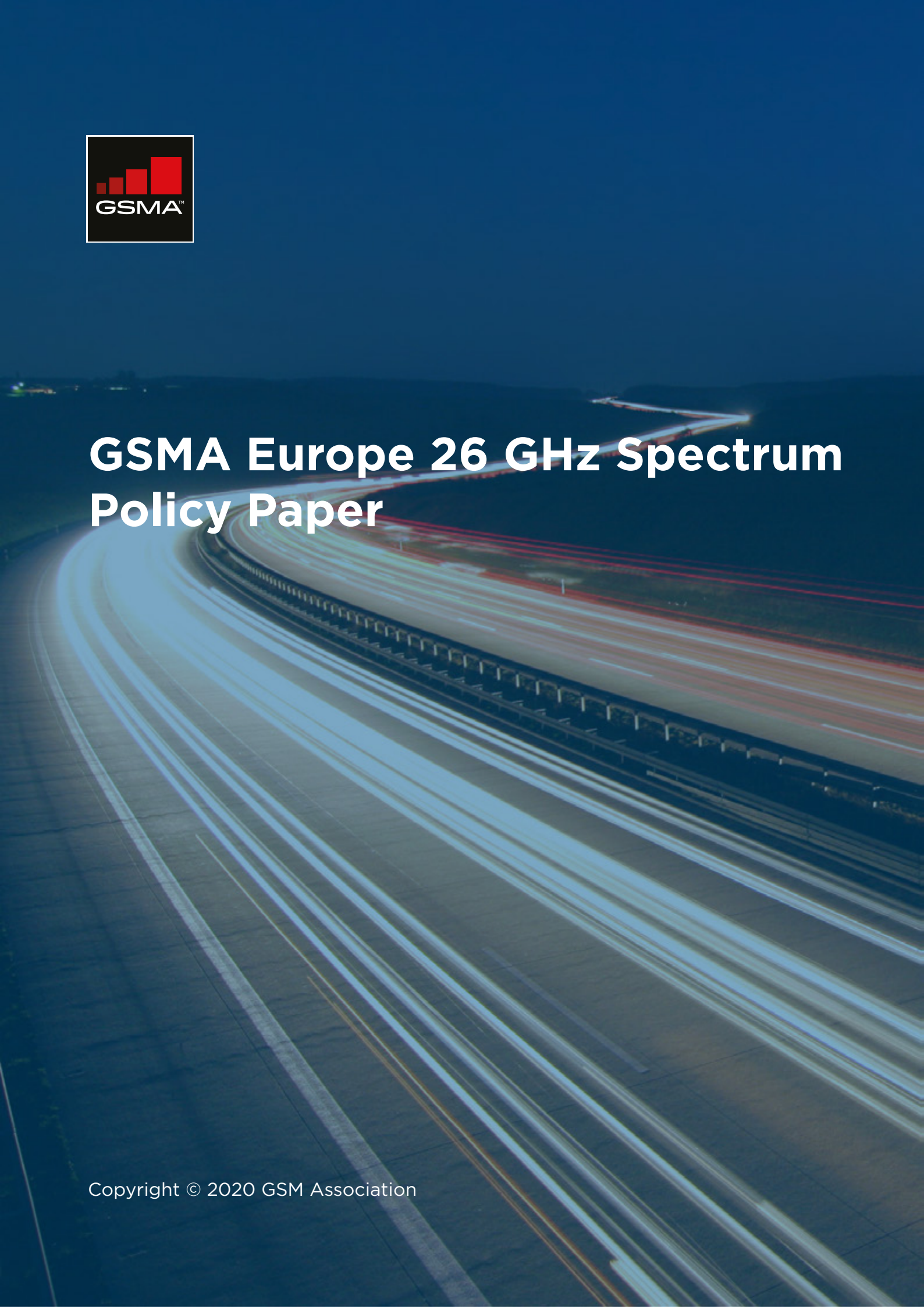

GSMA Europe 26 GHz Spectrum Policy Paper

About the GSMA

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators and nearly 400 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces the industry-leading MWC events held annually in Barcelona, Los Angeles and Shanghai, as well as the Mobile 360 Series of regional conferences.

