

Global mobile Suppliers Association

GSA response to the
RSPG Public Consultation on the

Draft RSPG Opinion
“Spectrum Sharing –
Pioneer initiatives and bands”

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Summary

GSA is grateful for the opportunity to provide comments on the draft RSPG Opinion on Spectrum Sharing – Pioneer initiatives and bands.

In the following, we provide the views of GSA on the co-channel sharing of spectrum from the perspective of mobile communication networks based on IMT technologies specified by 3GPP, including 4G and 5G NR (also referred to as “licensed networks” in this document).

We note that the issues of **inter-service** and **intra-service** spectrum sharing often get conflated, and result in misunderstandings:

- Inter-service spectrum sharing refers to the co-channel sharing of spectrum between new users of a service and existing users of other services in a given band (i.e. between different services as defined by the ITU-R: Mobile, FS, FSS, MSS, etc.).
- Intra-service spectrum sharing, on the other hand, refers to the co-channel sharing of spectrum between different networks of the same service (e.g. different IMT networks within the Mobile Service) in a given band.

GSA considers that inter-service and intra-service spectrum sharing have different implications in the context of IMT networks. For this reason, we treat these separately in what follows.

We note that IMT networks (in contrast to other networks such as WAS/RLAN) are designed to deliver a predictable QoS by managing the number of spectrum users, and to efficiently distribute the radio resource among these in a deterministic manner. It is precisely for this reason that IMT technologies rely on individual licensing to deliver the challenging technical requirements as set out by the ITU-R.

Inter-service sharing

In the context of inter-service spectrum sharing, GSA considers that – where the clearance or frequency re-planning of the incumbents is not viable – sharing should be *preferably* considered first in bands where the geographic locations of existing incumbent users are known, are not ubiquitous, and do not vary with time in relation to the IMT networks. GSA also considers that two-tiered frameworks for the sharing of spectrum between IMT networks and existing users of spectrum should be considered in the first instance.

GSA does not consider that database assisted mechanisms – of the type often associated with licence exempt equipment – would be needed for IMT networks. This is because the operation of equipment in IMT networks is already effectively managed by a database (i.e., the mobile network itself) and any necessary restrictions on the operation of the equipment – as set out by the regulator – can be readily implemented by the network itself. This is especially pertinent with regards to our position above on the preference to avoid “dynamic/opportunistic” inter-service spectrum sharing in the context of IMT networks.

Intra-service sharing

Intra-service spectrum sharing among IMT networks – where required – can be achieved through dynamic network slicing (an important 3GPP technology innovation), dynamic spectrum pooling (e.g., via 3GPP MOCN technology), geographic spectrum leasing, or local

licensing. In all these cases, the conditions for intra-service spectrum sharing can be captured in the relevant licences as specified by the regulator.

The points raised in the draft Opinion

1. Building on previous relevant deliverables from RSPG and taking into account different spectrum sharing technologies and approaches, as well as Member States initiatives, the RSPG investigated more dynamic spectrum sharing options. They are described in the Report RSPG21-016.

GSA notes that in Report RSPG21-016, term “dynamic” sometimes refers to mechanisms in which there is an opportunistic access to spectrum (e.g. CBRS GAA), while at other times it refers to solutions that are intended to provide higher spectrum efficiency, predictable QoS and incentives for long-term network investments (e.g. 5G slicing).

2. Some examples of possible options are represented by the Italian “*club use*” at 26 GHz, which follows the principle of “*use-it-or-share-it*”, the spectrum pooling approach in the IMT-Bands, the Licensed Shared Access or the geolocation functionalities/geolocation database solutions². The current models could develop and improve, and furthermore new sharing models will occur in the future. It is recommended that Member States keep track of future developments.

GSA notes that “the Italian club use at 26 GHz” and “spectrum pooling in the IMT bands” are examples of intra-service spectrum sharing whereby an IMT network operator can use the spectrum licensed to the other IMT network operators at a given time and location, subject to the agreement of the said IMT network operators, i.e. where there is a minimum 200 MHz of available spectrum for an operator which can be potentially expanded up to 1 GHz, depending on usage by the other license holders. Moreover, these are subject to licence conditions that are known to the prospective licensees prior to the respective assignment/auction processes.

Implementation of such intra-service sharing mechanisms does not strictly require the use of database-assisted access to spectrum. For example, club use or spectrum pooling among IMT networks can be implemented via multi-operator core network (MOCN) technologies¹.

GSA is of the view that intra-service spectrum sharing holds some potential. However, it cannot replace the need for individually licensed mobile spectrum. The predictability of individual licensing will remain necessary for long-term network investment while sharing should be seen as a complement.

