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RADIO SPECTRUM POLICY GROUP

RSPG Report on European Spectrum Strategy

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RPSG Report on European Spectrum Strategy

Introduction

1. Radio spectrum is a critical input to a wide range of commercial and governmental services providing huge social and economic benefits. These benefits could substantially grow in the future, and may come from a more diverse range of services and applications. Given expected increasing demands for spectrum, and limited radio spectrum resource, new challenges in how spectrum is used and managed will need to be tackled to enable these benefits.

2. The rapid pace of change in wireless communications technologies and markets presents immediate challenges for spectrum management. However, there is also a cumulative effect of these developments and a need to look beyond current policy initiatives, to the medium and longer term.

3. In recognition of these future opportunities and challenges, the 2018/19 work programme agreed that the RSPG should lead European thinking on a longer-term European spectrum strategy that looks to the medium and longer term of spectrum management (e.g. a 10-30 year horizon). The workplan set out that these discussions should seek to challenge established thinking about spectrum management. Given the long term horizon, this report, based on RSPG thinking and discussions with stakeholders, may include observations which may form part of the future work of the RSPG.

4. The RSPG established a working group on European Spectrum Strategy (ESS WG) at the beginning of 2018, its objective is to develop the discussion on long term strategic issues for Europe. The group identified six interconnected themes to guide its discussions on European spectrum strategy:
   - Meeting the needs of all spectrum users
   - Innovation
   - Sharing
   - Harmonisation
   - Receivers and Standards
   - The role of market mechanisms.

5. The working group has met during 2018 and 2019 and held two stakeholder workshops in Dublin and London. The work has also been presented at RSPG stakeholder events in December 2018 and May 2019. Diverging views from stakeholders have been expressed, reflecting different sectoral needs and drivers for sectoral access.

Context

6. European spectrum strategy is being considered in the context of rapid ongoing technological development and evolution in various sectors, as well as longer-term economic and societal changes, both of which could have significant implications for the role of spectrum policy supporting the single market.

7. Broad categories of likely technology changes identified at this stage include:

- further advances in how spectrum is utilised for communications, including new capabilities for exploiting much higher frequencies;
- new mechanisms for managing and/or sharing spectrum, for example in more dynamic and automated ways, potentially changing the role of traditional spectrum managers; and
- innovation in technologies as diverse as robotics, artificial intelligence, space launch and batteries, which could stimulate new applications and business models with new spectrum requirements and demands.

8. Alongside technology changes, wider changes in society, such as an aging population, the growing importance of transport, environmental protection, cyber-security and migration could also drive new spectrum needs, although the implications of these for spectrum policy are hard to predict.

Meeting the needs of all spectrum users

9. There is already a wide range of spectrum users and applications, both commercial and governmental - from wireless microphones and video cameras to cellular mobile, broadcasting, satellite positioning, radars, earth and climate observations, etc. This breadth of uses looks set to grow further, in ways which are not always predictable. Many sectors are looking to benefit from new wireless applications in the future, from farming to transport and manufacturing.

10. Therefore, in order to maximise the future overall benefits from spectrum use, spectrum policy will need to take into account the needs of all spectrum users. Some users may be newcomers with different needs compared to today's spectrum users, which may be translated into new spectrum demands – for example, having demand for access to spectrum over varying geographical areas, needing different quality of service requirements and having varying abilities to engage with spectrum management processes. Potential future spectrum users might:
    - Operate in any sector – from private households to public services to the full range of private sector industries.
    - Operate new business models
    - Operate in any location,
    - Vary in size – from individuals and micro businesses to large corporates

    We should aim to engage with new players to become aware of their needs, as well as potentially considering what new applications / technologies / services could arise in the future (recognising that these are not always predictable). Spectrum demands may be expressed either directly to spectrum managers or captured through existing processes (CEPT / ETSI).

Innovation

11. Whilst some future social and economic benefits will come from the growth of existing applications that use radio spectrum, future benefits are also dependent on innovation, which could come from:
    - Existing spectrum users - for example innovating within spectrum bands in which they already hold rights, including by introducing new, higher performance technologies;
    - Potential new spectrum users (as discussed above) – for example new entrants experimenting with ideas for new technologies and new applications/ services, or manufacturers of radio equipment for different industrial sectors (e.g. automotive, logistics, agriculture).

