

REPORT ON THE PRINCIPLES FOR THE RELEASE OF THE 3rd 5G ‘PIONEER’ BAND AT 26 GHz AND SHARED SPECTRUM ACCESS WITHIN THE BAND (and potential model for release of subsequent mobile bands above 26 GHz).

Background

The purpose of this contribution from Cluster 2 of the Spectrum Policy Forum is to form the basis of advice to DCMS and Ofcom on the importance of the early release of the third 5G pioneer band at 26 GHz and to create an industry consensus on the basis of shared spectrum access to be applied to that band.

It is intended as a living document, as there remains a lot of detail to be sorted out, but this will be more effectively addressed later if a solid industry consensus can first be achieved on the broad principles. A separate document abstracts from this document an industry consensus on the high-level broad principles that should guide the release of the 26 GHz band and the basis for shared spectrum access within the band.

1. LIKELY USE CASES

- Zones of Exceptionally High Demand (e.g. dense urban areas)
- Integrated access and backhaul along routes of exceptionally high traffic
- Fixed Wireless Broadband Access
- Industry 4.0 supporting ultra-low latency
- Track side to train connectivity¹
- Generally low mobility and sedentary user traffic

2. SPECTRUM SHARING POTENTIAL

The 26 GHz band was declared as 5G pioneer band² first and foremost for its high “capacity” advantages. However, bands above 20 GHz, in general, have quite distinct technical characteristics that tend to limit range, dramatically drive up costs of contiguous wide-area coverage to unsupportable levels and exhibit significantly reduced or a total lack of building penetration. These limitations open-up spectrum sharing opportunities on a scale not feasible in bands below 5 GHz – as well as motivating cost sharing (e.g. site sharing) in order to make deployment economically viable.

This will facilitate innovative approaches to spectrum sharing by virtue of the greater radio isolation that is achieved between indoor and outdoor environments, and the more localised propagation when used outdoors.

In terms of specific spectrum sharing attributes of the use cases identified:

- Fixed Wireless Broadband Access is likely to address fringe areas beyond economic reach of full fibre

¹ As identified by Ofcom, see: https://www.ofcom.org.uk/data/assets/pdf_file/0024/123657/Rail-connectivity-advice-DCMS.pdf

² Radio Spectrum Policy Group RSPG16-032 FINAL: Strategic Roadmap Towards 5G For Europe; Opinion on spectrum related aspects for next-generation wireless systems (5G)

- Track side connectivity is along known paths that never change and, in some place e.g. cuttings, which are well screened. Though, coordination with outdoor wide area networks to avoid interference, or guard bands, is still required
- Industry 4.0, in many cases, will enjoy Radio Frequency (RF) screening from the modern type of building construction
- Zones of Exceptionally High Demand are in already known locations such as sporting venues and main railway stations. They can be identified today, catalogued and an optimised spectrum release model tailored to maximise spectrum and investment efficiency.

More mmWave bands will be available for 5G and identified in WRC-19, in particular 66 -71 GHz is the band, which will offer most possibilities for sharing approaches, as it is focused on unlicensed usage.

3. TECHNICAL SPECTRUM PLANNING CHARACTERISTICS

“The EU Decision on harmonisation of the 24.25-27.5 GHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services in the Union”³ establishes the most relevant technical spectrum planning characteristics. This includes a requirement to assign spectrum blocks in multiples of 200 MHz with any remaining spectrum assigned in multiples of 50 MHz blocks to allow full use of band.

It is recommended that the backhaul link(s) of any 26 GHz integrated access and backhaul (IAB) solution be treated as fixed links with regards to above horizon transmission in alignment with current point to point links operating in this band.

4. BAND AND SUB-BANDS AT 26 GHz

The European (CEPT) 5G defined ‘pioneer’ band at 26 GHz is defined between 24.25-27.5 GHz.

The EU Decision requires that by 30 March 2020, Member States shall designate and make available on a non-exclusive basis the 24.25-27.5 GHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services.

The European Electronic Communications Code (EECC) requires Member States to allow the use of at least 1 GHz of the 26 GHz frequency band by 31 December 2020 in order to facilitate 5G rollout, (provided that there is clear evidence of market demand and of the absence of significant constraints for migration of existing users or band clearance).