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1. Introduction

The experience of the last 20 years has demonstrated that demand for harmonised spectrum for mobile broadband has been growing year over year. Driven by unit price reductions that are hard to match in other sectors[1], usage of mobile networks has exploded[2]. Operators have managed to deliver that growth by making intensive use of the relatively small amount of harmonised spectrum made available. The first wave of "mobile bands" in Europe released before 2010 (900 MHz, 1800 MHz, 2100 MHz) amounted to 380 MHz in total. During the 2010s, an additional set of harmonised mobile bands (800 MHz, 2.6 GHz) provided 240 MHz more. The growth in harmonised spectrum supply was, in sum, marginal when compared with the growth in traffic.

Looking at those developments from a financial perspective, we see that mobile retail revenues in the big 5 EU markets were 20% lower in 2019 compared to those in 2010[3]. Despite that reduction in revenues, operators have paid very significant sums for scarce spectrum resources. At the same time, they have also invested very heavily on upgrading their networks with the latest technologies and to allow a more efficient use of the very limited spectrum holdings.

In GSMA's view, this trend is unsustainable. The average Return on Capital Employed (ROCE) for the biggest 5 EU telco operators was only 5% in 2019, below the cost of capital and half of what it was in 2010[4]. In order for investors to see any reason to finance the network upgrades required to meet the ambitious EU connectivity goals, a change of strategy is required from policymakers. To be effective, this strategic change needs to permeate all the way to those in charge of spectrum policy – their decisions amount to roughly 10% of the telco sector's CAPEX and have very significant power to shape market structure and dynamics. The recipe for change is, in our view, very simple:

1. Maximise harmonised spectrum supply for mobile broadband and,

2. Award spectrum licences to players with clear economic demand, and with appropriate and affordable roll-out requirements, while avoiding spectrum auctions conditions that extract rents from the sector or that distort the market through spectrum reservations.

The identification of new frequencies in "5G pioneer bands" has been an important step by policymakers in Europe to provide the industry with clarity and predictability at a critical time. The availability of 60 MHz of low band spectrum in the 700 MHz band plus 400 MHz in mid-band spectrum (3400-3800 MHz) as well as 3.2 GHz in 26 GHz band is a substantial increase that offers the prospect to not only make a difference, but help Europe take a leading role globally. European Institutions and Member States should, however, not be complacent. Unless all that spectrum is made available in a timely manner, at reasonable prices, and under fair and efficient conditions, the industry will not be able to provide the innovative and competitive 5G services and experience that end users are expecting. Based on that premise, the GSMA has developed the following policy recommendations regarding the 26 GHz band awards in Europe.

1. Revenues per GB in the big 5 European markets in 2019 were just 3% compared to their level in 2010. Source: Analysys Mason DataHub
2. Mobile data traffic in the big 5 European markets has grown by a factor of 50 during this period as well, while voice traffic has increased by 50%. Source: Analysys Mason DataHub
3. Source: Analysys Mason DataHub
4. David Pringle (2019) "Are Europe's Top Telcos Making Money?: A financial guide for policymakers & investors."

2. Spectrum Requirements in 26 GHz to Deliver on 5G Expectations

GSMA position: Regulators should plan to award all 3.2 GHz of spectrum in the 26 GHz band, with a clear roadmap for making it available, in order to allow 800 MHz contiguous spectrum per operator and the competitive provision of a meaningful 5G experience.

