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techUK response to Ofcom Call for Input: 5G spectrum access at 26 GHz and update on bands above 30 GHz

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Introduction

About techUK
techUK represents the companies and technologies that are defining today the world that we will live in tomorrow. In a very real sense techUK represents the future.

At the heart of tech in the UK is an ecosystem of 270,000 companies producin g digital technologies, products and services. From east to west, north and south, from enterprise class organisations to established medium-sized businesses, growing small businesses and an exciting generation of tech start-ups: the UK is a hotbed of tech talent and techUK exists to represent the sector in its entirety.

Our role as techUK is to ensure that we seize the potential for good and address the disruptive new challenges that change and innovation always present. We work to understand the opportunities that technology provides; to support the companies and innovators that can realise those opportunities.

This underpins our simple vision to ensure that tech is good for the UK, the UK is good for tech and that tech is good for people.

techUK has been facilitating the UK Spectrum Policy Forum[1] which has published a report on the 11th of July "Authorising 26 GHz and/or other millimetre-wave bands for 5G use"[2] – July 2017.

techUK response to the call for input

Summary of the techUK position

techUK supports Ofcom's prioritisation of the 24.25-27.5 GHz (26 GHz) band in relation to millimetre wave spectrum for 5G, its intent to support international harmonisation in the band for such services, and its timely availability for use in the UK. We note that equipment is already being standardised, chipsets are foreseen in 2018/ 19, with equipment availability anticipated by 2020 to enable services thereafter.

techUK is supportive of the work of the UK Spectrum Policy Forum (SPF) on 5G spectrum and in relation to the 26GHz band endorses the views of the SPF.[3] In particular the desirability of avoiding any unnecessary complexity and including availability of national licences to facilitate investment in networks at scale.

In addition to the 26 GHz, compatibility and sharing studies with other systems in the following bands, identified by WRC-15 for future wireless broadband usage (including 5G), will be considered at the European level:

- 31.8-33.4 GHz
- 37-43.5 GHz
- 45.5-50.2 GHz
- 50.4-52.6 GHz
- 66-76 GHz
- 81-86 GHz

[1] http://www.techuk.org/about/uk-spectrum-policy-forum
[2] https://www.techuk.org/insights/reports/item/11046-spf-report-authorising-26ghz-and-or-other-millimetre-wave-bands-for-5g-use
[3] ibid

The current usage of these bands and initial prioritisation for study were the subject of a recent ECC PT1 questionnaire.

Satellite focussed techUK members while supportive of 5G related services in the 26 GHz band believe however that there should be continued access for satellite services (FSS + EESS). As discussed below, given that 5G coverage in the band is unlikely to be contiguous across the country this should be practicable.

5G Equipment and Technology Availability

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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.

Pre-Standard Equipment

techUK member companies are actively contributing to the standardisation activities taking place in 3GPP for 5G New Radio (5G NR). In 3GPP, two bands will be defined for 5G NR in the 24.25-29.5GHz frequency range: 24.25-27.5 and 26.5-29.5GHz with the target for completion in Release 15. The former has been identified by the RSPG as the priority millimetre band for 5G in Europe. To date, due to the overlap (26.5 – 27.5 GHz) between the two ranges and with a view to addressing multiple markets, the major focus for development work by global manufacturers has been on the range 26.5 – 29.5GHz for which pre-standard equipment is already available, for testing and trials. Satellite focussed techUK members however wish to clarify that such development work in overlapping bands should not presume future availability/ licensing of the 28 GHz band for 5G services in the UK.

Pre-standard equipment for 5G deployments for bands above 31 GHz are also being trialled for example at 40 GHz and above 70 GHz which may support the use of relevant millimetre wave bands at circa 40 GHz and above 66 GHz for 5G.

Commercial Availability of Equipment

Spectrum availability, regulations and standardisation development, are progressing well to be able to deliver 5G within the anticipated timescales of WRC-19 or indeed before in some instances. Commercial product availability will be in line with these timescales and dates agreed within 3GPP for "non-standalone" and "standalone" NR.

