Your response

Question	Your response
Question 1: Do you have comments on the overall approach to the review?	Confidential? – N The Advisory Committee Wales welcomes this timely review into the future of spectrum management. Spectrum is crucial to the citizens of Wales given their increasing reliance on it, and related technologies, to go about their daily lives. It is also crucial to the businesses of Wales using a range of emerging technologies to innovate in a number of important sectors and who consider wireless connectivity to be an important complementary technology. Whilst we agree with the overall approach and that the efficient use of spectrum is important, given the finite availability of spectrum, this should not be the only goal. Effective use of spectrum for the citizens, organisations and businesses here is as an important principle too. Spectrum can be used efficiently by a range of (technical and economic) measures, but not be effectively used from the perspective of the user. In particular, for those groups whose needs do not readily meet spectrum efficiency-based criteria, e.g. rural communities. We will illustrate this point in our response, and it is an issue we will explore further as a committee in our work. We would also like to make a comment on our approach to this consultation. Whilst there are numerous types of spectrum use, as described in the consultation, we have out of necessity and priority largely focussed on the mobile and wireless broadband uses of spectrum. This is not because the other uses are unimportant, they are. It is because the opportunities to address key connectivity, social and economic challenges are significantly greater for citizens, organisations and business in Wales who use spectrum for these purposes. Indeed, they are of national importance.

Question 2: Have we captured the major trends that are likely to impact spectrum management over the next ten years?	We agree that the two major trends identified are likely to be very important to how spectrum should be managed here in Wales. In particular, from our work, we can see the diffusion of wireless capabilities into many new sectors, from agriculture to health here in Wales and that numerous innovations based on "Internet of Things" concepts are common. Such developments, where spectrum-based services are integral to new innovations, is important to businesses in Wales and therefore their availability, particularly in rural areas. The next 10 years is unlikely to be solely about coverage for mobile broadband but rather the underpinning of national[1] [2] and rural innovation capabilities in key sectors, e.g. agriculture, energy and transport. High frequency spectrum is expected to remain important. For both traditional backhaul as well as the delivery of higher speeds for new fixed wireless applications. These innovations are being developed here or innovations that are likely to include technologies are being developed here in Wales where access to these bands are necessary to the innovators success, e.g. 5G, 28 GHz band and similar services. We would include three further major trends that we have encountered. Firstly, that the reliance placed upon services using spectrum by the citizens, organisations, communities and businesses of Wales will only continue to increase. Clearly the move home arising from the coronavirus raised awareness of the reliance on domestic connectivity. In some instances, the reliance is likely to be long-term and place high demands on wireless network performance, for example high bandwidth, low latency applications for higher education students at home. For businesses, readily available, flexible, low-cost access to whichever spectrum band and related capabilities is seen as a means of reducing the risks of innovation. Spectrum management has important consequences for all, but it can seem

[1] https://gov.wales/innovation-wales-strategy
[2] https://gov.wales/digital-wales-strategy

	like a very technical and abstract concept. This should not be the case as the 2020s is likely to demonstrate that, as never before, spectrum-based services will increasingly be embedded in everyday routines of the people and businesses in Wales. This reliance needs to be at the heart of spectrum management. Secondly, awareness, interest and understanding of the implications and potential role of spectrum reliant capabilities and services exists in key areas of Wales' economy. From higher education to microbusinesses. Whilst better rural access in Wales is a well understood trend, this increasing awareness and understanding in multiple new sectors and industries needs to remain a focus of spectrum management. For example, developments such as TV White Space and The Things Network and LoRaWAN have raised awareness of the potential of wireless and innovative uses of spectrum bands in the provision of innovative connectivity alternatives and new services in Wales. This awareness, interest and understanding is creating new expectations and requirements of spectrum management, e.g. greater flexibility, capability and engagement. Thirdly, there is a role for spectrum management to support efficienct use of spectrum in the reduction of the wireless markets energy / carbon footprint in Wales and the UK. Given the expectation that data throughput rates and the number of connected devices will increase significantly in this period it is likely without other mitigations that the overall energy footprint of spectrum delivered services will increase. Spectrum management will need to consider how it addresses the carbon emission per bit of throughput in its authorisation in the 2020s given UK and Welsh Government carbon reduction targets[3] [4].
Question 3: Could any of the future technologies we have identified in Annex 6, or any others, have disruptive implications for	We can see the disruptive potential of all the named technologies in Wales. These technologies are likely to have both implications for spectrum management,

