Intel Corporation Response to UK Ofcom Call for Input "5G spectrum access at 26 GHz and update on bands above 30 GHz"

Intel Opening Comments

Intel notes Ofcom in their "Call for Input" indicates "*It also sets out our current thinking on which other bands we will prioritise for 5G*" and while there are a number of specific questions focussing on the 26 GHz band there didn't seem to be a clear place to submit input on "*other bands*". In our opening comments below we have tried to provide a succinct input on these "*other bands*" plus we have also added a paragraph on "*Reform of the Telecom Market Structure and the Importance of Fibre*".

5G Spectrum in General

Similarly to Ofcom, Intel believes 5G applications will require access to spectrum in low (<1.5 GHz), mid (2-6 GHz) and high (e.g. mmW) frequency bands. For the higher range we support 24.25-27.5 GHz (and 27.5-29.5 GHz) as the most desirable since, with a suitable radio tuning range, it is possible to capitalise on initial 5G deployments in other leading markets.

While there is significant discussion on spectrum suitable for 5G "mmWave" there needs to remain a focus on securing access to existing IMT bands for 5G as well as freeing up new spectrum below 24.25 GHz for 5G, i.e. 3.4-3.8 GHz band as one example.

700 MHz

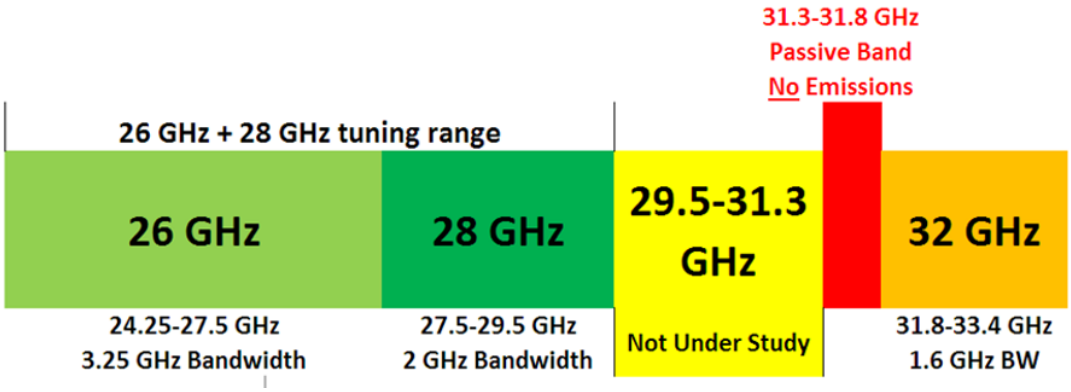
Intel supports the release of the 700 MHz band as identified by the RSPG for 5G in Europe.

3.4-3.8 GHz

Intel supports release of the 3.4-3.8 GHz band as identified by the RSPG for 5G in Europe plus we also support consideration of the 3.8-4.2 GHz band for 5G/IMT. Intel will respond to the Ofcom consultation "Improving consumer access to mobile services at 3.6 GHz to 3.8 GHz" having already submitted (via the GSA) comments to the previous Ofcom consultation relating to the 3.4-3.6 GHz band.

32 GHz (31.8-33.4 GHz)

Intel is less supportive of 32 GHz (31.8-33.4 GHz) for 5G which seems to also reflect the current position of Ofcom. Our concerns are based on 31.8-33.4 GHz having a smaller bandwidth; is not adjacent to the 28 GHz band (27.5-29.5 GHz); and is adjacent to 500 MHz of passive service spectrum with stringent protection requirements, thus significantly limiting tuning-range possibilities. Intel has consistently supported the tuning range concept for the 26 GHz / 28 GHz range but we have reservations over suggestions of a possible tuning ranges including the 32 MHz band for the reasons mentioned above and depicted in the diagram below.