The 26 GHz band (24.25 GHz – 27.50 GHz) is one of the pioneer 5G bands in Europe, and has the best propagation characteristics in the so called millimetre waves frequency range. EU Technical harmonisation was finalised earlier in 2020 , and EU Member States should allow use of at least 1 GHz for wireless broadband by the end of 2020[5], with certain caveats, as stated in the European Electronic Communications Code[6]. While this 1 GHz is a minimum, we believe more of the band needs to be licensed, if mobile operators are to be able to compete fully in the provision of innovative 5G services.

The 26 GHz band has the potential to provide a substantially enhanced end user experience compared to other pioneer 5G bands, but only if policy makers strive to make available around 800 MHz per operator. 5G devices supporting this band can already handle up to 8 carriers of 100 MHz, offering great scope for a differential service experience. In practice, however, the service could be compromised unless each user is able to access a large amount of bandwidth at any given time. Equipment manufacturers have demonstrated[7] [8] that 800 MHz of spectrum is needed in this band in order to achieve a throughput of around 4 Gbps, and therefore provide a meaningful improvement on the 2 Gbps that can already be achieved in the 3.5 GHz band with 100 MHz of spectrum.

Those figures reflect that, while the technology has progressed a lot and the 26 GHz band is already available for implementing mobile services, there are structural challenges and differences in mmWaves radio technology when compared with mid-bands radio technology.

Firstly, the number of spatial layers (i.e. the number of simultaneous information streams that the base station is able to transmit) achievable at mmWaves bands today is only 2 compared with 8 in the 3.5 GHz band. Looking forward, we see inherent limiting factors to what is achievable in mmWaves compared to mid-bands. As a result, mmWaves are foreseen to reach up to 4 spatial layers while mid-bands could evolve to 16 or even 32, increasing even further the gap in capacity per MHz.

Secondly, propagation losses are much higher in mmWaves than mid-band spectrum, reducing the coverage area and resulting in a lower signal level and worse performance per MHz in every point of the coverage area. If 400 MHz in mmWaves is equivalent in capacity to 100 MHz in mid-bands in lab conditions, in a real deployment more bandwidth will be needed to compensate for the reduced performance in the cell coverage area.

In sum, we believe that in terms of mobile 5G user experience, only a minimum of 800 MHz contiguous spectrum in mmWaves would produce an enhanced end user experience compared to 100 MHz contiguous spectrum in mid-band spectrum. We acknowledge that technology will continue to evolve and could prove us wrong, but it is not

5. Commission Implementing Decisions (EU) 2019/784 and (EU) 2020/590
6. Article 54 EECC states that Member States shall by Dec 31st 2020 allow the use of at least 1 GHz of the 24,25-27,5 GHz band for terrestrial systems capable of providing wireless broadband services, provided that there is clear evidence of market demand and of the absence of significant constraints for migration of existing users or band clearance
7. Verizon and Samsung reach multi-gigabit throughput over 5G NR and mmWave spectrum, Samsung, Sept. 2018
8. TIM Exceeds Downlink Speed of 4Gbps on 5G Live Network with 26GHz mmWave Frequencies, TheFastMode.com, Sept. 2020

the role of regulators to outguess the market and decide how much spectrum is required by a particular service or a particular provider. What policy makers can and should do, however, is ensure that enough spectrum is awarded in an open and objective way, avoiding artificial scarcity that would prevent end users from enjoying the full potential of 5G. In terms of effective availability for wireless broadband services, we perceive the following constraints and uncertainties in the short term. The GSMA encourages regulators to address the challenges and provide a sound expectation of effective availability of the full band in due time.

Protection of passive services in lower adjacent band

There is a requirement to protect Earth Exploration Satellite Services (EESS) in 23.6-24 GHz, which could potentially limit possible uses and/or network equipment availability in the lower part of the 26 GHz band. In this regard, WRC-19 agreed on a two-step approach for unwanted emissions into 23.6-24 GHz from IMT systems in the 26 GHz band. Initial limits of −33 dBW/200 MHz TRP for base stations and −29 dBW/200 MHz TRP for terminal stations are set for early deployments, followed by more stringent final limits, which will apply to new installations after September 2027. This agreement was a compromise between a higher protection of EESS and the feasibility of producing network and device equipment complying with the more stringent limits. In Europe, CEPT decided to adopt an earlier date for implementation of the new limits, so that new equipment installed from 1st January 2024, rather than September 2027[9], must be compliant with the more stringent limits.