“Geolocation database solutions” on the other hand, are typical examples of how inter-service spectrum sharing can be implemented, whereby a spectrum user would seek to operate in the presence of incumbent services at a given time and location.

¹ For radio access network (RAN) sharing, the two most commonly used solutions are known as MOCN (Multi Operator Core Network) and MORAN (Multi Operator RAN). With MORAN everything in the RAN (antenna, tower, site, power) except the radio carriers is shared between two or more operators. With MOCN, two or more core networks share the same RAN, meaning that the radio carriers are shared. The existing core networks could be kept separate. MOCN is the most resource efficient solution as it gives the mobile operators the opportunity to pool their respective spectrum allocations, resulting in improved trunking efficiency. MOCN has been supported since 3GPP Release-6 for UMTS, since Release-8 for LTE, and since Release-15 for 5G.

However, as we elaborate later, we do not consider that such database solutions are required for the implementation of some important inter-service spectrum sharing scenarios.

If database solutions are proven to be needed for the implementation of certain inter-service or intra-service spectrum sharing, GSA would suggest to consider the development of the existing European harmonised frameworks specified at ETSI for such purposes (i.e., LSA and eLSA, respectively).

3. The RSPG invites Member States to consider network slicing and roaming agreements, as well as other forms of access to spectrum resources, as complementary elements to promote spectrum sharing.

Network slicing

GSA considers that it should be a high priority for Member States to adopt policies which would encourage and facilitate the provision by MNOs of connectivity solutions to a range of industrial/business users – in the form of customized services or private networks – through the slicing of public networks.

GSA notes that IMT networks are themselves highly sophisticated spectrum sharing systems: through technologies such as cellular frequency re-use and network slicing, IMT networks allow billions of users and devices to share the same frequencies in the pursuit of a wide variety of use cases and with a predictable/managed QoS².

In our opinion, network slicing is not only a technological innovation, but can also help Europe fulfil EU policies in relation to climate change. Network slicing is a key element in making smart and energy-efficient cities a reality, while avoiding the need for a multitude of individual dedicated networks for different applications.

Local roaming agreements

GSA considers that local roaming solutions may have unintended consequences and may have negative implications in the context of incentivising network investment and may not lead to efficient use of spectrum and therefore significant caution is needed when considering these. In case of such localised roaming solutions (to enable coverage in sparse areas for example), and according to provisions in the EEC Directive (Article 61, Paragraph 4), they should be limited in time and scope.

4. The RSPG seeks to nudge a change of mindset: all considerations in the field of spectrum made by policy makers, spectrum managers, users and industry should be done by pursuing better spectrum efficiency through more spectrum sharing, including by following the principles of “*use-it-or-share-it*”.

GSA notes that spectrum sharing does not necessarily imply a greater spectrum efficiency in all circumstances, and that this depends on the nature and requirements of the use cases involved. In fact, it is quite possible that in some cases, spectrum sharing and its impact on the

² Note that 3GPP has also specified Dynamic Spectrum Sharing (DSS) which allows an MNO to dynamically share the resources available in a radio carrier between LTE and NR, thereby providing a useful migration path. This can be categorised as intra-operator/inter-technology spectrum sharing, and should not be confused with intra-service spectrum sharing.

performance of the wireless systems can result in a reduction in the utility of the services involved. We also address this under (12).

On the principle of “use-it-or-share-it”, GSA considers that where there is a justified demand from industrial/business users to deploy private IMT networks (independently of public IMT networks) within limited geographic areas, market-led intra-service spectrum sharing should be preferably achieved through *leasing* of spectrum from the individual wide-area/national IMT network licensees.

We consider that Member States should take measures to facilitate the leasing of spectrum from MNOs by industrial/business users on a geographic basis, where the relevant MNOs have no plans to use their spectrum holding at the location in question, and subject to fair and proportionate costs to the new users.

GSA recommends that Member States should perhaps focus less on changing mindsets in general and instead consider “...better spectrum efficiency through more spectrum sharing...”, on a case-by-case basis.

GSA considers that voluntary/market-led spectrum sharing is always preferred. The “use-it-or-share-it” approach can be a solution in carefully assessed and justified situations. Any sharing agreement implies access to a secondary market. GSA considers that provisions in the EEC create the right premises for a more fluid secondary market and this should be strengthened at Member States level.

5. When assigning new rights of use, Member States should consider sharing spectrum between incumbents and new users using innovative and more dynamic solutions.

GSA welcomes the use of innovative solutions to inter-service spectrum sharing.