These innovations in spectrum use may support or complement wider innovations such as new business models or ways of delivering commercial and governmental services.

12. The RSPG thinks that innovation will be critical to sustaining and growing the EU Digital Single Market. Wireless innovation is enabled by effective spectrum management. However, spectrum managers do not drive innovation: it is industry that innovates, while regulation provides a framework within which innovation can flourish (noting that inappropriate regulation can also impede innovation).

13. Although innovation is a complex process, dependent on many factors, in terms of spectrum access, key requirements are likely to be:
    - Ability to develop and deploy new technologies and new services for targeted markets;
    - Being able to start out small, and preferably quickly, to experiment with new ideas; with the ability to grow and capture the benefits of innovation if successful.

14. Therefore, to support innovation we need to consider the spectrum policy levers we can use to address these requirements.

<u>Developing and deploying new technologies and new services</u>

15. The aim of **technology and service neutrality** is to provide spectrum users the freedom to deploy new technologies and services without needing to seek regulatory approval or changes.[1] The process of seeking of approval, even if eventually granted, can introduce uncertainty and delays for the innovator which can frustrate the process of innovation. Technology and service neutrality principles should be promoted in the rights of use of spectrum where possible in EU member states.[2]

16. Although technology and service neutral licenses should in principle enable existing licensees to deploy new technologies, factors which may make it harder to achieve technology and service neutrality in practice are:
    - Regulatory EU harmonisation decisions that specify the technical conditions of use in particular frequency bands for specific services (i.e. ECS WBB). These aim to support economies of scale for those services / technologies, but can limit the potential for others to be deployed.
    - The out of band receiver performance of existing standards and deployed radio equipment, is often based on assumptions about their *existing* spectrum neighbours. For example, if a band is lightly used with no emissions near the band edge, radio equipment deployed in the neighbouring band may rely on this and be poor at rejecting signals from the adjacent band. Subsequently deploying new technologies and services with different characteristics may then create significant issues for the new and/or neighbouring use, that the spectrum manager may need to address.
    - Competing technologies targeting the same frequency band for the same / similar applications can create conflict in standardisation due to coexistence issues. For example, this could mean that deployment of one technology constrains the other or result in neither

[1] See also Section 6 of RSPG16-004 FINAL - RSPG Report on Efficient Awards and Efficient Use of Spectrum – for further information on technology and service neutrality

[2] RSPP https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012D0243&from=EN

working effectively if both are deployed. National or wider EU regulatory technology neutral sharing conditions may be necessary to achieve efficient use.

17. In addition, the developers of new technologies sometimes request changes to block and band edge masks, even where licences are technology neutral. It is important to consider in each case whether such changes are consistent with principles of technology and service neutrality, and their impact on adjacent services.

Starting small and quickly, with ability to grow

18. Innovators want spectrum to made available quickly, under least restrictive conditions and with minimal barriers (including fees) but often also need the ability to access spectrum on a long-term secure basis in order to support investment, and development of their business model. There are a range of levers which are relevant to achieving this, and across the membership of RSPG there are various national initiatives in place to respond to spectrum demands from small and medium sized enterprises (SMEs) and there is great benefit from sharing national experiences. Levers may include:

a) **Test and trial licences** – These are generally suitable for research and technology development, but not for commercial deployment. This could help, for example, to assess spectrum needs and to convince investors to support the innovation. However, they do not secure long term access to spectrum. So whilst the concept for a new service or technology may be proven, such licences may not support the ability of a service to grow and enjoy commercial returns. There is need to address the next step for innovators beyond test and trial licences. There may also be a need to share best practice for tests or non-commercial trials.

b) **Spectrum and / or regulatory 'sand boxes'**. 1) Where spectrum is set aside with the specific aim of enabling trials or innovative new users to access spectrum, including allowing commercial deployments. This could be an evolution of the type of regime in operation for SRD's but with fewer restrictions than exist in the SRD. 2) The possibility of being temporarily exempted from some of the regulatory measures that would normally apply. There could still be a need to assess how these could be further developed with higher power applications. Further to any temporary relaxation, there would be a need to assess whether the authorisation regime is adequate to allow for this flexibility in the longer term to support viable investment.

