



## **GSMA's response to the Draft RSPG Opinion on a Radio Spectrum Policy Programme (RSPP)**

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## **About the GSMA**

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with over 350 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.

For more information, please visit the GSMA corporate website at [www.gsma.com](http://www.gsma.com). Follow the GSMA on Twitter: @GSMA.

## 1. Introduction

The GSMA welcomes the opportunity to contribute to the next phases of the RSPG and the European Commission's work via a response to the public consultation on the future of the RSPG program.

The program must be focused on exploring urgent ways to resolve the growing gap in achieving digital transformation in Europe. The Radio Spectrum Policy Programme is a mean to support key Union policy areas such as the European Gigabit Society, the European Green Deal, New industrial strategy for Europe, Shaping Europe's digital future and the Digital Decade ambitions. It is, therefore, paramount for the RSPG Opinion to address how all these initiatives will be enabled by different policies, including spectrum, in a competitive environment.

The European Electronic Communications Code (EECC) redefines the regulation of electronic communications in Europe. As a priority, Member states had to transpose the EECC into national law by 21 December 2020, two years after entry into force.

Citizens and business of the European Union request more data, higher speed, resilient networks, better connectivity, flexibility, home connection and, overall, an improved customer experience.

Terrestrial public mobile operators and Members States must partner together to make all this possible and ensure good quality ICT infrastructure by finding the best solutions based on an efficient spectrum policy: right amount of spectrum, at the right time, with the right conditions and at the right price.

The European Electronic Communications Code (EECC) redefines the regulation of electronic communications in Europe and its implementation should remain the highest priority and done to ensure full alignment with the true spirit of the document. It is important that spectrum policies are defined with due diligence for the recommendation on how to ensure the market is thriving.

The introduction of 5G offers new opportunities that will provide significant benefits to citizens, businesses and the public sector. To fully realise this socio-economic potential, we invite the RSPG to ensure that the following key principles are respected and addressed in the RSPG program:

- Clear and protected spectrum right of Use (ROU). Licensed spectrum remains essential to guarantee the necessary long-term heavy network investment needed for 5G and to deliver high quality of service. The risks surrounding network investment are significantly increased without the assurances of long-term, reliable and predictable spectrum access.
- Spectrum sharing frameworks can play a complementary role but must be carefully designed to avoid undermining the potential of 5G. Sharing can also play a role where clearing a band is not feasible by opening up access to new spectrum for 5G in areas where it is under-used by current incumbent users. In these cases, the protection of the incumbent uses should be guaranteed. Still, prospective bands for sharing must be harmonised and available in the right amounts, in the right areas and at the right times to support 5G. More complex sharing regimes (e.g. three-tier) with set-aside spectrum for General Authorised Access may limit, or eliminate, the potential for 5G services in the band.

- Provide clarity on impact of moving away from non-market based spectrum awards. A comprehensive cost-benefit analysis/regulatory impact assessment should be conducted to justify that a set-aside, sharing approach would deliver a better socioeconomic outcome for a country compared with a fully market-based award.
- Ensure justified spectrum demand are met. Focusing on understanding the spectrum users' needs to identify the right solution must remain the objectives. We should not try to find a way to justify different spectrum award approaches which do not meet the needs or can guarantee protection of the investment.
- Do not impose unnecessary regulation. Market based approaches are working and have been proven to be very successful. Policy makers should only intervene where there is proven market failure. Unnecessary market regulation can distort competition. Voluntary spectrum sharing approaches are typically preferable to set-asides.

## 2. Spectrum Sharing

The global success of mobile services has been built on a foundation of exclusively licensed spectrum as it supports widespread services and the certainty needed for, national, long-term heavy network investment and high-quality service. Exclusive licences have provided the certainty of access to spectrum, a critical component of mobile networks, to support huge investments in high quality, wide area mobile networks worldwide. This exclusive licensing approach has been central to connecting well over 5 billion people to mobile services worldwide. Mobile technologies continue to evolve to make the most efficient use of licensed spectrum to deliver better services to more people in more places.