GSA notes that the growing demand for terrestrial mobile broadband connectivity, and the fact that frequency re-planning or clearance of incumbents to allow IMT deployments may not be possible or needed in all cases, mean that increasing levels of spectrum sharing between IMT networks and other services may be inevitable going forward. As such, the mobile industry has been very active in recent years in establishing efficient inter-service spectrum sharing frameworks at a global level in order to allow more extensive use of the scarce spectrum resource. GSA considers that any conditions relating to inter-service sharing of spectrum should be specified in a transparent manner in the relevant licence obligations prior to the assignment/auction of the band.

However, we do not consider that “dynamic solutions” for inter-service spectrum sharing are necessary – or desirable – for use cases which require a predictable QoS and, in particular in the context of IMT networks as elaborated next.

GSA also recommends that the RSPG and Member States identify the use cases that are being targeted when proposing “innovative and more dynamic” solutions, and to examine if and why those use cases cannot be covered with spectrum sharing that is already possible with existing regulatory frameworks (i.e., the various flavours of licensing or licence exemption). This would help establish whether such “innovative and more dynamic” mechanisms are actually necessary.

User requirements

GSA considers that predictable access to spectrum and a stable interference environment (both co-channel and adjacent channel) are essential to enable reliability, low latency and spectrum efficiency and to incentivise investments in capacity and coverage. This is key both for public and private networks, and is evidenced by our extensive interactions with a wide range of industrial/business customers. Dynamic/opportunistic spectrum sharing frameworks are not aligned with a predictable and consistent access to spectrum as demanded by users who rely on a reliable QoS.

We note that individual licensing, in all its various flavours (whether nationwide or local), is essential for delivering predictable QoS by allowing the licensee to manage the number of spectrum users, and to efficiently distribute the radio resource among them in a deterministic manner. It is precisely for this reason that IMT technologies are designed to operate subject to individual licensing in order to deliver the challenging technical requirements set out by the ITU-R.

GSA considers that where certain parties are contented with deploying communications networks with *dynamic/opportunistic* access to spectrum, the use of bands that are subject to general authorisation (licence exemption) are recommended for this purpose. Such opportunistic access is, for example, offered by 5G NR-U (New Radio – Unlicensed) which is a 3GPP solution to be used in licence-exempt spectrum.

Complexity

GSA considers that in order to minimise costs and complexity, spectrum sharing between IMT networks and incumbent users should be preferably considered first in bands where the geographic locations of existing incumbent users are known, are not ubiquitous, and do not vary with time in relation to the IMT networks. This would avoid the complexities – as well as the uncertainties in spectrum access – which would be associated with dynamic sharing of spectrum.

6. The technical conditions for a sharing solution can be defined on a case-by-case basis, leveraging on the investigated technical possibilities and approaches.

GSA agrees that the technical conditions for sharing solutions should be assessed on a case-by-case basis, depending on the nature of the band and existing users.

While we acknowledge the need for increased inter-service spectrum sharing, we re-iterate our response under (5) with regards to the desirability of avoiding “dynamic” spectrum sharing in the context of use cases requiring predictable QoS (e.g. via IMT networks) and the requirements of licensed users of spectrum.

7. Where one or more incumbent users for services other than Electronic Communication Service occupy a band, Member States should assess whether sharing conditions can be applied in a multi-tier sharing approach.

We understand that by “multi-tier sharing”, the draft Opinion refers to the co-channel sharing of a new user with one or more incumbent users.

In order to minimise costs and complexity, GSA recommends that the number of tiers in multi-tiered sharing frameworks should not exceed two. We consider that – where frequency re-planning or clearance of incumbents may not be possible – two-tiered systems for the sharing of spectrum between IMT networks and existing users of spectrum should be considered in the first instance.

As commented under (5), GSA recommends that inter-service spectrum sharing opportunities for IMT networks first be considered in bands which involve incumbents whose locations are not ubiquitous and do not vary with time in relation to the IMT networks. This is to ensure stability of QoS and to incentivise long-term investments in the networks.

We consider that the conditions for such inter-service spectrum sharing can be readily captured in the relevant licences as specified by the regulator, and implemented via appropriate coordination mechanisms.

If there is a proven need for the use of databases to support such inter-service spectrum sharing, GSA would suggest to consider the development of the existing European harmonised framework specified at ETSI for such purposes (i.e., LSA).

8. Member States could consider sharing solutions that may help vertical industries and other spectrum users to access spectrum on mutually beneficial basis.

GSA considers that individual wide-area/national licensing is the preferred authorisation regime for the delivery of services with a predictable/managed QoS, e.g., IMT networks for eMBB, URLLC and mMTC.

We consider that the huge investments by MNOs over the past decades in Europe's mobile communication network infrastructure should be exploited to the greatest extent possible. As such, we consider that the Member States' priority should be to encourage and facilitate the provision of services by MNOs to industrial/business users enabled through network slicing – where there is demand – using the MNOs' large-scale network assets operating in nationwide licensed spectrum. This approach helps to address the digitalisation of industrial/business users, to optimise their operations, to optimise the overall energy consumption, and bring other benefits in the context of the environment.