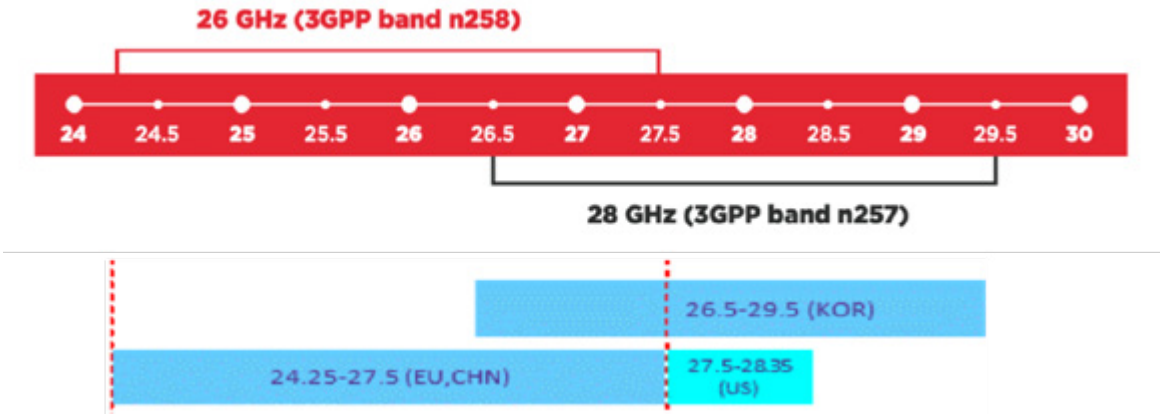
The two-step approach assumed that mass-market deployments would not occur during the initial step and therefore the aggregate emissions from 5G deployment would remain below the EESS protection requirement. After the transition period, CEPT assumed that the more stringent limits in WRC-19 Resolution 750 for unwanted emissions from 5G into 23.6-24.0 GHz (−39 dBW/200 MHz TRP for base stations and −35 dBW/200 MHz TRP for terminal stations) would provide protection of the EESS in the band 23.6-24.0 GHz.

As of today, there is no certainty that equipment manufacturers will be able to comply with the stringent limits by January 2024. This adds very significant uncertainty for mobile operators and their ability to use at least the lower portion of the band by 2024 to provide 5G services. The GSMA considers that bringing forward the date by more than 3 years is not justified as uptake of mmWaves deployments in Europe are not expected before 2025, and would endanger the benefit of economies of scale. The GSMA encourages Regulators to take this fact into account when evaluating how much spectrum is effectively released, and to periodically review the protection requirements in accordance to the real deployment to ensure that they remain proportionate.

9. The agreement in WRC 19 was to introduce the more stringent limit in Sep 2027. Europe has however opted for an earlier deadline.

Availability of end user and network equipment for 3GPP band n258

The upper part of the 26 GHz band (3GPP band n258) allocated in Europe for 5G is also part of the 28 GHz band (3GPP band n257) already in use in other regions (Korea and Japan). The ecosystem for band n257 as well as for band n261 (US 28 GHz band) has already developed given the demand from mobile operators deploying networks in those countries. The awards of 26 GHz band have been delayed in Europe and elsewhere, which in turn has caused a delay in the availability of the device ecosystem in band n258. This situation has created 1 GHz of overlapping spectrum where there is already an ecosystem developed with existing handsets and network equipment (see picture below).



The ecosystem for band n258 will undoubtedly develop and grow after awards of 26 GHz band progress around the world and demand for devices and network equipment grows. In the meantime, the upper 1 GHz of 26 GHz band is the only range where an ecosystem already exists (depending on CE-certification of devices supporting n257). The ecosystem development for band n258 depends on European regulators having clear roadmaps for awarding spectrum in the whole 26 GHz band.