This creates two distinct sub-bands for consideration in the UK:

A relatively “clean” 1 GHz of spectrum (26.5-27.5 GHz) and 2.25 GHz of spectrum currently quite extensively used in the UK for fixed links and PMSE. The 1 GHz sub-band could be released earlier, while the other 2.25GHz band is being freed up. The focus of attention for

³ Commission Implementing Decision (EU) 2019/784 of 14 May 2019, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D0784&from=EN>

this statement of principles is for the immediate release of this 1 GHz sub-band, but many of the principle laid out still apply to 2.25GHz.

For the 2.25 GHz sub-band:

- Whilst the priority is the early release of the 1 GHz, it is desirable to put in hand a process for future release of the 2.25 GHz sub-band
- No new use should be put in this band to facilitate an early release.
- New use by existing systems should be rationalised and be at the user's own risk of a later demand for the band to be cleared
- Least Restrictive Technical Conditions specifying the protection of passive systems in adjacent bands at 23.6-24.0 GHz at a TRP level of -42dBW (ECC Decision 18 (06)) is likely to require a significant guard band above 24.25GHz when used for IMT. Some studies by the vendors have pointed out that up to 1 GHz guard band may be required
- In the meantime, some opportunistic eMBB, mMTC or URLLC⁴ 5G use is likely to be possible without interfering with existing services (e.g. in well screened buildings) but would still require to synchronise/coordinate with the wide area networks deployed by MNOs to minimise interfering with them
- Ofcom are planning for 2.25 GHz of spectrum (between 24.25 -26.5 GHz) to be made available for sharing to support 5G indoor applications, existing fixed-wireless services and satellite earth stations that operate in the band. If taken up by industry this could potentially impact the options for future authorisation of outdoor deployments⁵
- It is desirable for the sub-bands to be planned with a holistic view of the entire 26 GHz band so as to avoid an unnecessary band fragmentation.

5. NATURE OF THE DEMAND

The three 5G pioneer bands together enable the diverse range of 5G use-cases, including delivery of rural coverage as well as high capacity systems in urban areas. The 26 GHz pioneer band is to solve problems at specific location of high and exceptionally high traffic demand, by providing an additional capacity layer during peak demand periods. As such, there will not be a well-defined roll-out or start point of large-scale deployment, rather the band will be utilised as aggregate demand across 5G bands increase.

The likely use cases that have been identified would be compatible with individual licences. Other than for mobile devices associated with 26 GHz base stations, a general authorisation (licence-exemption) regime is not appropriate due to risks of interference to other services or between 5G deployments, especially noting the synchronisation requirements, particularly between adjacent users of the spectrum, of TDD systems, if large guard bands or separation distances between such systems are to be avoided.

⁴ URLLC - Ultra Reliable and Low Latency Communications

⁵ See Ofcom's statement on enabling wireless innovation through local licensing

<https://www.ofcom.org.uk/consultations-and-statements/category-1/enabling-opportunities-for-innovation>

Many of the use cases envisioned in this document, and future ones, are likely to require high speeds, with ultra large bandwidth connectivity which requires uninterrupted spectrum of more than 200 MHz. Means of achieving this in as many locations as possible is highly desirable.

6. IDENTIFICATION OF POLICY PROPOSALS (shortlist of ideas for consideration)

a) EXCLUSIVE NATIONAL LICENSING – The ‘conventional’ model has proven to be effective in promoting competition, supporting investments in networks at scale, development of a devices ecosystem and has delivered good outcomes for consumers. It is fundamental to pioneer 5G bands (i.e. 3.5 GHz and 700 MHz) that sufficient spectrum is offered on an exclusive license basis, so MNOs are able to deliver the quality of services expected from 5G and that also applies to the 26 GHz band in dense urban areas.

The EC Implementing Decision for the 26 GHz band recognises that synchronised operation is necessary to ensure that spectrum is used efficiently. This will most likely require exclusive licencing in order to coordinate a synchronisation framework supporting several licensees of the band. Sub-leasing of spectrum would be led by the licensee of the band although it is noted that Ofcom are generally not in favour of sub-leasing spectrum as a mechanism for granting access to spectrum for users.