This can be achieved through voluntary/mandatory provisions for MNOs to provide solutions to industrial/business users in the form of customized services (including private networks) via slicing of the MNO's public networks.

GSA considers that the connectivity and spectrum needs of industrial/business users should be carefully assessed by Member States in formulating evidence-based policies in any consideration of the direct authorisation of such users' access to spectrum.

GSA considers that where there is a justified demand from industrial/business users to deploy private IMT networks (independently of public IMT networks) within limited geographic areas,

- a) market-led intra-service spectrum sharing should be preferably achieved through *leasing* of spectrum from the individual wide-area/national IMT network licensees. The Article 51 of the EECC provides for enhanced conditions that allow a robust secondary market and more flexible collaboration between the licensees and those who seek access to spectrum.

- b) intra-service spectrum sharing could be also achieved through local licensing of frequencies which are not used by wide-area/national IMT networks. Any local licences should be available to all interested parties, and should not in any way compromise the availability of nationwide licensed spectrum – with large contiguous blocks – for wide-area/national IMT networks³.

We consider that the technical conditions for spectrum leasing and local licencing can be readily captured in the relevant licences as specified by the regulator, and that there is no need for database assisted spectrum access in this respect.

If there is a proven need for the use of databases to support leasing and local licensing, GSA would suggest to consider the development of the existing European harmonised framework specified at ETSI for such purposes (i.e., eLSA).

Finally, GSA considers that industrial/business users who already use spectrum in dedicated bands (e.g. utilities) should be encouraged to upgrade their wireless technologies to 5G for more efficient use of their existing spectrum assets and for a more sustainable solution.

9. Member States may need to assess any competition issues arising from the measures introduced.

GSA agrees.

Specifically, and as also outlined under (8), GSA considers that where spectrum sharing is achieved through local licensing, these should be available to all interested parties, including the MNOs.

10. Whenever appropriate and useful, sharing conditions may be adopted for achieving the goal of a more efficient use of spectrum, in particular to fulfil coverage objectives, as well as to promote a faster network roll-out, increase the coverage, improve the capacity and the quality of service. The licensed operators must be informed in advance about the technical conditions and parameters of such a spectrum sharing approach.

Our comments below are in relation to intra-service spectrum sharing among mobile networks.

GSA agrees that spectrum sharing/pooling among IMT networks, in combination with network sharing, can in certain instances be helpful to fulfil coverage objectives, promote a faster network roll-out, and improve quality of service to users.

GSA considers that any conditions relating to spectrum sharing/pooling among IMT networks should be specified in a transparent manner in the relevant licence obligations prior to the assignment/auction of the band (see EEC Article 51, Paragraph 4).

³ We note that Recital 25 of Commission Recommendation (EU) 2020/1307 of 18 September 2020 states: "To avoid spectrum scarcity that leads to higher bids in spectrum auctions, best practices may cover measures not to reserve spectrum in 5G pioneer frequency bands for the purposes of public security and defence, as far as possible or measures to reserve EU-harmonised radio spectrum for electronic communications services for private radio spectrum users, as regards both the amount of spectrum and the choice of a specific frequency band, only when duly justified."

GSA considers that any desired sharing/pooling of spectrum among wide-area/national IMT network licensees should ideally be market-led, and can already be implemented through MOCN technologies specified in 3GPP.

Where there are considerations to mandate such sharing of spectrum or networks between mobile operators, we recommend that Member States carefully examine the implications on competition and the diversity of networks which provide service in a given geographic area.

In addition, we note that network deployments take place over time and are based on evolving traffic demands and uptake of use cases. Therefore, spectrum in specific geographically remote/rural areas may not be used by MNOs in the early days of network deployment but according to MNOs' strategies and long-term plans. As such, any sharing of not-yet used nationwide licensed spectrum by IMT networks in a given geographical area should take into account the planning of networks before concluding on the efficiency of MNO spectrum use.

11. Member States should favor spectrum sharing agreements, including those based on spectrum pooling among licensed operators, if necessary attaching conditions to those agreements, when they pursue public interest objectives such as more efficient use of spectrum, including enhanced coverage and/or capacity and network densification.

We refer to our response under (10).

12. Spectrum sharing should not be considered the answer to any shortage of frequencies when addressing conflicting demands by various spectrum users or sectoral needs. Furthermore, some sharing solutions and approaches may work well in some circumstances and not in others. When defining and introducing sharing obligations and conditions Member States and the Commission could consider the implementing scenario and its foreseen development and in particular the opportunity to preserve confidence for all users.