40.5-43.5 GHz (37-43.5 GHz)

Intel supports Ofcom's position to "*promote 37–43.5 GHz as a globally harmonised tuning range for 5G, with the sub-band of 40.5-43.5 GHz being best suited for 5G use in the UK and Europe*" but we do not believe that support for this 37–43.5 GHz tuning range should adversely impact progression to access 24.25-27.5 GHz in Europe as the first mmWave 5G pioneer band.

The rational for supporting the 37–43.5 GHz tuning range; in so much that it can be harmonised globally thus maximising economies of scale while allowing different administrations/regions the ability to identify the most appropriate frequencies within the range to be used for 5G; are the same arguments that apply to the 24.25-27.5 GHz and 27.5-29.5 GHz ranges.

66-71 GHz

Intel notes that Ofcom may consider making the 66-71 GHz band available for licence exempt use. This approach from a licensing perspective is supported by Intel but we do **not** believe it is necessary to have an IMT identification for this band to allow 5G licence exempt deployments.

Intel was surprised by UK Ofcom position as detailed in the input to ECC CPG on 66-71 GHz in so far as the "*UK proposes that CPG endorses the proposal to include 66-71 GHz as a priority band for study under WRC-19 AI 1.13, and include relevant text into the CEPT brief*". Intel's preference is **not** to seek an "IMT" identification primarily as this band, as Ofcom acknowledges, is adjacent to the 57-66 GHz band which is being made available in many countries for licence exempt use by multi gigabit applications. We are concerned that if 66-71 GHz is designated for IMT that other technologies currently accessing the 57-66 GHz band today could be deliberately precluded from accessing the 66-71 GHz band. Furthermore, licence exempt use of the 66-71 GHz band by multi gigabit applications, can be implemented in a similar way as for the 57-66 GHz band, based on the existing allocation to the Mobile Service in the ITU Radio Regulations as further detailed in Recommendation ITU-R M.2003 "Multiple Gigabit Wireless Systems in frequencies around 60 GHz" for which ITU-R Working Party 5A is in the process of finalizing a revision to extend the frequency range up to 71 GHz.

71-76/81-86 GHz

Intel believes that this is an important band for 5G overall but more for backhaul noting regulations for such usage are already in place (both at ITU and CEPT level) based on the existing FIXED allocation. While it is feasible to consider options to make usage of this band easier e.g. light licensing, this is not an ITU issue but a regional regulatory issue. Intel is aware that some Administrations are looking at this band for flexible access/backhaul if coexistence can be ensured but even for that usage an IMT identification is **not** required. We believe it is possible to realize such flexible usage through appropriate regional licensing conditions since the regulatory framework is already in place due to the MOBILE allocation.

Reform of the Telecom Market Structure and the Importance of Fibre

Another approach to be considered is to reform the telecom market structure. EC Recommendation 2007/879/EC (17th December 2007) "*on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC (Framework Directive of 7 March 2002)*

of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services" defines seven telecom markets e.g. Market #4 is defined as "*Wholesale (physical) network infrastructure access (including shared or fully unbundled access) at a fixed location*". It appears that the provisions of this Recommendation assumes existing copper based markets. Neither Directive 2002/21/EC nor Recommendation 2007/879/EC attempt to define new markets for passive, optical fibre suitable, telecom infrastructures and/or for game rules for these markets. Both are applying ex-ante regulatory approach which is understandable because they are dealing with legacy copper based infrastructures. For new optical fibre these markets could be for empty ducts/tubes or dark fibre in the last mile, both including last few metres from the street, through the property to the building wall/cellar. For these markets an ex-post regulatory principle should be applied to enable establishing and thus emergence of dense optical fibre based access networks. The availability of fibre in the last mile could assist replacing the majority of the 26 GHz fixed links and open 26 GHz (possibly at a later stage 28 GHz) for 5G networks and services. Intel believes that a courageous, future oriented reform of the telecom markets would accelerate the rollout of optical fibre in the UK and Europe and ensure leadership in forming of the Gigabit Society as well as in 5G as a prerequisite for this society.