[3] https://gov.wales/prosperity-all-climate-conscious-wales

[4] https://www.theccc.org.uk/publication/the-path-to-net-zero-and-progress-reducing-emissions-in-wales/

how spectrum is managed in the future? When might those implications emerge?	directly in how they enable new means of management, and indirectly, creating new disruptive innovative applications which place new demands upon spectrum management. Our research suggests the latter is likely to be application specific. For both, it is difficult to forecast the future expectation of precisely when these technologies are likely to be disruptive in different markets and sectors. However, the views here suggest that these innovations are largely at a conceptual or early stage. A common direct example we have encountered has been the use of AI and blockchain in enabling automated spectrum management. Specifically, these included opportunities to make spectrum available to innovators on a real-time, pay-as-you-use basis for new applications, reducing cost and risk in trialling and development. Rather than say when this is likely, we would observe that expectations are high that this will happen in this time frame. An example of the application of emerging technologies placing new demands on spectrum management are electric vehicles (EVs). The expectation here is that they will increasingly become data analytic devices that will place new demands upon how spectrum supports them. For example, data intensive EVs could communicate between themselves without relying on a cellular network, as is likely to be the case in rural locations and for rural applications of EVs. However, in some applications, particularly data heavy ones where processing will most likely occur in the core and not at the edge, e.g. agri-tech, the was not seen as significant to spectrum management other than the provision of access. This idea was developed further in an expectation of spectrum management having a role in managing how applications use spectrum, not only for spectral efficiency and energy/carbon efficiency as described above, but also in order to be ‘data efficient’, i.e. that only data that needs to be sent is being sent.

Question 4: Do you agree that there is likely to be greater demand for local access to spectrum in the future? Do you agree with our proposal to consider further options for localised spectrum access when authorising new access to spectrum?	Yes, in Wales there is likely to be a growing demand, particularly in rural and other geographic locations that are difficult to reach with current wireless network business models. We agree that a 'one-size-fits-all' approach where geographic size of these types of licence will not work (para 4.36), indeed we think that this should include not just the size of licence but the size of licence 'bundles' that can be supported. We note the specific reference for local access to 'mobile services' in the consultation [Table 2]. For the avoidance of doubt the proposals for local access need to specifically include fixed broadband / fixed wireless access as well (as referenced in para 4.31 bullet 2). Ofcom has made shared access and local access licences available in a number of bands[5] and we expect demand to require a continuation of this policy area and welcome the Innovative ways of licensing – bundles of 'local access' licences in specific geographic locations that make new business models economic and reduce risk for new entrants are one potential way to make FWA provision work in rural Wales. We intend to explore and monitor this in our future work as a committee. A very specific example of demand for local access in an appropriate wider geographic location in Mid Wales is the proposed National Spectrum Centre[6]. We see new licencing options that enables Wales to make use of its radio spectrum in new ways, enabling research and economic development, to be particularly advantageous. The importance of Fixed Wireless Access [FWA] to the provision of broadband to rural areas of Wales has previously been highlighted by the ACW and recently by the NICfW[7]. Creating conditions for new, low-cost consumer devices and network technologies developed by a wider range of organisations (paragraphs 4.43 – 4.52) is central to the success of FWA. We note

[5] https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/shared-access
[6] https://www.aber.ac.uk/en/news/archive/2020/11/title-238043-en.html
[7] https://gov.wales/digital-communications-infrastructure-wales-report

	the T-Mobile USA ongoing roll out of FWA and how it addresses the well understood challenges of CPE installation, management and quality of service (consistency of access, capacity and speed) that support a viable FWA service provider business model that have been understood since Ionica. We support proposals that specifically encourage the entry of new services, new business models and service providers for FWA, e.g. current network operators and Alt Nets, as well as communities themselves to building their local own FWA services if they need to.
Question 5: Do you agree with the actual and perceived barriers identified for innovation in new wireless technologies, and our proposed ways of tackling those?	We agree with the observation in S4.45 that "barriers may exist, or be perceived to exist, for smaller players". In particular, we agree with the increasing scope (S4.44) for a growing range of devices used by microbusiness and SMEs using low power and low data rates as they can currently access exempt bands. However, we also see higher power, longer range applications developing e.g. based on drones. In some instances, we have encountered barriers or perceived barriers to innovation (S4.45) and that to address these the breadth of potential use cases needs to be considered when developing co-existence conditions or equipment standards (S4.50). Whilst we agree with the proposal to support smaller players and start-ups (S4.49) with innovation and development of new products through international standardisation and awareness, we would suggest greater engagement with this community is also important. Early-stage start-ups and microbusinesses undertaking development are often highly knowledgeable about their specific device requirements, but often seem to be lacking in awareness of appropriate bands to use and / or perceive flexibility of licensing to be low. We think greater engagement, support and information would help resolve this. It is also important for Ofcom to examine not just licence exemption to help smaller business innovate but to enable co-existence and access to spectrum that supports the innovation they are developing, e.g. telemetry and drones, and which readily has low cost network equipment and devices available. We suggest that more outreach by Ofcom is needed at an appropriate