c) Promotion and implementation of innovative **spectrum sharing approaches** to assist innovators with access to spectrum. Some such approaches are discussed in the section on spectrum sharing below. This raises the need to assess how authorisations need to be framed, and whether the authorisation regime is adequate to allow for this flexibility.

d) Encouraging **trading and leasing of individual rights of use**, so that innovators can more easily gain access to spectrum that is already licenced and in the market.

e) **Accessibility and agility of harmonisation and standardisation** processes. Standardisation, as supported by the Radio Equipment Directive, and harmonisation can be a means by which innovations can gain the scale economies to help them grow from a niche service to a mass market one with low cost equipment. It can also have a range of other benefits, such as helping to creating a more certain environment for investors and spectrum users, and supporting the development of competition and the single market. However:

- Smaller players may not always be aware of these benefits and lack the capabilities to engage with harmonisation and standardisation processes. There is an ongoing need to help them to understand how and when decisions are taken.
- Harmonisation and standardisation processes may be perceived as slow and cumbersome, and whilst supportive of innovation for some users, they could hinder innovation if they delay and/or introduce barriers to new applications or innovative new models of spectrum use, such as cognitive technologies. There is an ongoing need to assess how to reduce delays and barriers to innovation.

Spectrum sharing

19. Spectrum sharing is an essential part of spectrum management and is already in in place for many bands and uses. The RSPG recognises the need to respond to ever increasing demands for spectrum through greater and more intense spectrum sharing, which is becoming possible because of more sophisticated technology and new authorisation approaches. This is particularly the case in higher frequency bands such as the millimetre wave frequencies, where different propagation characteristics mean that traditional lower frequency approaches, such as dedicated national licensing, are not necessarily the sensible default.

20. Spectrum sharing is the common usage of the same spectrum resource by more than one user. Sharing can be made with respect to all three domains: frequency, time and place.[3] Multiple users can share spectrum for a similar type of use; alternatively, users can share spectrum for different uses (for example, fixed links and satellite earth stations, or government users and commercial users). Shared access may be on a general authorisation basis with appropriate conditions, or an individual authorisation basis (for example geographic sharing, where different users currently use the same frequencies in different places). Users sharing spectrum may operate with the same level of priority, or there may be a priority user or group of users having priority over others (or multiple tiers of users with different priority levels).

21. An updated approach to sharing could be a corner stone of future spectrum policy to facilitate future sharing solutions and hence efficient use of spectrum, as a way of meeting the needs of all spectrum users. An updated approach will need to involve a change of mindset to realise as much sharing as possible and see sharing as the norm, rather than the exception. The vision for a new mindset towards sharing could include:
    - changing the mindset of all stakeholders that “exclusive” use will often not be a realistic option in the future. This applies as much to stakeholders/applications which request spectrum, as those who already have allocations. For example, this could include giving new users access to spectrum that has previously been assigned to others, in areas where the “incumbent” does not use it.
    - challenging assumptions that making a band available for harmonised use automatically means clearing all existing users and awarding exclusive, national licences.
    - promoting sharing studies that focus on finding sharing solutions / co-existence solutions. While recognising the need for protection of incumbents and adjacent users, applying overly conservative approaches to protecting incumbents limits the opportunities for sharing. Technical assessments for developing sharing solutions should consider long term development requirements of all users (incumbents, adjacent users, new entrants). Worst case scenarios should not be the end point in technical assessments, but should be assessed

[3] RSPG Opinion on Licensed Shared Access. RSPG13-538 November 2013

on a case by case basis. The burden of technical assessments should be shared between industry and administrations.

- promoting to industry and spectrum users the benefit of developing new sharing mechanisms, and spectrum managers support for these, so that industry helps to come up with innovative sharing solutions, working with spectrum managers.
- increase in the robustness and sensitivity of both transmission and receiver equipment to facilitate more and better sharing and more sophisticated co-existence.

