ITU IMT-2020 targets and future vision will require bandwidths up to 1GHz[2]

Question 4.5: What quality of service is required? How sensitive is the service being offered to variations in radio interference from other operator's 5G cells and other spectrum users?

We require guaranteed spectrum quality to give confidence to commit substantial investments in 26 GHz technology. This is best achieved by assigning blocks of spectrum to be managed by the mobile network operator, in the same way that interference is managed in lower frequency bands. This includes potential backhaul and mobile use within the operator's network.

Rights and obligations of auction spectrum must be clearly defined.

Interference control in any Ofcom coordinated licences needs to be clear.

We understand the MoD spectrum is lightly used, but it is important that any residual use is clearly explained and there are no later surprises after the spectrum is awarded.

Question 4.6: Will end users be fixed or mobile?

We envisage that the main application for 26 GHz will ultimately be mobile, but initially and continuing in future it is quite possible that fixed broadband could be delivered using 26 GHz in certain geographic locations where fixed fibre broadband is not economically viable.

[2] See Sec 4.13 of Doc. [5/40] Draft new Report ITU-R M.[IMT-2020.TECH PERF REQ] - Minimum requirements related to technical performance for IMT-2020 radio interface(s) https://www.itu.int/dms_pub/itu-r/md/15/sg05/c/R15-SG05-C-0040!!MSW-E.docx.

Question 4.7: What are the characteristics of 5G at 26 GHz which make this band particularly suited to the service you plan to deploy? What other spectrum bands could be used as an alternative, or in preference to, the 26 GHz band? To what extent could carrier aggregation and other techniques reduce your reliance on 26 GHz?

The benefits of 26 GHz spectrum are the wide bandwidths potentially available and the good prospects of a large / global 5G ecosystem.

We consider that 32 GHz would be a very good alternative to 26 GHz if and when sufficient global support can be secured and Ofcom should continue to support this option in international discussions.

Carrier aggregation of 26 GHz with other bands is likely to be important to give a suitable user experience, given that 26 GHz coverage is not expected to be ubiquitous. Aggregation of sub-6 GHz carriers will not match what 26 GHz or other mmWave bands can achieve in terms of data speeds and capacity density.

A sub-6 GHz macrocell could provide the control plane, with 26 GHz boosting data speed in coverage areas.

Question 5.1: Should Ofcom consider licencing options other than the 3 examples set out above (licence exempt, shared coordinated and area defined) for the 26 GHz band? If so, what other options do you consider should be included?

Yes – the primary option should be to make available exclusive national licences suitable for national mobile network operators and any other interested parties, via an auction process. Ofcom has suggested area defined licences covering urban locations rather than national licences. We don't think that such local area licences meet the needs of an operator such as BT/EE. We note that Ofcom previously awarded 28 GHz regional licences and these have eventually been traded and consolidated and ended up as national licences, or near national licences, held by MNOs.

It is important that operators have exclusive national licences if they are to commit to the large investments needed to deploy mmWave 5G networks. The licences awarded on a national basis should allow the possibility for the licensee to lease spectrum on commercial terms to other parties where it is not used.

In section 5.23 of the call for inputs, Ofcom discusses the possibility of national licences and, if we interpret it correctly, the idea that in areas where a national licence is unused after 5 years it may be possible for Ofcom to issue overlay/additional licences. Recognising that the 5G mmWave ecosystem will take time to evolve, and that the substantial investments in network deployment will necessarily occur progressively, we suggest a longer timeframe within which the primary licensee has priority is more appropriate.

We do however think it worth exploring further what safeguards Ofcom may require if it were to award national licences and rely on commercial leasing by the licence holders to accommodate parties that may need access to spectrum in a specific location where the main licensee has not deployed its network and has no credible plans to do so. For example

we would be open to looking at whether a more structured trading arrangement could be organised by Ofcom if commercial trades cannot be agreed and spectrum in the location of interest to another party remained unused and leasing refused, despite the possibility to trade with several national operators to get access to spectrum at a given location. For example, starting after 5 years Ofcom could review all such refused leasing requests on an annual basis and if no evidence of plans by the licensee to deploy at the given location is furnished then an overlay licence for the site could be issued by Ofcom. Such overlay licences could be subject to cancellation during an initial period where the primary national licence holder has priority, but permanent thereafter. The appropriate fee would also need to be determined.

We note that "Network slicing" should guarantee quality and capacity for specific applications and requirements of "vertical" industries and would avoid the need of such other industries to hold their own national 5G spectrum.

Question 5.2: What methodologies could be used to pre-define 'high demand areas' for area defined licences?