	technical level with the specific aim to engage and support each innovator. We also agree with international standardisation work which enables network equipment and CPE to be developed for rural FWA use and through this standardisation. We see this work as enabling new business models, reducing costs are reduced and the viability of business models for the rural provision of FWA is improved. Encouraging new market entrants[8], especially in rural locations in Wales. A specific example relates to the development of key underlying technologies for wireless communications above 3 GHz, which requires RF systems based on compound semiconductors – an area of particular strength in South Wales. Greater engagement and co-ordination of the specific bands being proposed through international standards will enable the Welsh compound semiconductor industry to align their R&D activities to address large global markets for these technologies. This will contribute to the development of a diverse telecoms supply chain both in Wales and across the UK. At the other end of the development process, in the shared access spectrum analysis states that chipsets, base station and devices are known to be available. However, small businesses and communities looking to use spectrum here in Wales need off-the-shelf equipment to be available in order to lower the cost and risk of new business models, encouraging new entrants. Whilst chipsets, base stations and devices may exist in some bands it is not yet the case across all relevant bands. We would also extend the observations and proposals in S4.43 – 4.52 to also include higher education institutions, including those departments dependent upon these technologies. After the coronavirus lockdown these institutions are likely to need to innovate with wireless based networks and services to meet new needs, and to meet the expectations of the next generation of engineers and

[8] https://www.gov.uk/government/publications/telecoms-supply-chain-review-terms-of-reference

	developers who will develop and deliver the technologies covered by this consultation.
Question 6: Do you agree with Ofcom's proposals to improve our outreach and reporting activities, and spectrum information tools? • **Are there additional ways that Ofcom could better engage with existing and future users and providers of wireless communications?** • **Please explain any specific areas where you believe more or better provision of information could provide value to stakeholders**	Yes, as observed in our response to Q1 and Q5 we agree with Ofcom's proposals, in particular regarding start-ups, micro- and small business and rural communities based here in Wales. We fully support Ofcom's ongoing efforts to engage with the private and public sector on the subject of spectrum licensing and innovation. And the observation through engagement already undertaken that "spectrum needs to be authorised in a range of different ways". From our comments above we see the need for this will only continue and diversify here in Wales. Spectrum management is seen as highly technical and conceptual, even by individuals and organisations working in the sector. We observe that there is a gap between the importance of spectrum and the level of understanding and engagement, despite Ofcom's many spectrum information sources (S5.28), engagement work and the recent innovative licencing of bands. For example, we note the example given in the consultation of the shared access to specific spectrum bands, which we wholeheartedly support. However, we have not seen significant take-up in Wales as commented above. Hence our support for the proposals in paragraphs 4.36 – 4.42. But we think this has to be supported by targeted information, outreach and engagement to those individuals and communities who can best exploit them. In particular, we think the spectrum management information provided needs to address the barriers to understanding. We think new areas of the Ofcom spectrum management website could address the technical complexity of the subject and include language that is more accessible and raises awareness. We have found it hard to engage some stakeholders with this consultation despite its strategic importance, because of how technical it sounds. We agree wholeheartedly with Ofcom's proposals [paras 5.30 – 5.43] - "Expanding our work to understand assist and inform"