22. It will be important to gain experience of new sharing technologies and more dynamic approaches to spectrum management, in order to develop understanding of their costs and benefits and develop trust in their use. Initial systems that demonstrate proof of concept shall be encouraged, and could demonstrate that it can then be reused and considered for sharing solutions in other frequency bands. Building confidence in enforcing sharing solutions is also likely to be important and, in particular, the ability to appropriately and proportionately address any interference concerns that may arise.

Harmonisation

23. Harmonisation of the technical conditions of spectrum use across borders, and of equipment standards which can use those frequencies, has well established processes which have worked for more than a decade, embedded in the EU framework. Great benefits have been derived from technical harmonisation in the EU and across Europe through EU Decisions, ECC Decisions and ETSI Standards supporting implementation of the Radio Equipment Directive (RED).[4] This has provided legal certainty to the market to invest in equipment that will be supported across the EU, giving confidence to spectrum users, ensuring efficient use of spectrum and enabling economies of scale for both network and consumer equipment, enabling swift deployment of networks and availability of services and assisting in efficient spectrum usage across the EU

24. Appropriate spectrum harmonisation can also play an important role in enabling innovation. For example, the early identification of 5G bands by RSPG encouraged the market to respond and develop standards for those bands.

25. Looking forward, the emergence of new uses, as discussed above, can lead to more complex sharing environments with multiple services co-existing in the same or adjacent bands. This combined with the use of higher frequencies (where there is less potential for interference and cross border coordination is potentially less of an issue) and faster industry developments with possible global reach and effects, could all have implications for how spectrum managers develop the best approaches harmonisation in the future.

26. In addition, it is worth noting that in some cases, the regulatory and standardisation initiatives from other regions has led the way in advance of EU harmonisation, with the development of standards, responding to market demand, without specific EU harmonisation measures already being in place. For example, both network and consumer equipment was produced for access to 2.3 – 2.4 GHz without EU harmonisation.

27. RSPG, in its capacity as a strategic body of national spectrum experts, believes that this changing context raises a number of questions about what might be the optimum approach to

[4] https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=celex:32014L0053

harmonisation in the future, recognising that spectrum bands should be treated in an appropriate way given their characteristics and the nature of the services / technology.

28. First, will the current EU favoured models of either harmonisation of technical conditions based on single service use (i.e. individual authorisation ECS for WBB) at one end or general authorisations with non-protected / non-interference at the other end, continue to provide optimum and efficient spectrum use as required under the EU Framework?[5]

29. Second, the RSPG has considered that whilst a level of technical harmonisation is often beneficial, and has enjoyed wide support, it should be considered how to apply harmonisation to the amount necessary. Would it be beneficial in the future to consider a range of approaches to harmonisation, including perhaps a more permissive approach in appropriate cases, for example to provide better opportunities for sharing?

30. Although technical harmonisation can help to promote innovation, there are also ways in which harmonisation has the potential to stifle innovation. For example, if harmonisation comes too late or is focussed on only one technology (i.e. where the RSC decision specifies a service). There is always a need to balance technical harmonisation and flexibility to support innovation.

31. The lack of uniformity of national demand might mean a too rigid harmonisation approach at the EU level could leave spectrum underutilised in some part of the EU. Although Article 45(3) of the EECC allows alternative use of all or part of the band in harmonised radio spectrum in the case of a national or regional lack of market, which goes some way to addressing uneven demand, this is on an exceptional basis only and likely to be only on the basis of national decisions. This raises the question as to whether a flexible approach at the outset, for instance, harmonisation decisions which facilitate sharing or greater co-existence could produce more spectrally efficient harmonisation decisions. This may be particularly relevant where the specific characteristics of the band or the proposed uses are considered, for instance harmonisation at higher frequencies where cross border interference might be less likely.

32. Where harmonisation decisions are considered necessary, it may also be relevant to consider whether such decisions need to be indefinite to achieve their objectives (for example, development of a market or economies of scale), or whether they could be time-limited or subject to periodic review. Some uses never materialise (or not to the extent expected) meaning that spectrum is sterilised, or could be being used but in an inefficient way. Review of harmonisation decisions could allow flexibility for innovation or higher value use in the future.

Receivers and standards

33. Effective radio equipment and equipment regulation is just as important as effective radio spectrum harmonisation and coordination to meet the objective of efficient spectrum use.