CFI Questions

5G Equipment and Technology Availability

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

Question 2.1 A) What are your planned timelines for commercial availability of network equipment and devices for the 26 GHz band?

Intel Response

Infrastructure: Intel doesn't supply products on the infrastructure front. Intel however enables the ecosystem to adopt network transformation technologies which are key requirement for 5G. In line with this strategy we have developed a reference design baseband (BBU) solution (FlexRAN) for vRAN (including virtualization of L1) which can execute different workloads on Intel Architecture (IA). FlexRAN currently supports LTE and is software upgradable to 5G when 3GPP specs are released.

Devices: Intel is in the process developing chipset supporting Non Stand Alone (NSA) and/or Stand Alone (SA) 5G modes of operation. Intel shares the chipset timelines to its partners under NDA.

Industry is actively developing 5G technology and the standardisation activities essential for mass market support are well underway. The European Commission has already recognised the importance of spectrum for 5G having published a 5G spectrum strategic roadmap and CEPT has mirrored this with their own 5G roadmap. It is Intel's understanding that 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.

Intel proactively participates within 3GPP assisting to progress development of Release 15 of 5G New Radio (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 working on the specification for a "standalone" version of NR which is expected to be complete by June 2018.

Intel anticipates product availability will be in line with these dates agreed within 3GPP for "non-standalone" and "standalone" NR.

Question 2.1 B) When will equipment for testing and trials be available?

Intel Response

Infrastructure: Intel partners with Terminal Equipment manufacturers to enable Trials based on FlexRAN design and concept.

Device: Intel's plan is to ready for Interoperability Development Testing (IODT) and Interoperability Testing (IOT) with major Infra vendors and operators after 3GPP Non Stand Alone (NSA) and Stand Alone (SA) specifications are released.

Intel, like other ecosystem vendors, are already engaged in pre-commercial testing and trials. Some example of trials under way in many countries are detailed below (no indication of Intel's collaboration should be assumed or implied) –

- Arqiva and Samsung 5G trial in the **UK** at 28 GHz
- **United States** Verizon and AT&T 28 GHz trials. Verizon announced commercial launch in 2017.
- 28 GHz trials in **South Korea** for 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 MHz, 4800-5000 MHz, and 24.75-27.5, 37-42.5 GHz for 5G use.
- **Russia** operators Megafon, MTS, Tele2, Veon intend to build first 5G network clusters in 2018. The State Commission for Radio Frequencies has recently decided to allocate spectrum to operator MegaFon for a "research and pilot launch" of 5G during the 2018 FIFA World Cup. The license covers the 3.4-3.8 GHz band and the 25.25-29.5 GHz band and is valid until 15 August 2018 in the 11 cities that host the World Cup (Moscow, Kaliningrad, St. Petersburg, Volgograd, Kazan, Nizhny Novgorod, Samara, Saransk, Rostov-on-Don, Sochi and Yekaterinburg)"
- **Sweden** Telia Company is conducting field trials in the Stockholm area and plans to bring 5G experience to customers in Stockholm and Tallinn in 2018.
- **European Commission** published 5G Action Plan with preliminary trials from 2017 onwards, and pre-commercial trials from 2018. Likely bands are 3400-3800 MHz and 24.25-27.5 GHz (see pioneer band discussion)

Question 2.1 C) Please specify the specific mmWave tuning ranges supported and their timing.

Intel Response
Infrastructure: FlexRAN baseband is capable of supporting sub-6 and mmWave frequency ranges.

Devices: Intel is planning to support 26.5-29.5 GHz and 39 GHz mmWave frequencies for 5G chipset solution. Since Intel is not a handset manufacturer Intel cannot comment on availability of commercial handset.

One important factor enabling 5G mobile broadband is spectrum harmonization to facilitate economies of scale and global roaming. However, harmonization is not limited to a situations where all Regions have identical spectrum allocations. Noting the importance of global harmonization, it is critical to understand the benefits from "tuning ranges" since frequencies that are adjacent to one another can be leveraged for inclusion in a single product design.