GSA agrees. We also refer to our responses under (4).

GSA considers that, broadly speaking, spectrum sharing should only be considered where there is a clear demand for additional spectrum which otherwise cannot be made available, and where the benefits of sharing outweigh the costs. In other words, spectrum sharing – and complex proposals for intra-service spectrum sharing in particular – should not be considered as goals in themselves but must bring tangible net benefits to users of spectrum.

GSA also considers that

- where possible, bands considered for use by IMT networks should be cleared of existing users of spectrum, particularly in the geographical areas where IMT networks are to be deployed, in order to avoid uncertainties within the interference environment, and to deliver the challenging IMT-2020 QoS requirements specified by the ITU-R.
- where cost-benefit (or other) analysis indicates that clearance of existing users might not be a viable option to make room for introduction of IMT networks, sharing of spectrum between IMT networks and existing users of the band could be considered, always subject to least restrictive technical conditions⁴;

⁴ Least restrictive technical conditions mean the imposition of minimal regulatory technical requirements (e.g., emission limits) which would result in an acceptably low probability of harmful interference between radio systems.

- where sharing of spectrum between IMT networks and existing users is the only option available, careful consideration should be given to the sharing objectives and requirements, and their impact on the operation of all parties, and should not deter the substantial long term investments needed for the roll out of IMT networks;

13. In the work of standard and regulatory organisations such as ETSI and CEPT, Member States should promote studies on sharing approaches, compatibility and technologies that would lead to increased possibilities of sharing or co-existence solutions. While recognizing the need to protect incumbents and adjacent users, any technical assessment for developing sharing solutions should consider long term developments requirements for all users (incumbents, adjacent users, new entrants). Member States should also encourage CEPT and ETSI to develop harmonized standards and regulatory deliverables which support administrations in implementing specific sharing/co-existence solutions, where appropriate.

We recognise that CEPT in any case addresses inter-service spectrum sharing issues extensively as part of its normal activities. We also recognise that, specifications for the technical implementation of spectrum sharing is more within the scope of ETSI than CEPT.

GSA is of the view that increased possibilities of inter-service spectrum sharing will be key in the coming years. IMT networks are increasingly able to efficiently support inter-service spectrum sharing through advanced technologies such as active antenna systems and beamforming.

Having said that, and as commented under (5), GSA recommends that inter-service spectrum sharing opportunities for IMT networks first be considered in bands which involve incumbents whose locations are not ubiquitous and do not vary with time in relation to the IMT networks. This is to ensure stability of QoS and to incentivise long-term investments in the networks.

We consider that the conditions for such inter-service spectrum sharing can be readily captured in the relevant licences as specified by the regulator, and implemented via appropriate coordination mechanisms.

If there is a proven need for the use of database solutions to implement inter-service or intra-service spectrum sharing, GSA would suggest to consider the development of the existing European harmonised frameworks specified at ETSI for such purposes (i.e., LSA and eLSA, respectively).

14. Member States and the Commission should encourage the development by industry and standardization organizations of high-performance transmitter and receiver specifications and the inclusion of appropriate essential requirements and test specifications for all equipment in harmonised standards and product standards in general and more specifically, when relevant to guarantee the effectiveness of spectrum regulatory decisions. Such essential requirements should provide sufficient guarantee that equipment cannot be modified by the user in a way which would negatively affect the sharing/co-existence solutions.

GSA acknowledges that high-performance transmitter adjacent channel leakage ratio and receiver adjacent channel selectivity can allow spectrum users to be better neighbours and can facilitate adjacent channel coexistence. As such, the ETSI Task Force for European Standards for IMT (TFES) harmonized standards has included these requirements since 3G.

It is important to remember that harmonised standards contain the minimum requirements that manufacturers need to meet to place equipment on the European market. Therefore, they are a regulatory burden that applies to all equipment sold in the European Union. When the requirements arising from spectrum decisions depend on how the equipment is deployed or used (for instance, the requirements are applicable only at certain locations), then those requirements should not be captured in the harmonised standard.

It is also important that consideration of improved receiver parameters apply to the receivers of all services in the bands under study.

GSA agrees with the RSPG's proposal on ensuring that equipment cannot be modified by the user in a way that may affect other services in the same/adjacent bands.

While GSA acknowledges that improvements in adjacent channel selectivity might be feasible, especially when dealing with older equipment, and that this can facilitate adjacent channel coexistence, we note that there is little/no room for improved rejection of co-channel interference which appears as an increase in the noise floor. It is for this reason that co-channel coexistence of different systems at the same time and place is typically not possible, unless the systems have extremely undemanding QoS requirements.

15. Member States should encourage industry to design receivers able to tolerate a given degree of unforeseen interference, in line with the need to avoid building sharing solutions based on worst-case scenarios.