34. Adequate RF performance of transmitters and receivers is important to ensure transmitters do not emit unreasonable amounts of power into the adjacent spectrum and receivers can operate effectively in the presence of transmissions in the adjacent spectrum. The technical parameters

[5] See European Electronic Communications Code (EECC) – https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52016PC0590

for these aspects are covered by ETSI harmonised standards supporting the Radio Equipment Directive (RED).

35. RED has led to greater focus on the performance of receivers and receiver parameters as part of standardisation processes. Given the increasing demand for spectrum it is important to work spectrum resources harder, and there may be more to do to ensure better receiver standards. Improved receiver resilience might enable greater spectrum sharing, however at present standards risk being developed for the interest of individual sectors.

36. An updated vision regarding receivers and standards could include:

    - Current authorisation approaches tend to be based on how much interference a service / equipment can cause, but not how much they should be expected to tolerate. The lack of articulation of how much interference a service or device should be expected to tolerate from services or devices in adjacent bands can cause difficulties when implementing sharing, or when adjacent services change. A common problem is that receivers in a band with a new neighbour are often not good enough to deal with the new radio environment. It may be desirable to explore whether it would be possible to set more explicit expectations about the interference environment, including that receivers should not be so sensitive that they listen acutely to everything in the near radio environment and constrain future evolution of neighbours. Consideration could be given to ways of defining these expectations, including the possibility that receiver performance requirements could evolve into a "Listening Mask". Coexistence should be based on an acceptance of interference between services, and we should work with incumbents that currently expect no interference.

    - Spectrally inefficient or oversensitive equipment are barriers to sharing. There is an increasing need to consider 'state of the art' receiver performance in setting standards and in coexistence studies. New standards should avoid "locking-in" poor receiver performance for the long term. This could take into account the cycle for renewal of equipment, as locking in poor performance is likely to have a bigger impact when considering receivers that are likely to have a long replacement cycle.

    - The need to continuously improve receiver performance, with legacy equipment potentially to be reviewed for "over sensitivity" and protection of the legacy receivers reduced where appropriate.

37. However, in reviewing expectations for receiver performance, we must be mindful that when designing a receiver, there is always a trade-off between performance and cost. There has to be a balance between the implementation costs of sharing and the value likely to be achieved. In addition, the RSPG also recognises that in many cases receivers in the market are better than the standard.

<u>Ensuring that the standardisation process is not a barrier to innovative players</u>

38. To support innovation, it will be important to ensure that standardisation processes do not create barriers to innovation, particularly for smaller players. Standardisation could be perceived as a threat to their intellectual property, as innovative players may need to involve their

competitors to develop a standard. However, it may be important to consider whether any barriers to innovation relate to the current framework itself, or the implementation of the framework.

39. We also need to enable new players to engage with and benefit from standardisation processes, and to explain to explain to smaller players what we are doing to help.

The role of market mechanisms

40. The use of market mechanisms, including competitive awards, trading and leasing, is facilitated and encouraged through the current EU regulatory framework in the interests of ensuring efficient and effective use of spectrum. However, there are a range of different understandings of the benefits and limits of market mechanisms between Member States, particularly beyond the use of auctions (competitive awards). The Code recognises that each member state manages spectrum nationally, and the RSPG recognises that that different methods are used to by member states to manage spectrum efficiently.

41. There are areas of spectrum management where market mechanisms may have a more limited role, or may not have a role. General Authorisation produces huge economic and social value but market mechanisms (such as trading, auctions and fees) are not relevant to the allocation and management of spectrum under general authorisation.

42. Stakeholders and member states have commented on the difficulty of capturing social value within market mechanisms, particularly with regard to government uses and / or other non-commercial uses. Market mechanisms are not generally applied to government or non-commercial uses / users of spectrum in most Member States.

43. In a changing spectrum environment with more dynamic use, more sharing and more innovation, future demand is increasingly difficult for regulators to assess. When they work well, auctions and trading and leasing may help secure optimal use of the limited and valuable spectrum resource by allowing spectrum to be allocated or transferred to those commercial users and uses that can generate the greatest benefits for society. The market, through trading and/or leasing and least restrictive technical conditions (block edge masks) as anticipated in Article 51 in the Code, can in principle enable faster changes to higher value commercial use than regulatory processes, which can take many years for due process and for sufficient notice to be given to licensees.