	stakeholders in Wales who will benefit from wireless technologies in the future, but also existing and new spectrum licensing. We also think this should include engagement with stakeholders who are developing and innovative uses for wireless devices in Wales, e.g. Agri-tech, drones. We also understand that greater engagement on standardisation and trialling licences with the players in the telecoms equipment supply chain here in Wales would also be welcomed. We therefore support the provision of an expanded programme of activities to increase the diversity of needs, engage with, assist and support stakeholders with their activities, whether it is a community looking to install fixed wireless project or a drone-based telemetry product. This is an aspect of spectrum management we hope to continue to monitor and explore.
Question 7: Do you agree that it is important to make more spectrum available for innovation before its long-term use is certain? Do you have any comments about our proposed approach to doing this?	We fully agree that the wireless innovations and an increasing diversity of uses can come from a wider range of individuals, communities, businesses and institutions than ever here in Wales and elsewhere in the UK. We cannot know who the successful innovators will be. We agree that the gains made from the existing uses of wireless spectrum need to be preserved. We also agree that the incentives to invest in commercial services or use spectrum for scientific other critical purposes. However, this cannot be at the expense of new innovative uses, and in particular this cannot be at the expense of individuals and communities who could benefit from the proposals to enable a market for, or where necessary by alternative means, the provision of fixed wireless broadband services to rural communities. Flexibility stood at the heart of the much of what stakeholders had to say to us about the future of spectrum management. We agree that the principle of flexibility needs to be central to how Ofcom manages spectrum and supports the use of and the innovation that relies upon spectrum here in Wales. We think that flexibility will underpin the effective use of spectrum, in balance with

	efficient use, as described above. The take-up of spectrum by pioneers to explore new spectrum uses long before they are known is one measure of the successful, flexible and effective management of spectrum.
Question 8: Do you agree that it is important to encourage spectrum users to be 'good neighbours' to ensure more efficient use of the spectrum? Do you agree with our proposals to: **a) increase realism in coexistence analysis at a national and international level?** **b) encourage spectrum users to be more resilient to interference?** **c) ensure an efficient balance between the level of interference protection given to one service and the flexibility for others to transmit?** **Do you have any comments on which of these will be the most important?**	Yes, we agree that what has been achieved and delivered to date through the efficient use of spectrum needs to be maintained. However, spectrum use is not yet 'effective' for all citizens, communities or businesses in Wales. Whilst initiatives such as the Shared Rural Network, TV White Space trials and others are addressing some challenges, we agree that a balance has to be struck to deliver effective use of spectrum and that efficiency as a priority cannot be achieved at the cost of connectivity for all and increased innovation. Demand for bandwidth being greater than supply of spectrum is not the case across the whole of Wales [para 7.21- 7.22]. Situations where supply is limited, and spectrum has not been fully used need to have the same emphasis in these proposals in order to achieve effective and efficient use of spectrum as proposals relating to shared use and interference. We consider it important for management tools or concepts to be developed to ensure that future licences enable spectrum to not remain underutilised in locations and new entrants with new innovative business models to enter. Given the examples and needs we have encountered in Wales, we would say that a) and b) are most likely to encourage the solutions to rural connectivity challenges and in addition c) is important to enable the sort of early-stage development work of new applications of wireless connectivity. Many of the examples given in the answers to previous questions, and others we have encountered, will rely on these being implemented promptly and effectively.
Question 9: Are there any other issues or potential future challenges that should be considered as part of this strategy?	Confidential? – N None

Question 10: Do you agree that continued use of our existing spectrum management tools (as set out in sections 4-7) will be relevant and important for promoting our objectives in the future, in light of future trends?	Confidential? – N Yes
Question 11: Is there anything else we should be considering doing, or doing differently, to promote our objectives?	In summary we fully support Ofcom's review of its strategic approach to the management of spectrum in Wales in the 2020s. Spectrum is a vital piece of 'soft' critical national infrastructure of Wales and the UK. The additions we would make to Ofcom's approach are: 1. **Flexible Access to 'Innovation Spectrum'**: There is an increasing demand from innovators in Wales for access to spectrum that suits the needs of the innovation they are working on, rather than spectrum supporting a specific set of point solutions, as has been traditional. This is further complicated by the integration with other emerging technologies e.g. drones and compound semiconductors 2. **Flexibility of spectrum management**: As already described, this is seen by many stakeholders as a key outcome of this strategy. This is especially true for innovators who are working on the many applications of "Internet of Things" here in Wales. Automated spectrum management and similar tools can provide flexible and real-time access and are potentially an important part of the answer. 3. **Raising Awareness and Understanding**: Finally, spectrum users understanding and awareness of the need for access to and consistency of wireless services will likely develop beyond access (i.e. coverage) in the 2020s and is a challenge that this spectrum management strategy needs to address. The consistency of data rate (throughput) experienced in urban and rural areas in Wales is already a growing issue, requiring sufficient bandwidth and power to meet demand. In the future other parameters (e.g. latency) are likely

	to be as important. As coverage has been a challenge in rural areas, the challenge will be providing a consistent broader set of service parameters over the next 10 years as new service developments make them increasingly important. We see flexibility and effectiveness in spectrum management, balanced with efficiency, as a key part of the answer.

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