"Here the term “exclusive” means the rights (i.e. authorisation or licence) to use a given range of frequencies in all the defined high population density areas are assigned to a single party. This is analogous to the situation today where rights to use public mobile spectrum on a national basis are assigned exclusively to single operators. It is acknowledged that such licences are do not necessarily give exclusive rights to use spectrum in all places in the sense that Ofcom retains the powers to issue additional licences in a given band/location, although we note that in considering whether to do so it would be necessary to consider amongst other things the risk of interference occurring.

b) MIXED SPECTRUM RELEASE MODEL – The different technical characteristics of this band including beam-forming, larger capacity, greater radio isolation between indoor and outdoor and between geographical areas, suggest that alternative approaches to licensing can be contemplated. One possible scenario that could be workable would have two distinct components as follows:

- i) HIGH POPULATION DENSITY MODEL WITH EXCLUSIVE ALLOCATIONS (less than 10% of the UK by geography) - where blocks of at least 200 MHz are auctioned for exclusive use. The exact boundary (somewhere between 3 and 10% by geography) would be established through consultation by Ofcom but embracing at least dense urban areas. The consultation might also include identifying whether any exceptionally high traffic concentrations at very specific locations outside of dense urban areas might be included in the defined areas for exclusive allocations.
- ii) NON-URBAN MODEL WITH SHARED ACCESS – The non-exclusive approach could be based upon the established fixed link assignment model of “first come first served”.

A first come-first served approach would need to include a mechanism to deter speculative acquisition of licences (hoarding). One solution might be an “implementation obligation” to be completed by a defined date in the licence (a broad parallel to a self-defined coverage obligation). The administrative authorisation should be automated (on-line access to a spectrum management tool/database) to keep costs down as the largely manual fixed link assignment process today is too man-power intensive and that adds to costs and delays.

Assignments would be for multiples of 200 MHz blocks, allowing others to co-locate or be in near proximity.

Further research is required in order to determine the feasibility of a non-exclusive approach and the administrative overhead that would be introduced. Whilst it can be imagined that a non-exclusive approach is suitable for supporting a best-effort capacity layer, such an approach may be unsuitable if the service is backhaul where reliability requirements and service obligations are higher. Such an approach may also restrict the ability for network synchronisation, which could lead to either introduction of guard-bands between operators, or an acceptance of unpredictable interference and possibly receiver blocking, reducing the overall value and utility of the band.

c) HONG KONG MODEL FOR NATIONAL PRIORITY ZONES OF EXCEPTIONALLY HIGH DEMAND

- For a well-defined limited number of *national priority* zones of exceptionally high traffic demand a Hong Kong model of reverse auctions for deployment of network infrastructure could be applied. In this scenario, the bidder proposing to build coverage in a national priority zone for the least money would secure access to the physical asset or location but it would include an obligation to also carry, at a cost, the traffic of all the other mobile operators at that location using their licenced spectrum. This model could be extended such that the spectrum could be assigned for that specific location, or could be the right of permanent access to Club Spectrum (see next two sections for explanation of what is “club spectrum”).

d) CLUB SPECTRUM

- ITALIAN MODEL - The club would comprise all the operators who each have won multiples of 200 MHz of exclusive 26 GHz spectrum at auction. Where a mobile operator finds themselves the sole provider of an enhanced mobile broadband service at a particular location they are entitled to access to the assigned “club spectrum” to boost capacity, offer higher data speeds and improve quality of service (lower contention). When another mobile operator turns up at that same location, the club spectrum is shared on some agreed basis. Every operator always has priority over their own assigned block of 200 MHz or multiple thereof).
- DCMS FTIR MODEL - This approach is very similar to what government set out in its Future Telecommunications Infrastructure Review. In that proposal, a mobile operator, finding themselves the sole provider of an enhanced mobile broadband service at a particular location, could use the entire band on an opportunistic basis. Access to the entire 1 GHz would open up an incredible boost to local capacity, data speeds and quality of service. However, they must release, on a dynamic basis, any

exclusive spectrum belonging to another mobile operator, should that operator turn up to run a competitive service in the same location. How fast is “dynamic” is a matter of definition and could include a period of notice to vacate the borrowed spectrum. There is also a choice as to whether the second mobile network operators, arriving late, has access to any of the remaining “Club Spectrum” or it stays with the first arriving mobile network operator as a competitive incentive to accelerate deployments. The most acceptable of the options would be equitable sharing of the Club spectrum at any location and this would necessitate a rapid access data base.