Intel noted with interest Ofcom's statement "*We consider that the frequency range 37-43.5 GHz has strong potential to become a 5G band for harmonisation of equipment. The benefit of identifying a wider frequency range is that we can select frequencies across the range that suit UK utilisation whilst also enabling global economies of scale.*" since we believe this equally applies to the 24.25-27.5 GHz and 27.5-29.5 GHz bands.

These "tuning ranges" are critical to delivering the benefits of harmonization as the radio units in user devices developed for one band can also be utilized in some nearby bands without requiring entirely new development efforts. As technology and volume manufacturing capabilities advance over time, further widening of radio tuning ranges may become feasible.

Finding frequency ranges which are available in major markets, or where the available frequency bands are close enough to be supported within a single radio, i.e. “widely harmonised over major markets” is critical to achieving the economies of scale necessary to support the business case for both manufacturers and operators. This type of harmonisation - widely harmonized over major markets - creates commonalities in regulatory requirements and technical specifications - reducing the cost and complexity of implementing and enabling 5G technologies.

It is of utmost importance to take into account and try to align with these early adopter developments in the 28 GHz band outside of Europe. This is particularly important as one of the European 5G “pioneer bands” is 24.25-27.5 GHz is directly adjacent to the 28 GHz band (and even overlaps by 1 GHz with the band that Korea considers for early 5G deployments (26.5-29.5 GHz)) which will enable a tuning-range for widely harmonised equipment.

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?

Intel Response
Intel prefers exclusive dedicated licenses (w.r.t. this call for input aka “area defined licences”) and we consider that auctions are the fairest way to provide access to spectrum since this approach determines fair market value for the spectrum and generally enables spectrum to be assigned to Operator who value it the most. We do urge caution since auctions should not be designed to maximise revenue via the auction process itself noting the substantial investment costs associated with network rollout; we believe the greatest benefit from spectrum is in its sustained use and not from the release process. Auctions should be designed to be an efficient process to maximize allocation of spectrum. The more operators spend in the auction, the less resources will be available for infrastructure deployment and rollout. Intel believes beauty contests are not perceived as fair or as transparent as an auction.

Where exclusive dedicated licenses are not feasible there may be some circumstances where complementary ways to access spectrum could be considered i.e. LSA (Licensed Shared Access) in the 2.3 GHz band where LSA could be an enabler to access spectrum for mobile operators. We note that Ofcom is proposing "shared coordinated use” licences which might contribute to maximising spectrum utilisation and efficiency but further consideration is likely required.

While Ofcom doesn’t raise this issue within the call for input, Intel believes it would be inappropriate to specify onerous rollout and deployment conditions and we’d prefer an approach that encourages Operators to provide an appropriate level of coverage suitable to their business needs. If Administrations / Governments desire greater geographical coverage further mutually beneficial deployment scenarios should be investigated (but not mandated).

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

Intel Response
As noted in our response to question 2.1 Intel proactively participates within 3GPP assisting to progress 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 working on the specification for a “standalone” version of NR which is expected to be complete by June 2018. Intel anticipates product availability will be in line with these dates agreed within 3GPP for “non-standalone” and “standalone” NR.

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?

Intel Response
Intel is not aware of any other aspects that need to be specifically addressed.

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.)

Intel Response
Intel is encouraged that within the 26.5-27.5 GHz part of the 26 GHz band the MoD confirm it is "extremely lightly used" making it relatively easy for Ofcom to enable access to this portion of the band for future 5G.