We urge Ofcom to not over complicate the licensing arrangements and to find the simplest possible approach that will deliver an outcome of early and scale investments in mmWave 5G networks. Given that the spectrum may be needed by a national mobile network operator in numerous locations throughout the UK, including urban areas, rural areas and other places such as transport hubs, the exclusive national licences are more appropriate than area defined licences in specific locations.

The area defined licences should be UK wide and not separate area licences based on high demand areas. We believe it will be very difficult to define numerous high demand areas and will over complicate the licensing process. The 28 GHz regional licences issued in the past have eventually become national or near national licences held by MNOs as a result of lengthy market based spectrum management processes, which provides evidence to support our view that issuing national licences at the outset is most efficient.

We think it will be very complicated to appropriately define the high demand areas in advance of the roll-out of mmWave 5G. Such areas would be where there are high concentrations of people (residing, working or at leisure). Also many new 5G applications/verticals also will define where area licences needed – e.g. factories, rail lines, motorways. We have no particular dataset to recommend for such analysis.

Question 5.3: What mechanism could be used to coordinate cell deployments by different operators in shared spectrum?

We do not think that shared spectrum is the most appropriate authorisation approach for all or part of the 26 GHz band, other than perhaps on an interim basis until existing services are cleared if the whole band is not awarded at the outset. As explained, we believe that exclusive national licences (with possibility to lease to other parties or share with other national operators on a voluntary commercial basis) are more appropriate.

Sharing between 5G operators, in spectrum not awarded by auction but managed and individually licensed at specific sites by Ofcom, if pursued, should be open to all parties. It

should also be confined only to a limited part of the cleared spectrum or spectrum that cannot be awarded nationally due to existing use. In this case the coordination and assignment rules Ofcom uses should be developed with potential licensees.

Question 5.4: What methodologies could be used for determining the proportion of spectrum to allocate using area defined licences and coordinated deployment?

Area defined licences should be on a national basis and apply to most if not all cleared 26 GHz spectrum. They should be of sufficiently large bandwidth to enable the existing national mobile network operators to commit investment in 26 GHz infrastructure. Coordinated deployment at individual sites could be done under leasing agreements with the area defined licence holders rather than by Ofcom in centrally managed spectrum that has not been awarded.

Given the likely relative volume of traffic on national mobile networks compared to local deployments, if Ofcom did keep some spectrum in reserve for individual coordinated site licences the amount should be a small fraction of the whole band so that sufficient spectrum is available for large scale investments of national infrastructure by national mobile network operators.

Question 5.5: Do you agree that the 26 GHz band should be released progressively? What risks do you envisage with such an approach and how can these be best mitigated?

The top part of the 26 GHz band is attractive as it is already cleared and is expected to be covered by the emerging 28 GHz devices ecosystem.

Nevertheless our initial preference would be for Ofcom to auction the 26 GHz spectrum all at once and have a licence condition that explains that the blocks in the bottom of the band can't be used in areas where there are existing co-channel fixed links for 5 years (or longer with commercial agreement between the auction winner and the fixed link licensee(s)). Two lot categories would be needed though, to reflect the different timescales within which the spectrum would be fully useable for 5G. However, we would be happy to work with Ofcom and the rest of industry, through the UK Spectrum Policy Forum perhaps, to explore the possibilities further before coming to a definitive view of whether the award of the spectrum should be phased or not.

We recognise that the cleared MoD part of the band (top 1 GHz) could be auctioned first and this part at least should be made available as soon as possible (by 2019 at latest based on current expectations of device availability). If that part were to be auctioned earlier than the rest of the band, which on the information we have at present is not our preference, the remainder of the band could be awarded later when clearance has progressed sufficiently. In the interim, coordinated shared access of that part via Ofcom could be considered, to provide supplementary spectrum capacity for 5G deployments. The auction of the lower part, whether later or at the same time as the upper part, could perhaps also specify that existing fixed link use could continue for 5 years, or longer on commercial leasing terms with agreement of the eventual auction winners that may be impacted by such continued use).

Other

We also support the work that Ofcom is undertaking with regard to the other 5G candidate bands being considered under WRC-19 Agenda Item 1.13. We certainly endorse Ofcom's comment (§ 7.13) that "32 GHz is a promising band for 5G", which is in line with the RSPG Opinion (RSPG 16-032) and we fully support the work to maintain this as a candidate. We ask that Ofcom promotes this band in international discussions. Furthermore Ofcom's proposal that 37 – 43.5 GHz could become a global tuning range should be explored further, to be used as available on a national or regional basis as appropriate. And for small cells, potentially operated on a licence exempt basis, the adjacency of 66 – 71 GHz to the existing 57 – 66 GHz licence exempt band, used for technologies such as WiGig, could provide a valuable complement to the other elements of 5G.