GSA notes that while adjacent channel interference can be mitigated through the use of improved filtering at the receiver, this does not apply to co-channel interference.

We note that in practice many systems are able to tolerate a given degree of unforeseen interference, and this also applies to IMT systems. GSA supports measures that can increase the efficiency of spectrum use, such as the development of high-performance transmitter and receiver specifications (as per 14).

16. In order to build confidence among spectrum users, Member States should strengthen market surveillance so as to ensure that equipment is well compliant with essential requirements. This is particularly important when sharing solutions are based on device features (such as those based on "*dynamic frequency selection*" or on authorisation from a database).

GSA considers that where there is an intention to introduce sharing frameworks (e.g. database assisted access for licence exempt equipment), Member States should ensure that adequate market surveillance capabilities are in place beforehand.

17. The RSPG recognises that already today radio spectrum is used on a shared basis. Free resources are hardly available, neither in time, nor in geography. Innovative sharing solutions and initiatives are mainly based on improving the authorisation process and on defining and implementing advanced technical sharing conditions. They aim either to (partly) automate it (e.g. via Artificial Intelligence or usage of information in a geolocation database) or to authorise "secondary"/additional spectrum usage (e.g. multi-tier-approach if and as long as a "primary" usage does not take place) and combinations thereof. This

makes it difficult to identify specific pioneer initiatives or bands from a frequency management point of view within the scope of RSPG.

GSA considers that the combination of existing spectrum authorisation frameworks based on individual licensing (nationwide or local) and licence exemption (general authorisation) in distinct frequencies respectively, as available today, is sufficient to cater for all foreseen intra-service spectrum sharing scenarios for innovative use cases. Where there might be demand for dynamic/opportunistic intra-service spectrum sharing, these can already be catered for by using licence exempt bands. Therefore, GSA does not see a need for additional spectrum sharing frameworks to cater for such dynamic/opportunistic use.

GSA does not consider that database assisted access is necessary for IMT networks in order to implement inter-service spectrum sharing. This is because the operation of equipment in IMT networks is already effectively managed by a database (i.e., the mobile network itself) and any necessary restrictions on the operation of the equipment – as set out by the regulator – can be readily implemented by the network itself. This is especially pertinent with regards to our response under (5) and the desirability of avoiding “dynamic” spectrum sharing in the context of IMT networks. GSA considers that where appropriate, various co-ordination approaches may be applied to facilitate spectrum sharing between IMT networks and existing users.

18. The RSPG considers that all spectrum bands are potential candidates for introducing and enhancing spectrum sharing solutions along the policy lines highlighted above.

GSA agrees that all bands are potential candidates for spectrum sharing. We refer to our response under (12), and that where sharing of spectrum between IMT networks and existing users is the only option available, careful consideration should be given to the sharing objectives and requirements, and their impact on the operation of all parties, and should not deter the substantial long term investments needed for the roll out of IMT networks;

19. The RSPG recommends fostering all possibilities of spectrum sharing, when making available frequency bands which are identified for harmonisation in EU, and, in particular, with regard to those bands currently under consideration according to the EC Mandates to CEPT to develop harmonised technical conditions for introducing 5G in priority frequency bands above 24 GHz and to amend Commission Decision 2005/513/EC on the harmonised use of the 5 GHz frequency band following WRC-19.

As we set out under (5), GSA acknowledges that increasing levels of spectrum sharing between IMT networks and other services may be inevitable going forward, and that the mobile industry has been very active in recent years in establishing efficient inter-service spectrum sharing frameworks, with the 26 GHz band being a prime example.

As such, GSA supports inter-service spectrum sharing as a means of introducing 5G in priority bands above 24 GHz.

In regards to intra-service sharing, GSA would further like to remark that whereas there is a need for sufficient contiguous individually licensed mmWave spectrum for commercial operators, there may be instances, such as when demand exceeds supply, where sharing alternatives such as club use can be beneficial.

20. Member States should foster the introduction of innovative technologies in support of a multi-tier spectrum sharing approach, in line with national circumstances.

We refer to our response under (7) and our preference in avoiding spectrum sharing frameworks which consist of 3 or more co-channel tiers where possible.

21. Based on the previous recommendations and considerations, the following Roadmap is proposed for the objective of increased Spectrum Sharing.

22. In order to facilitate the introduction of new spectrum sharing options in a context of scarcity of frequencies, the way the sharing conditions are defined should be based on realistic scenarios, rather than worst-case, and take into account as far as possible results of measurements to better understand the impact of real case interference.