As has been shown in other countries (e.g. UK), nationally unencumbered spectrum can be made available to build nation-wide networks while at the same time making other bands which have a handful of incumbent users and are difficult to clear available for sharing. Furthermore, policymakers can make the voluntary sub-leasing of national licences on commercial terms easier. It is important to recognise that sharing is an enabler to increase efficient use, not an objective on its own. The sharing framework should be tailored to the objective pursued, in order to prevent costly over-sophistication or fragmentation. Even relatively light "use it or share it" obligations can damage efficiency if they impose an operational burden on primary licensees, or if they are combined with other restrictions aimed at maximising opportunistic usage (low power, reservation for unlicensed use in the same band to serve as back-up, etc.).

Sharing among peers, in the sense of the RSPG report, is already done intensively in licence exempt or light licensed bands where all users have equal rights with obligations not to interfere and no ability to claim against interference from legal users: the so called 'non-interference and non-protected basis'. Innovation in sharing technologies and authorisation methods might be useful to facilitate co-existence among users of those bands, for example by providing centralised channel assignment or synchronisation, or by introducing a new tier of users with protection against interference, along the lines of the CBRS band in the US. However, more complex rules and protocols can easily make end user equipment more expensive. Additionally, there is a risk that rules enacted exogenously by spectrum regulators are not optimal and make future changes in the band difficult.

Regulatory initiatives to introduce sharing in existing licensed bands should focus on legacy service specific licences and technologies, in which the scope for increased efficiency is higher. They should be based preferably on a two-tier framework, where incumbents are provided adequate protection against interference and the second tier has no restrictions beyond those required to protect incumbents.

Where operators implement voluntary sharing in their spectrum, the owner of the licence will be able to judge if sharing is possible without affecting the most efficient use of the spectrum. The decision on how to share will be informed by:

- the risk of interference and to the investment, and
- obligations

In many countries, incumbent services are encouraged to share their spectrum in exchange for a lower annual spectrum fee. This incentive should also be applied to operators with obligations in place like annual spectrum fees.

Mobile operators should be permitted to voluntarily share spectrum to support faster services, improve coverage and drive innovation. Mobile operators often have voluntary infrastructure sharing arrangements to help lower the cost of extending and densifying their networks. Where there is demand for access to spectrum, mobile operators will be able to explore arrangements with the interested parties. It is important that such arrangements will not be unduly restricted by competition regulation.

There is a risky assumption that policymakers must impose leasing and sharing conditions to MNOs. Market mechanisms are successfully proving that MNOs are willing to share and lease spectrum, in fact MVNOs are a perfect example of commercial agreements to access spectrum and infrastructure from an operator. According to GSMA Intelligence, as of February 2021, there were 1,597 active MVNOs operating in 93 countries. In any case, any imposition of obligations or regulatory remedies should be the result of a thorough and consultative market assessment where a market failure is identified and a remedy is selected as the most appropriate.

As CEPT explored LSA a few years ago, capitalising on the work done before investing in more complex sharing framework should be done. The opinion should encourage member states to consider implementing spectrum sharing at a manageable scale and increase to match take up.

Complex sharing frameworks, such as those with three tiers, are likely to be less desirable to mobile operators. They may limit the amount of spectrum for prioritised licensed access – which may make a band unsuitable for 5G. They can also introduce conditions (e.g. relatively low power limits, small licence areas and short licences) that restrict deployment options (e.g. for macrocells or fixed wireless access) and discourage significant long-term wide-area network investment. In this way, complex approaches may negatively impact public access to cutting-edge mobile broadband services.

### **3. Spectrum needs and supporting EU vision/policies**

The RSPP opinion should invite the Commission and member states to clarify with a roadmap, the details of spectrum bands that will be made available. Additionally, the RSPG opinion should invite the European Commission and Member States to review their spectrum needs regularly between now and 2030 to address the consumer's needs. The spectrum needs should be assessed separately for licensed and license exempt usage to take into consideration the variety

and differences in served use cases. This monitoring could be formalised as part of the governance of the Digital Compass recently proposed by the European Commission.<sup>1</sup>

In this context operators will be re-farming their existing spectrum assets to 5G in the mid-term. The timing of this upgrade is a key and focal element and depends on many factors. Therefore, it should be encouraged by regulators but not mandated as this could distort the market.