Incumbent services in the lower part of the band

Fixed links for mobile backhaul, located in the 24.50-26.50 GHz portion of the band, are the main incumbent service. However, the constraints these links impose on future radio access 5G deployments vary widely across the EU. In terms of intensity of use, some countries have little to no links in the band; in others the fixed links are located in areas that are complementary to 5G deployments and a third set of countries have a large installed base of fixed links in densely populated areas, for which co-existence with 5G radio access in the same band must be considered.

In terms of the protection and guarantees granted to incumbents, there are also differences. In some countries the band can be cleared providing a notice of termination to licensees, with a relatively short transition period and possible compensations. In others, incumbents have strong property rights and cannot be forced to vacate the band in the required timeframe. CEPT also developed guidelines for the coexistence of 5G services with fixed links in the 26 GHz band that would possibly facilitate the 5G deployment in the interim period.

All those differences call for a nuanced approach that takes account of the particular circumstances of each country. It is of utmost importance however that there is a clear expectation of sufficient spectrum availability for mobile broadband on a harmonized basis. Without it, it will not be possible to preserve a competitive provision of 5G services – let alone to allow the provision of cross border services – and it will be challenging to build the economies of scale that are required both on the supply and the demand side.

3. Authorisation Scheme

GSMA positions:
1. Awards must be open and provide licensees with the maximum degree of certainty and predictability required to justify investment.
2. National licences providing spectrum leasing measures for local users are the preferred alternative, but also local licenses could be beneficial in specific situations to satisfy the demand for local or regional uses.
3. When the spectrum supply is limited, Club licensing can be helpful to maximise overall spectrum use, while first come first served administrative awards can be a good alternative where no excess demand is envisaged.

1. When supply is lower than demand and no operator is able to acquire in the primary market a sufficiently large amount of guaranteed spectrum, a club licensing option could enhance spectrum efficiency, allowing operators to access all of the available spectrum through pre-agreed rules.

The provision of quality mobile services requires guaranteed access to enough contiguous spectrum per operator in the areas where the services are intended to be deployed and demand is likely to appear. As mentioned before, **we recommend the full 26 GHz band to be made available in order to achieve around 800 MHz contiguous spectrum per operator**, especially in situations of overlapping deployments.

The award should be open, with no reservations for particular services or for those having property rights over the band. Considering the high importance of the 26 GHz band for the 5G ecosystem as a pioneer mmWave band in Europe, any reservation would lead to artificial spectrum scarcity and potential inefficient usage, further jeopardizing the 5G deployment in Europe. In our view, some, if not most, verticals needs can be satisfied using network slicing techniques[10], and the spectrum leasing, together with the small cell radius at 26 GHz, would make it possible for any of the different licensees to build a connectivity solution that benefits from usage of the full band in private compounds or other areas in which overlapping deployments are unlikely.

In addition, there are a variety of technical and commercial alternatives currently available that do not require spectrum reservations. When local licensing is not available, potential users that wish to deploy locally in the 26 GHz band could lease usage rights in the secondary market[11]. Unlicensed spectrum in the 5/6 GHz bands or in mmWave bands (i.e. 60 GHz) is another valuable option[12]. Those alternatives can and should be explored before any decision to reserve spectrum in the pioneer band is taken.

2. In terms of geographic scope, **national licensing is the preferred authorisation scheme** as it ensures the most efficient and effective use of the frequencies, by minimising the fragmentation and facilitating the synchronization, to the extent that the number of licensees requiring mutual nationwide coordination is limited. If there is demand for local spectrum use, it can be met through the secondary market (e.g. spectrum leasing) with a local leasing obligation like use-it-or-lease-it. Also, local licensing would only make sense when a high demand for local usage is demonstrated. Such an approach would satisfy and take into account the needs of vertical industries, taking away the need for reservations for vertical players that differ from the needs to public services. Coordination between geographically adjacent local licensees could be an issue for interference management and should be addressed as well.