Trials

Some example of trials under way around the world are detailed below –

- **European Commission** 5G Action Plan indicates preliminary trials from 2017 onwards, and pre-commercial trials from 2018. Likely bands are 3400-3800 MHz and 24.25-27.5 GHz
- Arqiva and Samsung 5G fixed broadband access trial in the **UK** at 28 GHz
- 28 GHz trials in the **United States** by Verizon and AT&T. Verizon announced commercial launch in 2017.
- 28 GHz trials in **South Korea** in time for the 2018 Olympics with SK, KT and LG U+ using 1 GHz of spectrum per operator.
- Early system trials planned in **Japan** for 27.5-28.28 GHz, starting 2017 in Tokyo, and continuing as a larger-scale field trial through 2018 and 2019.
- **China MIIT** recently opened consultations on 3300-3600, 4800-5000 MHz, and 24.75-27.5 GHz, 37-42.5 GHz for 5G use.
- **Russia** operators Megafon, MTS, Tele2, Veon intend to build first 5G network clusters in 2018.

- **Sweden** Telia Company is conducting field trials using 15 GHz in the Stockholm area and plans to bring 5G experience to customers in Stockholm and Tallinn in 2018.

The above trials use pre standard implementations in advance of the finalisation of the 3GPP release 15 Standard in bands made available for such purposes in the countries concerned. At this early stage, many of the above trials have been focussed on demonstrating high capacity Fixed Wireless Access services. Testing with mobile devices is also ongoing and being carried out by a number of chipset, equipment and device manufacturers.

Given the prioritisation of 26 GHz for millimetre wave 5G spectrum in the UK, techUK assumes that test licences in this band (particularly in the upper part) will be readily available. Given the Government's intention to support local, collaborative 5G pilots, a joined up approach to facilitate such pilots will be a priority.

mmWave Tuning Ranges
Equipment manufacturers in their responses to thi CFI may provide more detail on the tuning ranges supported. techUK believes the benefits from "tuning ranges" could be maximised since frequencies that are adjacent to one another can be leveraged for inclusion in a single product design thus maximising economies of scale. As technology and volume manufacturing capabilities advance over time, further widening of radio tuning ranges may become feasible.

techUK members however consider that having wider tuning ranges in 5G/ IMT devices should not be seen as the only way forward. It can also be beneficial to have multiple band 5G/IMT radios.

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?

In general, the industry is in favour of a licensing approach for 5G in the 26 GHz band that provides certainty around spectrum availability for 5G and a stable network investment environment enabling provision of predictable network performance for a diverse range of 5G use cases.

The industry's view is that the approach most likely to achieve a stable investment environment in 5G would be based upon an award designed with simplicity in mind. Noting the uncertain and challenging economics of 5G network deployment, avoidance of complex sharing mechanisms is desirable where simpler mechanisms are possible.

Although there will continue to be interest in the combination of licence-exempt and licensed spectrum within future mobile networks (both 4G and 5G), the industry's preference is for licence-exempt and licensed spectrum needs to be met within distinct bands, rather than through tiers of different usage being applied in the same band.

In order to support investment in acquiring and using the spectrum for novel 5G applications, MNOs prefer that spectrum for 5G should be in frequency blocks awarded with exclusive use and preferably nationwide licencing basis and applicable over a duration that justifies the significant network investments that will need to be made in 5G networks (e.g. 20 years or more).

However some companies, in particular the satellite focussed techUK members believe that there is study evidence that it is unlikely that 5G networks using millimetre wave spectrum will be deployed on a contiguous basis and therefore consider that associated spectrum licences should include appropriate co-ordination requirements with existing and planned satellite earth stations to enable sustainable long term access for related space services.

If alternative licence types are needed in 26GHz to meet market demand (e.g. mix of demand for national and sub-national spectrum), these alternative uses could be accommodated by assigning different usage rights in different sub-bands. Options should be tested via Ofcom consultations prior to finalising award conditions, so that demand for different usage characteristics, if this exists, can be established.

Operators of 5G networks will be seeking to provide highly predictable network performance for MBB and other potential ultra-reliable, low-latency 5G use cases, and hence certainty over the amount of spectrum available at different locations is key.

If Ofcom wishes to accommodate licence exempt applications, techUK believes that bands other than 26 GHz should be considered. We support Ofcom's intention to commence the process of developing regulation to facilitate ultrafast wireless applications in the 66-71 GHz band. These should however not be restricted to 5G technologies alone as there are a number of other viable technologies such as WiGig in these bands. Parts of this spectrum will offer better scope for lightly licensed and localised 5G applications.