The GSMA agrees that there is already more than 12 GHz spectrum available for wireless services, however, just counting bandwidth does not distinguish between licensed and license exempt spectrum and does not consider the different capabilities of frequency ranges. When considering the spectrum needs the use case which can be supported by different spectrum ranges need to be included.

5G will further require spectrum in three ranges:

- **Sub 1 GHz:** The UHF 470-960 MHz band is on the agenda for the upcoming WRC-23 conference and any low band is key for the growth of mobile services, not just due to its coverage capacities, but also for its 5G-ready capabilities. It is necessary to create greater equality between urban and rural broadband connectivity and address the digital divide. An opportunity to achieve this goal could be the mobile allocation of 470-694 MHz at WRC-23 which provides Europe with a respective option. To support this the RSPP should be more ambitious to take extended mobile usage in the UHF band into account.
- **Mid band:** We believe that additional spectrum in mid-bands will be required to address 5G consumer take up and usage. The RSPP and spectrum needs opinion should plan for exploring how to meet this growing demand from citizens.

A new report published by Coleago<sup>2</sup> in 2020 on mid-band needs for Europe, shows that 1-2 GHz of additional spectrum will be needed to cater for the continued full 5G (IMT-2020) capabilities for the next 10 years.

In particular, the RSPP should recommend that the future use of the 3.8-4.2 GHz is defined through the usual ETSI-CEPT process and not assumed to be authorised only for verticals' local use by default as proposed via the spectrum needs opinion. Also, the study on the 6 GHz band (6.425-7.125 GHz) must continue towards its availability for 5G, as well as the 2.3 GHz and 4.8-4.99 GHz range.

Spectrum awards should follow the proven and confirmed process of ETSI-CEPT collaboration, starting from the definition of the requirements, followed by a fair assessment of the different options including by accessing coexistence between the different systems and services. The regulation should only define the least technical and regulatory conditions for use and not discriminate the applicants. As a priority, national licences should be explored. Where quasi-national licences are not possible, exclusions zones can be defined in an LSA approach. Ultimately, localised licenses open to all spectrum users can be awarded on a level playfield basis.

- **High bands,** also known as mmW bands: Member states should plan to award all 3.25 GHz of spectrum in the 26 GHz band, with a clear roadmap for making it available, in

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<sup>1</sup> [https://ec.europa.eu/commission/presscorner/detail/en/IP\\_21\\_983](https://ec.europa.eu/commission/presscorner/detail/en/IP_21_983)

<sup>2</sup> <http://www.coleago.com/app/uploads/2021/01/Demand-for-IMT-spectrum-Coleago-14-Dec-2020.pdf>

order to allow up to 800 MHz contiguous spectrum per operator and the competitive provision of a meaningful 5G experience. Other bands, such as 28 GHz, 40 GHz, 50 GHz and 66-71 GHz should also be considered.

A very important element in proving mobile broadband services to European citizen is a respective environment for wireless backhaul solutions, whereas current backhaul bands will still play an important role but need support to maintain relevance in the 5G era – especially through wider channel sizes. In addition, new backhaul bands are needed to support evolving network requirements and growing traffic. The RSPG should support a timely availability of a sufficient amount of affordable backhaul spectrum under reasonable licensing approaches, terms and conditions.

#### **4. Innovative wireless services**

European Commission and Member States should actively ensure that further spectrum for 5G and beyond is made available in sufficient contiguous blocks to guarantee that mobile operators can meet the consumer's expectation, broadband national requirements as well as the definition of performance set out by the ITU.

#### **5. UAS/drones**

The GSMA supports the RSPG position when it says that the European Commission and Member States should support the development of UAS/drones within relevant harmonised ECS bands.

#### **6. Sector spectrum needs in response to combat climate change**

The mobile sector is taking collaborative action to be fully transparent about the industry's own climate emissions and have developed an industry-wide climate action roadmap, to achieve net-zero greenhouse gas (GHG) emissions by 2050, in line with the Paris Agreement. More than 60 mobile operators – which together account for 70% of mobile connections globally – are now disclosing their climate impacts, energy and GHG emissions via the internationally recognised [CDP global disclosure system](#). Moreover, 29 operator groups representing 30 per cent of global mobile connections have committed to setting Science-Based Targets as a part of a sector-specific decarbonisation pathway that allows ICT companies to set targets in line with the latest climate science. This move will enable full transparency for investors and customers involved in the mobile sector.