Densely populated areas and their surroundings will be the main focus for deployment for the mobile industry for the 26 GHz band. Therefore, those licenses should be aggregated into national level assignments. Outside of those densely populated areas, demand for the 26 GHz band from operators could be limited and licensing in a more geographically granular way would guarantee spectrum for different services.

3. Further refinements to the model can be introduced to account for situations where demand does not match with the spectrum supply.

When supply is lower than demand a club licensing option could enhance spectrum efficiency, allowing more than one operator to access to the available spectrum in agreement with the other operators.

On the other side, when demand is clearly envisaged to be lower than supply, a first-come-first-served authorisation scheme would simplify the assignment process thereby preventing sprectrum from going unused. However, taking into account that other operators' spectrum needs in this band could arise at a later stage, provisions should be made to ensure that access for these late comers can be granted, such as a cap in the spectrum that can be guaranteed to a single licensee, or through buildout requirements to prevent spectrum hoarding.

In addition, the low signal range in mmWaves spectrum means that there could be areas where

10. https://www.gsma.com/gsmaeurope/wp-content/uploads/2019/01/Spectrum-for-Vertical-Industries.pdf
11. See for example https://www.telcotitans.com/vodafonewatch/vodafone-uk-sub-leases-26ghz-spectrum-to-strattoopencell/621.article
12. https://www.cambridgeconsultants.com/case-studies/ocado-smart-platform

the deployments of the operators do not fully overlap, and there is scope for an enhancement in efficiency if the operators that have actually deployed are allowed to access unused frequencies. We therefore further propose two solutions that ensure at least a minimum amount of exclusive spectrum is guaranteed, but create an option to expand the utilised bandwidth if there are no other users in a geographic location. This will be particularly valuable **in the cases where the bandwidth available in the 26 GHz band in a first instance is justifiably limited due to the presence of incumbent users.**

• Club licensing for openly awarded licences: Prospective licensees would bid for a guaranteed minimum amount of frequencies they wish to have. In addition to that minimum, every licensee would acquire the option to use up to the full available band if it is unused by other licensees in the area, through a co-ordination mechanism between licensees; or

• Extendable licences for first-come-first-served administrative licences: The license would give the right to use the full available band until notified by the NRA of other licensees requesting to deploy in the same area, in which case all licensees need to coordinate as in the club licence. Mechanisms should be put in place to prevent spectrum hoarding and to ensure that licensees retain a sufficiently large guaranteed amount of spectrum as demand grows.

4. Rules to Manage Club Licensing

GSMA positions:
1. The club licensing regime should to the largest possible extent be managed by licensees.
2. Regulators should provide before the award a sufficiently detailed set of rights, obligations and rules, and facilitate conflict resolution post-award.

The options above rely on spectrum sharing among a relatively small number of licensees, that need to coordinate in any given area, and agree on how spectrum that is "in use" is defined, as well as on how the spectrum that is "not in use" by a particular licensee is shared by all the other licensees that request it.

Given a small number of licensees per area, the low signal range and the static nature of the base stations, coordination should not prove to be extremely challenging. On the other hand, the expected high number of transmitters might make it necessary to rely on a coordination mechanism. Some options include a spectrum access database (akin to the SAS technologies being currently deployed in the US for the CBRS band) or making use of a trusted third party frequency coordinator.

The sharing rules and the database technologies that eventually could support it should be as simple as possible. To that end, regulators should define in advance a sufficiently detailed set of rights and rules. Beyond that, licensees are the best placed to understand the needs and tailor the technical solution accordingly, within competition policy rules. Particular attention should be paid to the protection of commercially sensitive data. In case of conflict or disagreement among licensees, regulatory intervention post-award might be required.

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