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

3GPP is progressing development of Release 15 of 5G NR which is expected to be complete by December 2017. While this will be a "non-standalone" NR solution, operating with existing LTE (4G) carrier and 4G core network, 3GPP is also working on the specification for a "standalone" version of NR which is expected to be complete by June 2018. techUK anticipates that chipsets will become available in the 2018/19 time frame followed by devices.

The 26 GHz Band

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?

techUK is not aware of any other aspects that need to be specifically addressed. However we think it is prudent to mention that this band was highlighted as part of the pioneer bands for 5G roadmap. Note: CEPT has developed a roadmap on 5G[4] In this respect it is noted that "Europe has harmonised the 27.5-29.5 GHz band for broadband satellite and is supportive of the worldwide use of this band for ESIM. This band is therefore not available for 5G mobile in the UK.

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.

[4] http://cept.org/ecc/topics/spectrum-for-wireless-broadband-5g#roadmap

Fixed links issues:

While it is recognised that sharing between fixed links and 5G will be challenging it is important to retain the focus that industry is in favour of accessing the 26 GHz band for 5G in line with the EC preference to have this band as a first 5G "pioneer band". If the deployment of fixed links are dense and in a similar urban environment to 5G, it is expected that co-channel sharing is unlikely to be possible without the introduction of some form of detailed coordination approach.

The UK SPF has considered the question over whether all existing uses of 26GHz should be safeguarded e.g. whether there will continue to be demand for fixed link use, or whether this use might be migrated to other available bands over time, based on market demand. A view was expressed that a process should be started to examine the potential for clearance of fixed links from the 26GHz spectrum, with priority to release bandwidth from fixed link use in locations likely to be attractive for 5G deployment. It was noted that many of the fixed links are operated by MNOs and hence MNOs' cooperation may help facilitate such a process.[5]

techUK supports this view from the SPF and furthermore believes that In this case an early discussion with the Government would be advisable to support the Government's 5G ambitions.

Satellite services:

Satellite focussed techUK members consider that satellite systems must be permitted to continue to have viable access to the 26 GHz band for both existing and planned earth stations (operating in both earth-to-space and space-to-earth directions) across the relevant parts of the 26 GHz band where these space services are allocated frequencies by the ITU.

Ofcom should also consider whether compensation or other incentives such as reduced licence fees could accelerate the migration of existing systems from the band.

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?

With the above clarification concerning satellites services, techUK believes that Ofcom should start as soon as possible the appropriate spectrum management activities to facilitate availability of the 26 GHz band for 5G services.

<u>Understanding spectrum demand</u>

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

In UK SPF, the view of the mobile industry (i.e. mobile operators and 4G/5G equipment vendors) is that bands such as 26GHz will enable multi-gigabit data rates to be delivered within 5G networks, with dense spatial re-use and flexible configuration of spectrum, enabling both access and backhaul services to be provided.

[5] https://www.techuk.org/insights/reports/item/11046-spf-report-authorising-26ghz-and-or-other-millimetre-wave-bands-for-5g-use

It has been noted in the SPF's discussions that 5G networks are being designed to cater for different vertical market needs as well as delivering higher capacity and faster services to consumers. Whilst there is a possibility of vertical application providers emerging, network virtualisation in 5G will provide the opportunity for networks to cater for diverse vertical market needs, with different performance requirements, via network slicing. Hence, different types of deployment can be catered for via the same network, without needing to assign specific spectrum for each different use. Views were expressed that a key objective for the 5G licensing approach in the band should be to facilitate and encourage this type of operation with appropriate licence terms and conditions.

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?

Yes. These would be particularly interesting for the provision of eMBB hotspots around any areas of high consumer footfall and places where potential users can gather in large numbers. Serving these areas is a key goal for future 5G services.

b) Rural areas?

Yes, but not in the sense of rural wide area mobile coverage where there are other frequency ranges being considered for 5G that are better suited for this purpose. The 26 GHz band may have applications for fixed broadband access using 5G technology for example where fibre is not available.

c) Rail and road corridors?

Yes, this is a definite area of industry interest. Serving railways however may have specific challenges that may require special consideration beyond just deployments in the 26GHz band.

d) Specific types of enterprise or industrial sites?

Yes, this is one of the potential 5G market opportunities**.**

e) Indoors or outdoors?