In general, efficient spectrum policy supports climate goals. By ensuring availability of sufficient spectrum resources and avoiding unnecessary deployment limitations and requirements, spectrum regulators can reduce climate impacts:

- Availability of sufficient spectrum resources decreases the number of mobile sites needed, leading to smaller energy consumption, network duplication and smaller number of network equipment. Smaller number of network equipment leads to lower emissions caused by manufacturing.
- Availability of < 1GHz spectrum resources decrease the number of macro sites needed, leading to lower energy consumption, and less network equipment.
- Availability of spectrum for 5G enables operators to develop and offer network solutions needed for IoT and big data. These solutions enable new energy efficient and environmental solutions across several sectors, transport, manufacturing, agriculture, building and energy.

- Large contiguous spectrum blocks, potentially in fewer bands, are more efficient to deploy, leading to lower energy consumption, and less network equipment. This should be taken into account when studying new spectrum bands for IMT and when preparing for awards. Fragmenting spectrum bands e.g. with set-asides may not be climate friendly.
- Allowing operators to switch-off older mobile technologies (2G/3G) leads to less, more efficient, network equipment, enables more efficient spectrum use with newer technology, and thus smaller energy consumption.
- Allowing operators to deploy shared networks, leads to smaller number of network equipment.
- Avoiding unnecessary deployment limitations (e.g. unnecessary restrictions to transmission power, stricter EMF limits than recommended by ICNIRP) leads to smaller number of network equipment, and enables energy savings.
- Avoiding excess coverage and data speed obligations, enables optimizing network operations, energy consumption, and number of network equipment based on actual and timely demands.

## **7. Spectrum governance**

- **EC-CEPT cooperation**

The GSMA recognises that the existing cooperation between CEPT and EC is key to support EU policies and delivers excellent results. GSMA agrees that there is no need to set dates for coordinated spectrum awards, however, the coordination of dates for spectrum availability could be a useful element to allow for early deployment of new innovative wireless services.

- **National coordination/European Coordination/Negotiations with other countries**

The GSMA recognises that the sub group of the RSPG namely the good offices provides useful assistance to bilateral negotiations between Member states. We invite the European Commission and Member state to continue the engagement at RSPG and sub group levels with the industry. We also recognise the facilitator's role in the international negotiations with non-EU countries and the good results it provided.

Furthermore, GSMA recognizes that mobile operators as key stakeholders in mobile awards, have no possibility to challenge the national award decisions in the European process. We request better possibilities and clearer process for providing valuable inputs and raising concerns in EU-level.

- **Standardisation and spectrum governance**

For coexistence and sharing to be successfully in the same or adjacent band, high-performance transmitter and receiver specifications and the inclusion of appropriate essential requirements and test specifications for all equipment in harmonised standards are required. In this respect all receivers belonging to different services should be addressed.



Furthermore, the GSMA recognizes that mobile operators as key stakeholders in mobile awards, have no possibility to challenge the national award decisions in the European process. Thus, MNOs should have the possibility to attend and contribute to the peer review process and to provide valuable inputs. The EC should have a clearer role by facilitating the peer review process, and there should be real possibilities to address concerns in the award design, including license obligations, already before the awards to guarantee legal certainty. Moreover, in line with the European framework, there should be possibilities to foster the independence of National Competent Authorities. Additionally, the peer review reports should publish a summary of the discussions, reflecting all supportive and critical voices. A more open and transparent peer review process would help adopting the best practises in use throughout Europe and would focus spectrum awards on common EU digital goals, avoiding bias of short term national political agendas.

Technologies must be able to be adapted to increase protections from other services but also ensure spectrum efficiency. The review of these performances may need to reflect the usage and therefore be longer than others but timescales for review be automatic.

At the same time, any standards should not harm or make the telecommunication services unviable. In case regulatory conditions are included in harmonised standards they should remain least restrictive. Locally needed regulatory restrictions should not be enlarged to all equipment. Proper realistic ex-post / reactive actions are generally more appropriate than setting conservative non-achievable limits.