Intel notes that in the lower part of the 26 GHz band, 24.25-26.5 GHz coexistence with the fixed links is likely more problematic noting that there are ~2800 throughout the UK. Intel suggests that if coexistence is problematic in geographical areas where 5G at 26 GHz is likely to be deployed maybe consideration should be given to migrate these fixed links to an alternative band over a suitable timescale. However, it is important to first understand exactly to which extent coexistence might be problematic by carrying out sharing studies under realistic assumptions when it comes to the 5G / IMT network modelling. As stated by Ofcom in the introductory part of the CFI, the limited range of operation in the mmWave spectrum, combined with new technologies being developed for 5G, could facilitate greater geographic reuse of spectrum and thus contribute positively to the required coexistence with fixed links in the 26 GHz band.

Intel believes that since there is only one Earth Exploration Satellite Service Earth Stations operating within the 25.5-26.5 GHz range operating under Recognised Spectrum Access (RSA) it should be feasible to implement appropriate coexistence measures to enable 5G deployment in this band. As the EESS Earth Station is located well outside of urban areas which are considered to be the main areas for the rollout of 5G networks in the 26 GHz band, and since initial sharing studies show a required geographical separation distance of less than 10km, it should be possible to ensure coexistence through a coordination / protection zone around this EESS station without impeding the 5G network rollout potential in the band.

Intel notes that Programme Making and Special Events (PMSE) in the 24.25-25 GHz range is lightly used and these applications can likely be accommodated in other frequency bands suitable for PSME.

Intel notes the transition period defined by the European Commission for Short Range Devices (SRDs) in the 21.65-26.65 GHz for automotive radars / short range radars (SRR). While the transition phase had been extended to 2022 this is only for vehicles that where type approval was granted before 1 January 2018. The transition period will result in these applications eventually vacating this band. We do not see this necessarily as an impediment to 5G deployment in the 26 GHz band.

Ultimately, with the exception of fixed links, it does appear there is a good possibility for 5G deployment within the whole 24.25-27.5 GHz band without too much difficulty. Further consideration is needed to consider migration of the fixed links to other more suitable bands.

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?

Intel Response
Yes. Intel believes it is prudent for a moratorium to be placed on issuing new licences in the 26 GHz band for existing services.

Understanding Spectrum Demand

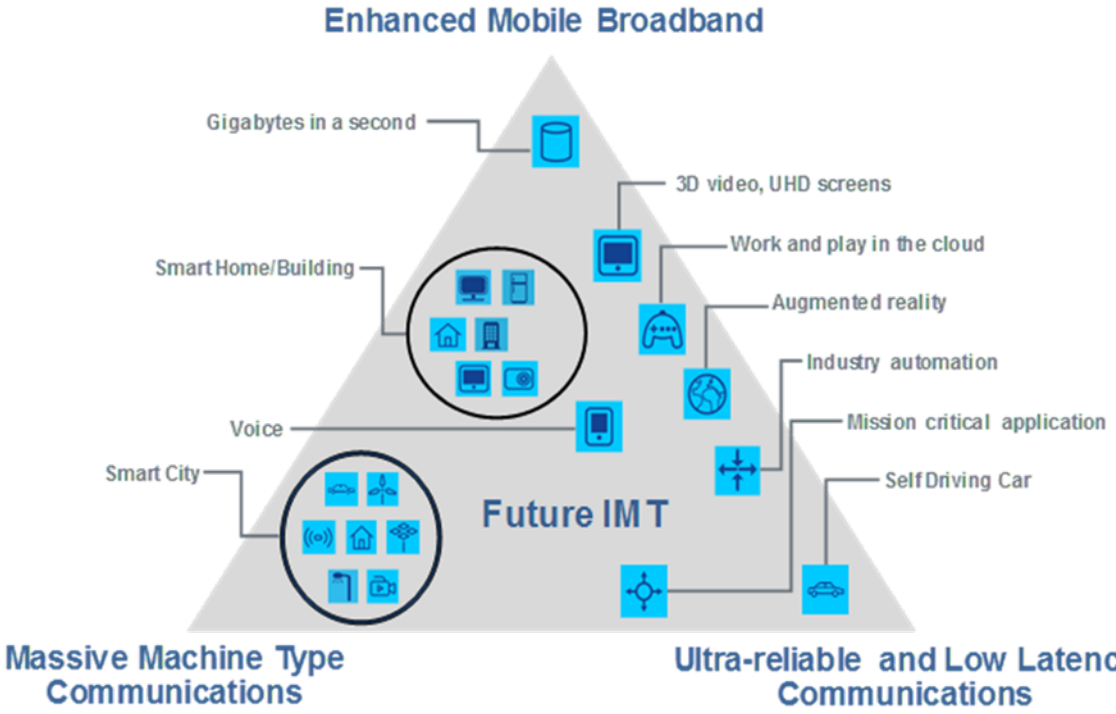
Question 4.1: What service would be delivered and to which consumer and/or organisations?