With either Club model Ofcom will need to create a fair and non-discriminatory sharing framework and specifically for locations where channels are not assigned by an auction process. This will need to strike the right balance between the earlier comer’s need for stability whilst holding open opportunities for later comers to the extent reasonable. It will need to allow flexibility when assignments are turned into working systems yet have the powers to deter squatters and hording. It might embrace innovative ideas like time-sharing at ad hoc multi-sport venues.

e) TECHNOLOGY INNOVATION DRIVEN SHARING MODEL – It is possible to envisage, in the longer term, advances in AI and other technologies allowing spectrum resources to be flexibly linked, in real time, to instantaneous local demand. This is something for the research community to address and demonstrate on Test Beds. If it becomes feasible, it could be more readily applied to the Club Spectrum (either model). It could become *an option* for exclusive spectrum holders where, when and if spectrum owners decided to pool spectrum for any purpose.

f) TIERED MODEL – The ideas short-listed above for consideration are not mutually exclusive. Far from it. The optimal solution is likely to be some combination that strikes the right balance to maximise spectrum efficiency and infrastructure investment.

Allocation of contiguous spectrum should be an important goal for any policy and release model in order to leverage economies of scale and allow efficient use of spectrum resources.

7. NEW MOBILE BANDS ABOVE 26 GHz

When this statement of principles has been finalised, it could serve as a model for the release of new mobile bands above 26 GHz yet to be released.

8. TIME-SCALE FOR RELEASE

The UK should align with the EU date of 30 March 2020 for designating and making available the 26 GHz band in order to maintain its lead in Europe in the deployment of 5G. This ambition leaves open how this is translated into national processes. This should be clarified in 2019. The release of the 1 GHz of shared 26 GHz spectrum for use on a first come first served basis outside of dense urban areas could be done very quickly. The auctioning of the

five 200 MHz channels for exclusive use inside of dense urban areas would need to be scheduled after the award of other 5G bands at 700 MHz/3.6-3.8 GHz is completed. In other words, the earliest that is practicably possible in 2020.

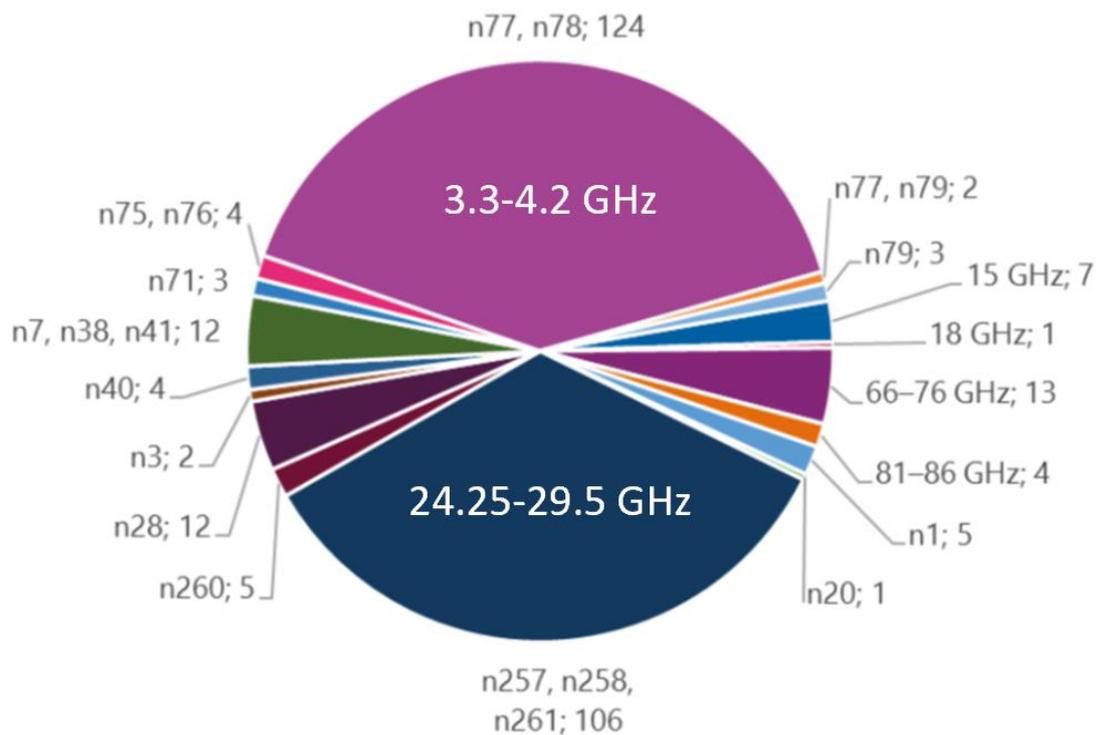
9. GLOBAL STATUS OF 26 GHz SYSTEMS, DEVICES AND APPLICATIONS

Equipment availability

New chipsets, mobile phones and infrastructure are entering the marketplace rapidly as 5G networks get turned on around the world. The Global Suppliers Association maintain up to date reports on current availability and the reader is encouraged to take a look at <https://gsacom.com/technology/5g/>. Registration is free of charge.