GSA broadly supports measures that can increase the efficiency of spectrum use (refer to 14 and 15), however, caution is advised regarding the use, in the sharing studies, of performance characteristics other than those applied in standards/specifications (referred in the RSPG opinion as worst-case). The reason being that for conformance testing, worst-case scenarios are evaluated (e.g. maximum transmit power, most difficult multicarrier combinations, etc.) in addition to adding margins for aging and other purposes. On the other hand, field measurements reflecting typical behaviour, are carried out under typical operating conditions and cannot reflect all aspects taken into account in conformance testing and should thus not be used as a basis for modifications or tightening of regulatory/standards requirements on base stations or terminals. Base stations and mobiles must always comply with the mandated limits under the worst-case conditions, as is demonstrated in conformance testing. Tighter recommended limits will therefore mean tighter conformance testing conditions, with possibly severe impact on product design and cost.

However, measurements or other information demonstrating product performance in a typical environment, may be relevant for compatibility analysis when aggregated interference is studied. A question that needs to be addressed in such a scenario is the responsibility for any actual interference, noting that vendor responsibility is only to meet limits applicable for conformance testing and that of the operator is to meet licensing conditions, neither of which will impose restrictions that guarantee interference free operation.

GSA supports efforts regarding improvements in propagation models to ensure that realistic results are provided

23. Member States shall promote the efficient use of spectrum by facilitating the implementation of spectral efficient systems by spectrum users and incentivising the update of their current technologies to new more spectrally efficient ones.

GSA agrees and notes that its members are vendors of equipment and networks based on 3GPP specifications, which define the most spectrally efficient wireless networks.

GSA would also like to request the RSPG to encourage administrations to incentivise the implementation of – or migration to – more energy efficient technologies (such as 5G) which would help in combating climate change.

24. Member States are encouraged to support the development of initial “proof of concept” systems in bands where advanced spectrum sharing systems, such as cognitive radio systems and other ICT or database assisted systems have been developed at least at the experimental level and are under the control of the regulator, and to devise how those systems can be reused and considered for sharing solutions in other frequency bands.

No comment.

25. Where it seems sensible and possible and there is demand, Member States are encouraged to issue temporary “test & trial”/“innovation & trial” licences (sandboxes), including in a multi-country context, where appropriate in order to foster innovation. Those licenses should give users, including non-traditional operators, the possibility to get access to spectrum.

GSA understands that most – if not all – Member States already provide such test/trial licences upon request. It is important that such test/trial licences are issued quickly and based on affordable prices.

26. The European Commission and Member States are encouraged to foster and authorise trials and experimental systems in the field of spectrum sharing whose framework makes use of Artificial Intelligence technologies, in order both to pave the way to the use of those technologies in commercial sharing frameworks and to build trust amongst users.

GSA agrees with the RSPG and notes that IMT networks are themselves highly sophisticated spectrum sharing systems which through technologies such as cellular frequency re-use, scheduling techniques, and network slicing, allow billions of users and devices to share the same frequencies.

New technologies such as AI and machine learning are also already being deployed and further developed to enhance the operation of IMT networks, at various levels of the radio protocol stack, in order to improve the management and sharing of the radio resource among the users of the network.

27. In order to introduce ICT-assisted or database-assisted spectrum sharing solutions, Members States might foster work by CEPT and ETSI to support the implementation of such spectrum sharing approaches. This would require the development of standard communication interfaces between the devices and the database as well as a framework for the establishment and management of databases.

28. Such work should remain sufficiently generic to adapt to sharing conditions in various frequency bands as well as to local specificities.

GSA acknowledges that ICT-assisted or database-assisted access to spectrum can facilitate inter-service spectrum sharing between licence exempt devices and existing users of a band. Examples include the TV White Spaces framework which involved direct communication between databases and licence exempt equipment.

GSA does not consider that such database-assisted mechanisms would be, in general, required in the context of IMT networks. This is because as outlined earlier under (5), GSA recommends that inter-service spectrum sharing opportunities for IMT networks first be

considered in bands which involve incumbents whose locations are not ubiquitous and do not vary with time in relation to the IMT networks. We consider that the conditions for such inter-service spectrum sharing can be readily captured in the relevant licences as specified by the regulator, and implemented via appropriate coordination mechanisms.

29. Where applicable and possible, and in line with EU single market objectives, when applying spectrum sharing solutions based on a geolocation database, Member States should leverage on the aforementioned standard communication interfaces and database management framework, and support the development of the DB-based spectrum sharing solutions, including those employing equipment capable of operating in a multi-country context taking into account interoperability requirements, while safeguarding public services interests such as those regarding public safety and national security.

We note that licence exempt equipment can often readily achieve inter-service spectrum sharing because of their low power emissions. We also acknowledge that where there is a substantial risk of harmful interference to existing users, licence exempt equipment can benefit from database assisted access to spectrum. This is where the operation of the licence exempt equipment is restricted based on instructions that are conveyed from a database to the equipment. One example is the TV White Space framework in the UK.