Intel Response
5G networks will have to meet increased capacity, throughput, and mobility requirements for consumers and businesses, which will require access to additional new spectrum bands. Intel therefore believes it is beneficial to have access to sufficient additional spectrum able to deliver these higher speed, lower latency, greater bandwidth services and applications.

The ITU Recommendation ITU-R M2083 "IMT Vision - Framework and overall objectives of the future

development of IMT for 2020 and beyond" envisages three broad usage scenarios –

- very high data rate services; **enhanced Mobile Broadband (eMBB)**
- massive IoT types of usage with very low power requirements; **massive machine type communication (mMTC)**
- very low latency for time critical applications; **ultra-reliable low latency (URLL)**



In some countries, eMBB is considered the priority service for deployment and the European political goals for the Digital Single Market (DSM) and the Digitising European Industry (DEI) indicate that European priorities should also be for mMTC and URLL use cases applicable in sectors such as health, transport, and manufacturing.

Intel believes it is important to build the appropriate framework to encourage investment as part of the Digital Single Market for wireless devices and services, in particular in preparation for 5G deployment including, Internet of Things (IoT) applications and Machine-To-Machine (M2M) technology.

Intel notes that by 2020 IoT device deployments will dwarf current user mobile device deployments. IDC predicts 50 billion devices will be connected to the Internet by 2020[1], spanning numerous market sectors and use cases. 5G technology will be foundational to the IoT and critical to its success across numerous market sectors. For example, additional data will also be generated by millions of Connected and Autonomous Vehicles with current estimates of 25 gigabytes[2] of data uploaded to the cloud per hour. Indeed the IoT will generate significant data demand on network operators. Connectivity requirements moving forward will require networks to be able to cope with increases in data volumes and increasing dependence on mobile data as well as to handle the complexity of a vast increase in the numbers of devices connecting to the internet.

In order to deliver a successful 5G ecosystem, Intel believes that to support the projected growth in data in a widespread, high quality, and affordable way the right regulatory and standardization environments are needed to incentivise new investments with availability to spectrum being a crucial component.

5G connectivity is imperative to realise the full power of the IoT and seize maximum potential of transformational IoT opportunities. However, as more than 85% of existing devices worldwide are based on unconnected legacy

1 Business Strategy: The Coming of Age of the "Internet of Things" in Government, IDC (April 2013),

2 Source: http://qz.com/344466/connected-cars-will-send-25-gigabytes-of-data-to-the-cloud-every-hour/

systems, it is critical to focus on development and deployment of solutions needed to address connectivity and interoperability of legacy devices. Intel believes to address connectivity and interoperability, it is important to capitalise on intelligent gateway solutions that can connect legacy systems and provide common interfaces and seamless communication between devices and the cloud.

Spectrum is an essential building block for IoT device connectivity. Ubiquitous, affordable, and high-speed broadband connections over licensed and license-exempt frequencies are critical to enable consumers and the public / private sectors throughout the IoT ecosystem. Effective and efficient management of this increasingly scarce resource must be a priority for a thriving IoT ecosystem.

Administrations / Governments need to consider the release of spectrum to deal with this growing need for mobile traffic since significant time is required for that spectrum to become available for use. Intel therefore suggests Administrations / Governments initiate appropriate actions sooner rather than later to address this issue.