Use of mmWave

The chart below shows the spectrum bands in which operators have been investing (in the form of demonstrations/trials, licences, network deployments, or service launches). The figure depicts the spectrum bands grouped into the new 3GPP 5G spectrum band definitions.



There is a clear pattern of investment in bands n77 and n78 (3300–4200 MHz), and bands n257, n258, and n261 (24.25–29.5 GHz). This validates Europe’s RSPG decision on the 5G pioneer bands.

Device availability

Data from GSA shows that a large number of devices supporting mmWave are already on the market:

Askey - 5G CPE Indoor CPE

Askey - 5G Fixed Wireless Indoor and outdoor CPE

China Mobile – Forerunner One 5G Smart Hub Hotspot

D-Link DWR-2010 Indoor CPE

Doogee 5G Docker for the Doogee S90

Fibocom FG100 Module (mmWave with external antenna module)

Fibocom FB101 Module

Honor Device name not released

Huawei 5G CPE 2.0

Balong 5000 mmWave

Huawei 5G CPE Win Outdoor and window CPE

Huawei 5G Mobile

Huawei MH5000

Inseego R1000 Home Router/MiFi

Inseego MiFi IQ 5G Mobile Hotspot

Jaton Tec 5G CPE Outdoor

Lenovo Z6 Pro (China 5G variant) Phone Qualcomm

LG V50 ThinQ Phone

Meizu 5G phone

Motorola 5G Moto Mod Snap-on dongle

Netcomm 5G Fixed Wireless Indoor Desk Mount

NetComm 5G Fixed Wireless Indoor Wall Mount

NetComm 5G Fixed Wireless Outdoor Wall Mount

NetComm 5G Fixed Wireless Outdoor Roof Mount

Netgear Nighthawk M5 Fusion

Nokia Fastmile 5G Gateway CPE

Nubia Mini 5G Phone

Nubia Red Magic Phone

OnePlus OnePlus 7Pro 5G

Quectel RG510Q Module

Quectel RM510Q Module Qualcomm

Realme Device name not revealed

Samsung SFG-D0100 Indoor CPE

Samsung Galaxy A90

Samsung Galaxy Fold 5G

Samsung Galaxy Note 10

Samsung Galaxy S10 5G

Sierra Wireless AirPrime module

SIMCom Wireless SIM8200-EA-M2

Sony Xperia 5G

Telit FM980M Module

WNC 5G NR MHS Hotspot

Xiaomi Black Shark Phone

Xiaomi Redmi Phone

Infrastructure availability

All the major infrastructure suppliers (Samsung, Nokia, Ericsson, Huawei) support mmWave in their base-stations.

Conclusions on the 26 GHz industrial eco-system

Ofcom can release the 26 GHz band in 2020 in the full confidence that it will have the support of the global industrial eco-system.

Explanatory note from the Chairman of Cluster 2 on the document source, version history and approval process

The source of this input document to Cluster 2 was an informal brainstorming session of some members comprising BT, Telefonica Three and Vodafone. The meeting note was turned into a report and refined by an expanded informal group to include Samsung and Qualcomm. It was then agreed by a fast track process by correspondence of members of Cluster2 and the Steering Board with comments received by Sky, CGIT UK Ltd and an independent. The document was approved for release to DCMS and copied to Ofcom by the Chairman of the SPF.

A later version of the report (or spin off document) may be produced to capture a finer level of granularity of detail. In particular ideas for how the areas of high traffic density might be defined offers scope for innovative thinking.

A linked document “7-POINT RESPONSE TO DCMS REEQUEST FOR INDUSTRY ADVICE ON THE HIGH-LEVEL PRINCIPLES TO BE APPLIED TO THE RELEASE OF 5G PIONEER BAND AT 26 GHz” was created out of this report. First draft was made by the Chairman, the document refined by the expanded informal group, approved at a meeting of Cluster 2 and cleared by correspondence by the Steering Group. The document was approved for release to DCMS and copied to Ofcom by the Chairman of the SPF.