In the context of networks which require managed QoS in individually licensed spectrum, GSA considers that static⁵ two-tier inter-service spectrum sharing frameworks should be considered in the first instance, and that the technical conditions for these can be readily captured in the relevant licences as specified by the regulator. If there is a proven need for the use of databases to support static two-tier inter-service spectrum sharing, GSA would suggest to consider the development of the existing European harmonised framework specified at ETSI for such purposes (i.e., LSA).

30. To facilitate sharing scenarios, Member States may consider the on-line availability of information about radio spectrum usage. When doing so, Member States should adapt the information, before making it available, in an appropriate anonymized format of spectrum usage, e.g. protection or exclusion zones, protection criteria, time of usage, in line with national circumstances (cybersecurity, confidentiality, other legal requirements, etc.).

No comment.

31. Given examples to provide authorisations in a dedicated spectrum band under a light licensing regime based on an automated platform, Member States may consider applying similar approaches to their respective authorisation processes to foster more dynamic spectrum sharing.

GSA consider that licensees could benefit from greater levels of automation in Member States' own licensing processes, as a means of cutting down the time between an application for a licence, any required calculations for the management of interference, and the issuance of the licence.

Such improvements in the Member States' IT systems and platforms are entirely a matter for the Member States, and should not be conflated with the introduction of dynamic spectrum sharing authorisation frameworks.

⁵ Where the incumbents are not ubiquitous and their location does not vary with time in relation to the IMT networks.

32. With the aim of facilitating spectrum sharing the RSPG invites Member States to share their experiences with innovative spectrum sharing solutions and initiatives. In particular, RSPG invites Member States:

- 33. to share experiences related to new sharing cases and more dynamic approaches to spectrum management authorised in their countries, including solutions to appropriately and proportionately address any interference concerns and coexistence issues;
- 34. to share best practices in cases having a multi-country and/or a cross-border dimension with EU footprint, taking into account the results of EU funded projects and pilots as well as trials targeting verticals;
- 35. to collaborate in multi-country, cross-border and public-private research and development projects, e.g. by using funding programmes of the Union, and share the results of those projects.

GSA considers that it would be helpful for Member States to regularly report on the extent of user adoption of any existing spectrum sharing frameworks in the Union.

36. The RSPG recommends the European Commission to continue funding and give priority to EU research projects aimed at increasing the commercial development of technologies and network architectures that can make spectrum sharing more efficient and ease its development.

GSA considers that it would be helpful for such studies to consider not only the relevant technologies and network architectures (which have been studied for many years), but also to examine the use cases and real user demand for – and the overall costs and benefits of – “dynamic” spectrum sharing mechanisms.

37. The RSPG recommends Member States to take into account developments towards innovative spectrum sharing solutions and initiatives outside the Union.

GSA considers that it would be helpful for Member States to closely examine the extent of user adoption of any existing spectrum sharing initiatives outside the Union, in Europe and further afield, and with a special focus on the opportunity cost of such initiatives vis-à-vis more established approaches to making spectrum available to users. When considering such initiatives, we recommend that Member States examine the context within which these were introduced and evaluate the relevance of similar solutions within their national context, if appropriate.

38. In order to foster a more dynamic spectrum sharing and a more automated access to spectrum for the mid-term, the European Commission and the Member States, on the basis of the appropriate deliverables from CEPT and ETSI, should identify use cases scenarios that require spectrum sharing and allow the development of a proof-of-concept sharing framework using ICT based systems with innovative technologies, such as Artificial Intelligence/Machine Learning and collaborative techniques. Member States should leverage on the above spectrum sharing solution to contribute to build trust amongst users and industry, together with enhanced market surveillance and spectrum monitoring, so to speed up the commercial application of the identified solution.

GSA considers that spectrum sharing – and complex proposals for inter-service and intra-service spectrum sharing – should not be considered as goals in themselves but must bring tangible net benefits to users of spectrum.

GSA considers that where certain parties are contented with deploying communications networks with *dynamic/opportunistic* access to spectrum, the use of bands that are subject to general authorisation (licence exemption) are recommended for this purpose. Such opportunistic access is, for example, offered by 5G NR-U (New Radio – Unlicensed) which is defined in 3GPP to be used in licence-exempt spectrum.

GSA acknowledges the interest of the RSPG in dynamic spectrum sharing and would recommend that the RSPG and Member States identify the use cases that dynamic/opportunistic sharing frameworks are expected to foster, and that cannot be addressed with spectrum sharing that is already possible with existing regulatory framework (i.e., the various flavours of licensing or licence exemption).