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?

Intel Response
Intel believes potential operators may provide a more comprehensive response but some initial **thoughts are captured below.**

a) Areas of existing high mobile broadband demand: Yes – likely high demand for eMBB.
b) Rural areas: Yes but not to the same extent as eMBB.
c) Rail and road corridors: Serving rail and road corridors using 26 GHz may be challenging and other lower frequency bands may be more suitable.
d) Specific types of enterprise or industrial sites: Likely but will depend on requirements of the enterprise / industry.
e) Indoors or outdoors: Yes both, but outdoor-to-indoor (and vice versa) could be constrained due to building attenuation and propagation characteristics of the 26 GHz band.
f) Specific nations or regions of the UK: It is likely initial 26 GHz deployments in significant urban areas.

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?

Intel Response
Intel has not responded to this question.

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?

Intel Response
Intel anticipates that the bandwidth required per operator is likely to be in multiples of 100 MHz and a minimum of 400 MHz per operator is required to enable operators to differentiate services provided in this band from those in other bands that might support initial 5G deployment, such as 3.4–3.8 GHz. Over time deployments are likely to become denser.

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

Question 4.5 A) What quality of service is required?

Intel Response
Intel has not responded to this question.

Question 4.5 B) How sensitive is the service being offered to variations in radio interference from other operator's 5G cells and other spectrum users?

Intel Response
Intel has not responded to this question.

Question 4.6: Will end users be fixed or mobile?

Intel Response
Intel believes that both, fixed and mobile, will be required but it is likely early 5G deployments will tend to be fixed but through time and as technology develops end-users will be become mobile.

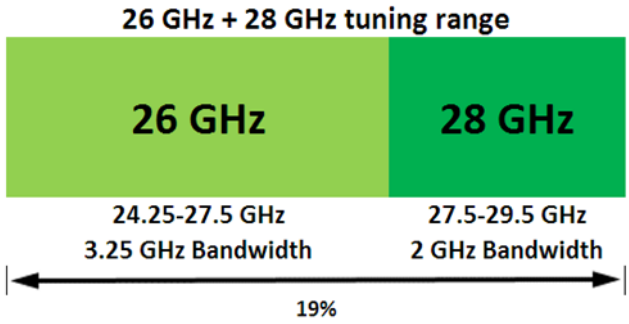
Question 4.7: A) What are the characteristics of 5G at 26 GHz which make this band particularly suited to the service you plan to deploy? **B)** What other spectrum bands could be used as an alternative, or in preference to, the 26 GHz band? **C)** To what extent could carrier aggregation and other techniques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

Question 4.7 A) What are the characteristics of 5G at 26 GHz which make this band particularly suited to the service you plan to deploy?

Intel Response
Intel believes one of the key characteristics of the 26 GHz band is the likely ability to accommodate larger channel bandwidths required to deliver enhanced Mobile Broadband (eMBB).

Question 4.7 B) What other spectrum bands could be used as an alternative, or in preference to, the 26 GHz band?

Intel Response
As previously stated the 26 GHz band is particularity suited for 5 G because of spectrum harmonization to facilitate economies of scale and global roaming but we have stated that spectrum harmonization is not limited to a situations where all Regions have identical spectrum allocations. This is where the benefits from "tuning ranges" materialise since frequencies that are adjacent to one another can be leveraged for inclusion in a single product design.
Intel believes it is of utmost importance to take into account and try to align with these early adopter developments since the European 5G "pioneer band" 24.25-27.5 GHz is directly adjacent to the 28 GHz US / Japan band plus it overlaps by 1 GHz with the band Korea considers for early 5G deployments (26.5-29.5 GHz).



Another benefit of the 28 GHz band is the fact that, whilst there are ~2800 fixed links operated in the 26 GHz band as outlined in this CFI, there are no fixed links operated in the 28 GHz band, based on the recent survey of CEPT ECC Project Team SE19 to update ECC-Report 173 on the current use and future trends for the fixed services in Europe, for which the UK reply indicates 2889 fixed links in the 24.5-26.5 GHz band and zero fixed links in the 27.5-29.5 GHz band.