44. Spectrum fees may also be used as an incentive tool, for instance if fees are set at levels which reflect opportunity cost. This may give licensees an incentive to use spectrum more efficiently. Fees can be a complement to other market mechanisms to ensure efficient use of the spectrum. In some countries, fees may be applied to governmental as well as commercial use, to reveal opportunity cost of government uses of the spectrum. However, the RSPG notes that incentive fees are not currently used by many member states.

45. Although not suited to all situations, transfer of rights of use for radio spectrum can be an effective means of increasing the efficient use of spectrum, and may support innovation and sharing by providing access to spectrum that is already licenced and in the market, including in harmonised spectrum (noting that in the case of harmonised spectrum, any transfer shall

comply with such harmonised use). However, spectrum trading and leasing does not seem to be extensively used by the holders of rights of use. There are concerns that trading might be inhibited by competitive dynamics that could lead to hoarding of spectrum and potentially stifle innovation by others seeking access to spectrum.

46. However, licensed spectrum remaining unused is not always an indicator of hoarding. Unused spectrum in certain locations might result from the spectrum having no value in those geographic places, for example if it is not economic to deploy there. In other cases, holders of spectrum may not deploy for a period of time, for example while equipment standards are developed and until demand increases. Concerns about spectrum hoarding have been addressed by national spectrum managers including by the application licence conditions, or using pricing to incentivise efficient use.

47. In some cases, the ability to trade spectrum may give licence holders incentives to take actions to make a spectrum band more valuable, for example, by promoting equipment standards for the band, if they can capture some of this increased value. However, liberalisation of licences (i.e. allowing change of use) to facilitate higher value use can be perceived as creating a windfall gain for the current licence holder; and spectrum managers may seek to return this value to the public (i.e. by re-awarding the spectrum). In these cases, there may be an important distinction between the source of the increase in value – whether this is due to the efforts or actions of the licence holder (e.g. innovation or creating a new market), or because of regulatory decisions or actions.

48. It might interesting and beneficial to understand whether more market transactions occur in other regions compared to Europe and, if so, whether this as a result of spectrum management decisions.

Closing observations

49. This report, which has a long-range outlook, has been developed further to interactions with stakeholders, who through their engagement with this process (workshops) have clearly articulated the importance of addressing opportunities and challenges for the future. The areas where this work suggests there may be the greatest potential for further consideration in order to support future spectrum benefits are:

    – Supporting innovation, because this will be an underlying driver of future spectrum benefits

    – Promoting spectrum sharing, because this is a key tool that spectrum managers have to facilitate more efficient use of spectrum

50. Further considerations for supporting innovation could include reviewing experiences of innovation – particularly the process by which new technologies, new services and new users have gained access to spectrum. This could include consideration of how accessible and agile regulatory / standardisation processes are and how they can be improved, particularly to support new spectrum users and innovators.; whether technology and service neutrality was achieved in practice and the impact this had; and whether EU harmonisation was successful and why (and if not, why not).

51. There may also be benefit to considering whether and how spectrum/regulatory sand boxes could complement existing authorisation tools, and how the approach to equipment standards / receiver performance can reformed to facilitate technology neutrality (e.g. to avoid assumptions about neighbours constraining future innovations).

52. Further considerations for how to maximise the overall value of spectrum through spectrum sharing could include reviewing both current and potential future spectrum sharing options, and their strengths and weaknesses for different requirements (building on the 2011 Collective Use of Spectrum report). Future thinking on spectrum sharing could explore the circumstances where new users can share spectrum that has previously been assigned to others (e.g. if unused); how harmonisation actions can allow for sharing, including between existing and new users, with clearance of existing users becoming the exception; and thinking about potential actions that could improve the incentives for existing and new spectrum users to contribute to sharing solutions (e.g. through appropriate technical studies) and actions to build confidence in sharing solutions – potentially including trialling new technologies and new strategies for monitoring and enforcement.