- **International negotiations at World Radiocommunication Conferences**

The cooperation between RSPG and EC regarding the preparation of WRC can promote harmonisation and, therefore, help building a broad ecosystem that leads to better worldwide connectivity, lower prices for networks and handsets, as well as better services.

## **8. Other policy areas with spectrum dimension**

- **Migrating regulatory service obligations to the latest technologies<sup>1</sup>**

Mobile operators worldwide are exploring opportunities to deploy 4G and 5G technologies by re-using spectrum currently supporting 2G and 3G services. The payoff from network rationalisation includes improved capacity, data speeds and broadband coverage.

For mobile operators around the world, it should be a voluntary opportunity to progressively reduce the extra cost of running multiple networks, if that is the reality for them, not as an obligation.

However, thanks to the potential for improved capacity, data speeds and broadband coverage, consumers and businesses also stand to gain. As a result, mobile operators can develop more innovative services based on 4G and, when the time is right, 5G.

Network rationalisation could be delayed by obligations to support legacy end user equipment (ie, e-call). GSMA encourages RSGP members to incentivise end users to migrate to the latest

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<sup>1</sup> <https://www.gsma.com/spectrum/resources/legacy-mobile-network-rationalisation/>

technologies, as an alternative to imposing obligations that ultimately result in inefficient networks and spectrum use.

Network rationalisation lessons learned include:

- Operators typically initiate legacy shutdown plans and usually switch off at different times depending on their user base;
- Which technology to retire depends on specific market circumstances and potential obligations;
- The full process generally carries a transitional period lasting for years, with preparations commencing earlier than formal public announcements;
- A reasonable formal notice period commonly comes along with a well-designed campaign targeting affected customers, possibly assisted by the regulator;
- Switch-off process may include upgrade incentives for long tail customers, with comparably priced plans, and handset recycling initiatives.
- Technology neutral legislation of non-telecommunications industries related to mobile services such as eCall is necessary to avoid artificially extended lifetime of legacy technologies.

- **Green New Deal / Climate change**

In general, efficient spectrum policy supports climate goals. Availability of sufficient spectrum resources and avoiding unnecessary deployment limitations and requirements, spectrum regulators can reduce climate impacts:

- Availability of sufficient spectrum resources decreases the number of mobile sites needed, leading to smaller energy consumption, and smaller number of network equipment. Smaller number of network equipment leads to lower emissions caused by manufacturing.
- Availability of < 1GHz spectrum resources decrease the number of macro sites needed, leading to smaller energy consumption, and smaller number of network equipment.
- Availability of spectrum for 5G enables operators to develop and offer network solutions needed for IoT and big data. These solutions enable new energy efficient and environmental solutions across several sectors, transport, manufacturing, agriculture, building and energy.
- Large contiguous spectrum blocks, potentially in fewer bands, are more efficient to deploy, leading to smaller energy consumption, and smaller number of network equipment. This should be taken into account when studying new spectrum bands for IMT and when preparing for awards. Fragmenting spectrum bands e.g. with set-asides may not be climate friendly.
- Allowing operators to switch-off older mobile technologies (2G/3G) leads to smaller amount of network equipment, enables more efficient spectrum use with newer technology, and thus smaller energy consumption.

- Allowing operators to deploy shared networks, leads to smaller number of network equipment.
- Avoiding unnecessary deployment limitations (e.g. unnecessary restrictions to transmission power, stricter EMF limits than recommended by ICNIRP) leads to smaller number of network equipment, and enables energy savings.
- Avoiding excess coverage and data speed obligations, enables optimizing network operations, energy consumption, and number of network equipment based on actual and timely demands.

- **Electromagnetic fields, EMF<sup>1</sup>**

Spectrum regulators should avoid unnecessary deployment limitations (e.g. unnecessary restrictions to transmission power, stricter EMF limits than recommended by ICNIRP) to allow for smaller number of network equipment, and enable energy savings.

We support the exchange of information and best practices between Member States to contribute to a better understanding by the public of these issues and promote transparency with regard to 5G technology.

Government policies for electromagnetic fields should be evidence-based, harmonised internationally and draw on the recommendations by expert bodies such as the World Health Organization (WHO) and the International Telecommunication Union (ITU).

Both these organisations recommend the human exposure guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP guidelines are designed to provide protection to all people (including children) against all established health hazards.