Question 4.7 C) To what extent could carrier aggregation and other techniques reduce your reliance on 26 GHz?

Intel Response

While “carrier aggregation” can be a solution to increase capacity and throughput there are additional complexities that need to be taken into consideration before relying in such an approach. It is interesting to note that the latest updated version of the 3GPP bands and Carrier Aggregation combination overview, which is based on the outcome the last RAN Plenary (RAN#76, January 2017) has 1208 CA combinations (1417 combination sets) which does not include NR bands and LTE-NR combinations.

24.25-27.5 GHz and 26.5-29.5 GHz are two of the new NR bands which are under 3GPP RAN4 discussion now. The bandwidths of these new NR bands could be 50/100/200/400MHz. Carrier aggregation within NR has not been discussed in RAN4 yet, but eventually there will be CA within NR bands. CA between LTE and NR are ongoing.

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?

Intel Response

While Intel can see merits as well as some limitations associated with “Licence Exempt (shared, uncoordinated)” and “Shared, coordinated deployments” we feel that dedicated exclusive geographically bound licenses (“Area Defined Licences”) are likely to be the preference for the MNOs. It will be these MNOs that are likely to be able to deliver 5G services in a timelier manner than new entrants.

Intel agrees with Ofcom’s cautious approach relating to future possibilities for “Licence Exempt (shared, uncoordinated)” use since we feel it is important to ensure 5G deployment in the 24.25-27.5 GHz is initially managed in an appropriate manner.

While not specifically related to the direct question asked Intel notes the linkage in the Ofcom “call for input” indicating that Ofcom may consider making the 66-71 GHz band available for license exempt use. As previously mentioned in our opening comments this approach is supported by Intel but we do not believe it is necessary to have an IMT identification for this band to allow 5G license exempt deployments.

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

Intel Response

Intel suggests that MNOs are better placed to pre-define ‘high demand areas’ for area defined licences.

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

Intel Response

Intel believes TDD network synchronisation could be one element to assist coexistence and sharing but this should be left to the operators adjusting their networks dynamically to optimise their mutual benefits and not be a subject to the regulatory measures.

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

Intel Response

5G networks will have to meet increased capacity, throughput, and mobility requirements for consumers and businesses, which will require access to additional new spectrum bands. Intel believes a range of spectrum resources will be required to satisfy the diverse requirements anticipated for 5G networks. The future will see the deployment of systems likely to be utilising existing mobile network frequency bands as well as operation in new contiguous spectrum in higher frequency bands.

Intel believes that market forces should have a part to play in determining the geographical extent of the license. The frequency band in question will likely be a contributing factor to the type of geographical license required and this may well vary between frequency bands. Administrations will likely have to take into consideration all these factors, and others, when determining the geographical extent of the license / licenses.

Intel believes Operators are better positioned to answer this question in more detail.

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?

Intel Response

Noting the lightly used portion of the upper 26 GHz band (26.5-27.5 GHz), and potential for more coexistence discussions related to the lower part of the 26 GHz band (24.25-26.5 GHz), Intel is supportive of a progressive release of spectrum in the 26 GHz band starting with the 26.5-27.5 GHz range. Our preference is for this upper part of the 26 GHz band to be released sooner than the anticipated 2019/2020 timescale.

Nothing the above, Intel does have some reservations with this approach since it could result in the upper 1 GHz allocation being assigned between multiple MNOs and then at a later date when the lower part of the band is opened (again split between various MNOs) there is a risk of a fairly fragmented spectrum block assignment situation between the MNOs. If this were to occur it would not really facilitate the need for very wide spectrum channels for 5G thus due consideration should be given to rearranging the assignments based on MNO allocations to maximise access to contiguous spectrum.