Yes, although outdoor to indoor transmission and vice versa might be limited. Outdoor operations in urban areas is envisaged. Indoor operation could include busy public areas such as shopping precincts, railway stations and the like. Please note for indoor operations other higher millimetre wave bands (e.g. 66 GHz) are also of interest on a complementary basis to 5G / WiGig type devices.

f) Specific nations or regions of the UK?

It might be expected that initial 26GHz deployments will be focussed on major metropolitan urban areas. However rural applications and deployments to service in transport corridors (e.g. motorway and rail) are also envisaged. These requirements exist throughout the whole of the UK.

techUK has been:

- engaging with local authorities on both the fit for purpose and supportive local regulations needed to enable 5G networks as well as spreading understanding on the opportunities for enhancing local communities and economies via the resultant connectivity, and

- facilitating partnerships between the digital industries and the rail and automotive stakeholders to enable applications and business models for next generation mobile technology.

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?

The number of cells will vary from single ones to multiple. techUK understands that an individual beam from a 5G access unit in the 26 GHz band will most likely be steerable over 120°. The operational environment will influence the exact deployment scenario. E.g. in city centres, street canyons may be served by a string of single sectors along the street providing contiguous coverage rather than sectors deployed around a central point. Ranges up to 200m could be possible but in all likelihood range will be limited by the surrounding operating environment. As demand grows the number of cells will grow and greater contiguity of related coverage may occur.

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?

Early deployments are likely to focus on the highest traffic areas. The SPF reports that the bandwidth needed per operator in bands such as 26GHz is expected to be in multiples of 100MHz and that at least 400 MHz per operator is required in order to enable operators to differentiate services provided in this band from those in other bands that might support initial 5G deployment, such as 3.4–3.8GHz. The expected re-use pattern implies that all this 400MHz would be required per cell per network.

Satellite focussed members of techUK however do not believe that there has been sufficient evidence to support the notion that terrestrial operators require access to 400 MHz per operator.

It is further noted that the ITU has identified a requirement for IMT 2020 / 5G to support channel bandwidth up to 1 GHz in millimetre wave spectrum which will need to be achieved through aggregation of channels from a number of bands.

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?

It is important that interference within and between networks is carefully managed to ensure satisfactory customer experience. Services that require high QoS and low latency for certain critical communications may be particularly vulnerable to interference.

Question 4.6: Will end users be fixed or mobile?

Both. It is possible that some early 5G applications will be fixed but as the 5G device technology develops so increasingly users (people and things) will be mobile.

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?

techUK understands that the key characteristic of the 26 GHz band is the possibility to accommodate wide bandwidth channels important for high capacity 5G eMBB delivery. The bands around 30 GHz strike a good balance between the availability of wide bandwidth and the feasibility of the technical solutions that can readily developed to use these frequencies.

Another frequency band, where devices are expected to be available early for some other markets, and that could provide similar characteristics, is the 28 GHz range from 27.5 – 29.5 GHz. However techUK recognises both that this is not a band studied in UK for 5G as well as the ongoing requirements for fixed satellite services in this band.

Other millimetre wave bands such as 32GHz, 40GHz and 66 – 71 GHz are being considered and UK industry members support consideration of these additional bands beyond 26GHz for 5G.