Compliance standards describe the methods used to determine that exposures from wireless network antennas or mobile devices are less than the recommended exposure limits. The international compliance standards for base stations and mobile phones are IEC62232 and IEC62209, respectively.

Also, the radio signals used by mobile technologies are extensively researched and have been for decades. The frequencies used for mobile operators comply with national or international EMF exposure guidelines, which cover all frequencies currently used by 5G and under consideration for 5G.

The 1998 International Commission for Non-Ionizing Radiation Protection (ICNIRP) guidelines form the basis of regulatory limits for mobile network antennas and devices in most parts of the world and are supported by the World Health Organisation. In March 2020, the 1998 ICNIRP guidelines were updated. The updated guidelines cover all frequencies used for mobile communications, including the frequencies used for 5G.

EMF-exposure limits and compliance control are important determinants of deployment costs and timings. Most Member States apply the ICNIRP Guidelines according to the Council Recommendation 1999/519/EC. In those few Member States where limits are more restrictive

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<sup>1</sup> <https://www.gsma.com/publicpolicy/emf-and-health>

there are not only delays in delivery to customers of the many benefits of 5G, but also greater anxiety from citizens about 5G. Additionally, lower exposure limits mean that operators are less able to share sites and have to build more sites to achieve the same network capacity, with higher costs, increased energy use and more visual impact. Restrictive limits can also affect the quality of service available to consumers and, in particular, the quality of indoor coverage. We therefore encourage Member States to adopt EMF-exposure limits in line with the ICNIRP Guidelines.

In operation the EMF exposure due to mobile network base stations varies with technology (for example, duty cycle) and in response to changes in traffic and is a function of the antenna beam gain in the direction of the assessment location, whether fixed or variable (for example, MIMO). However, some national authorities have based assessments on theoretical output powers or site configurations that are not achieved in practice. This is inaccurate and overestimates the size of EMF compliance zones. An alternative approach is described in IEC TR62669 whereby assessment of compliance based on the actual maximum time-averaged transmitted power or EIRP. This approach is being further developed in the draft IEC 62232 edition 3.

Theoretical studies demonstrate that 5G networks using adaptive antenna systems do not transmit at their theoretical maximum power and that beam steering reduces the time averaged actual exposure. In France, ANFR has made allowance for the influence of TDD and beam steering in the methods for determining RF-EMF compliance for 5G sites and for the estimation of exposure in nearby areas.

We encourage Member States to use measurement procedures based on the international technical standard (IEC 62232) so that information can be shared and pooled in a consistent way.

## **9. Pandemic response<sup>1</sup>**

In the wake of the social restrictions in place to help manage the threat of COVID-19, billions of people worldwide are relying on mobile access as family interactions, socialising and work activities move online. While the world shuts down normal activities to limit the spread of COVID-19, schools, businesses and day-to-day interactions continue to move from face-to-face to the internet. Mobile broadband, fixed wireless connections and mobile apps have become the main tools to remain operational and in contact with medical professionals, work colleagues and loved ones. We are witnessing surges across mobile voice, text and data services in both download and upload streams, as a result of changing user demands due to this extraordinary situation.

In response to the COVID-19 pandemic, a large number of countries have declared and implemented a state of emergency. During such an unprecedented situation, mobile operators have been working closely with governments to support the management of the crisis through the provision of mobile services to the public and government. Spectrum resources made available by some governments during the crisis can contribute to the optimisation of mobile network infrastructure in order to better serve the needs of communities and public services.

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<sup>1</sup> <https://www.gsma.com/newsroom/blog/keeping-everyone-and-everything-connected-how-temporary-access-to-spectrum-can-ease-congestion-during-the-covid-19-crisis/>

Some mechanisms that are being implemented are:

- Providing short-term/emergency spectrum licences to MNOs to access any portions of unallocated spectrum, renewable depending on national requirements
- Expediting the issue of short-term/trial licences to MNOs where new technologies may enable operators to assist on delivering or augmenting connectivity and deploying services on an ad-hoc basis
- Facilitating and expediting access to backhaul spectrum
- Extending deadlines for any ongoing transitions or renewals for licensees providing high-speed broadband and other critical services
- Removing red tape and restrictions on ways to immediately access more spectrum, including spectrum sharing