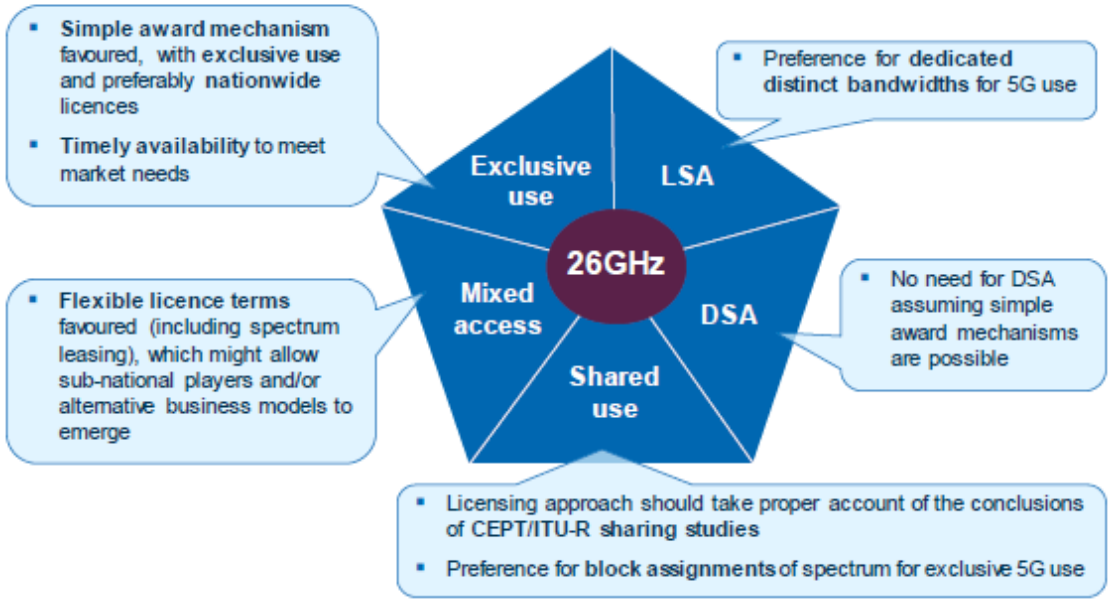
Spectrum Authorisation

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?

As reported above in the response to Question 2.2, the SPF has discussed the most viable licensing options that are covered in the consultation paper and has published views on these. In summary "MNOs prefer that spectrum licensed for 5G should be in frequency blocks awarded on an exclusive nationwide basis and applicable over a duration that justifies the significant network investments that will need to be made in 5G networks (e.g. 20 years or more)". Such licences should be tradable and, importantly, leasing should be permitted. In this way, where the licensee has not built out its network and spectrum remains unused, it could be made available to third parties at specific locations of interest on commercial terms. This approach could support investments required to build out millimetre wave 5 G deployments at scale as well as supporting more niche requirements.

The following figure, extracted from the SPF Paper, provides a good summary of the industry views that are reflected in the SPF Paper:

Figure 1: Summary of industry views on authorising 5G [Source: Analysys Mason, 2017]



However as discussed in the answer to Q 2.2, satellite-focussed techUK members believe that spectrum licences for 5G in the 26 GHz band should not be awarded on an exclusive nationwide basis that preclude spectrum sharing with satellite services given the likely non-contiguous nature of associated 5G networks. Use same wording as 2.2.

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

For reasons outlined above, it seems difficult to pre define where area defined licences should cover. To do so introduces considerable complexity.

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

techUK suggests MNOs are better placed to answer this question and any mechanism needs to be developed with and agreed by the licensees.

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

The SPF reported the view of the mobile industry (i.e. mobile operators and 4G/5G equipment vendors) that bands such as 26GHz will enable multi-gigabit data rates to be delivered within 5G networks, with dense spatial re-use and flexible configuration of spectrum, enabling both access and backhaul services to be provided. The bandwidth needed per operator in bands such as 26GHz is expected to be in multiples of 100MHz (e.g. around 400MHz per operator was suggested).

Terrestrial mobile focussed techUK members believes that for the Area Defined Licence in high demand areas, 400 MHz per operator should be the minimum target and that It is important that any spectrum that Ofcom retains does not undermine the ability to meet the bandwidths required for the auctioned licences. Also as noted earlier, for

eventual full scale deployments, 1GHz of millimetre wave spectrum per network operator has been suggested.

As pointed out in the answer to Q 4.4, satellite focussed members of techUK however do not believe that there has been sufficient evidence to support the notion that terrestrial operators require access to 400 MHz per operator.

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 SPF reported that the timing of availability of 26GHz spectrum in order to meet UK market needs is important. The industry envisages spectrum in the 26GHz band being deployed after 2020.

Terrestrial mobile members of techUK prefer a timely full release of the band but at least the upper part of the 26 GHz band should be released sooner than the anticipated 2020 deployment timescale.

Early availability of 26 GHz spectrum is important in order to put the UK at the forefront of 5G development in Europe allowing the earliest opportunity for the development of new services and applications in a real world commercial situation (as opposed to technology trials).

techUK notes that, in the event of progressive release of the spectrum or award of different parts of the band to a given operator, due consideration should be given to later rearranging the assignments based on MNO allocations that maximise access to contiguous spectrum once the lower part of the 26 GHz (24.25 – 26.5 GHz) is made available. This should also take into account the principles proposed in the answer to Q 3.2 in relation to space services.