About DTG

The DTG is the UK's unique not-for-profit collaboration centre that makes digital TV work. It brings together key players from across industries to achieve tried and tested interoperability- and deliver a seamless viewer experience. It works with members and industry to create a great television experience now and into the future. It underpins the free-to-air platforms Freeview, Freesat and YouView, and supporting the development of Sky, Virgin Media, BT and TalkTalk. It has been central to the distribution of TV in the UK for over two decades through the collaborative development of industry standards and best practice, and is currently embracing the convergence of content and networks across industries to focus on the efficient delivery of video to all screens - mobile, tablet and TV - in all formats: standard, high and ultra-high definitions.

The DTG supports the next generation of digital TV and related technologies through its work in the delivery of video to mobile devices, television on tablets, spectrum coexistence management, TV white space, in-home connectivity, cyber security, connected TV, accessibility and the UK UHD Forum. For more details, please visit dtg.org.uk and dtgtesting.com.

DTG's membership is uniquely drawn from the entire television ecosystem. Therefore, this submission has been written to reflect the diversity of views using feedback from the DTG's membership and as such raises areas for consideration but does not necessarily represent the views of all DTG member organisations. The DTG is made up of member companies who may also be submitting an individual response.

Responses to consultation questions

Question 1

Do you have comments on the overall approach to the review?

The DTG membership supports Ofcom's spectrum management vision which builds on the positions taken by the regulator over the recent years. We believe that the overall approach to the review is sound and we welcome periodic assessments of the way spectrum is used to inform future spectrum policy decisions.

We also support Ofcom's view that in some cases it is not possible to forecast accurately the way spectrum will be used in the future. In those cases, it becomes more useful to identify potential technology developments which might influence the way spectrum could be managed and establish flexible regulatory frameworks that can accommodate future uses.

We are pleased to see Ofcom efforts to balance current and future uses, and the document demonstrates that the regulator is exploring all options. Indeed, the report "Technology Futures" clearly shows the depth of Ofcom's analysis.

In Ofcom's work we recognise an acknowledgement of the importance of having a mix of technologies to deliver on the spectrum demands of the future.

Lastly, we are pleased to see the numerous mentions throughout the document to international organizations, such as the ITU, CEPT and ETSI. Indeed, we believe in the importance in having as many of the national policy decisions aligned internationally as it will enable larger markets for businesses.

Question 2

Have we captured the major trends that are likely to impact spectrum management over the next ten years?

We believe that Ofcom's work in identifying the major trends that are likely to impact spectrum management in the future is helpful and that the "Technology Futures" report is a useful companion to the analysis presented in this consultation document.

We also observe that whilst the increased focus on low-power communications is expected to provide a number of benefits, including an overall reduction of energy consumption, there are trade-offs to be considered. Reduction of energy consumption is only one of the factors to measure the environmental impact of a connectivity solution, which also include (among many others) the transmission/network topology and the lifespan of equipment (device obsolescence).

For example, when looking at reducing environmental impact holistically, the way TV content is currently broadcast (through DTT and satellite technologies) is very efficient and the lifespan of transmitters and receivers is much longer than for other IP-based solutions. Future spectrum management policies should account for wider environmental considerations.

It is also important to recognise that the majority of the services using spectrum today will still be available in the short-medium term. Whilst new technologies and new services would benefit from more flexible policy frameworks, it is important to ensure that services that today have a fundamental role in the UK society are safeguarded for as long as they are required.

Question 3

Could any of the future technologies we have identified in Annex 6, or any others, have disruptive implications for how spectrum is managed in the future? When might those implications emerge?

We have consulted with our members on the potential opportunities and impact that the technologies identified in Annex 6 could have on spectrum. Below we report some key considerations for each of the technologies.

Artificial Intelligence / Machine Learning

The expectation is that advanced algorithms will have a growing impact on wireless communications, and directly or indirectly therefore on spectrum management.

For example, machine learning could be used to improve the accuracy of wireless coverage maps. For example, these algorithms can be used to better assess the coverage of mobile services and therefore help to inform the regulator on coverage obligations.

Another example is how these algorithms can enhance the knowledge of receive-only services. We observe that this principle has been already used in the TV Whitespace (TVWS) framework, as the DTT protection datasets provided by Ofcom to the TVWS database operators used a number of techniques to statically assess appropriate protection levels to DTT receivers. The same principle can be applied in other bands, and in more dynamic scenarios too. In such cases, artificial intelligence and machine learning could become very important for advanced spectrum sharing.

Self-configuring networks

We recognise that a fundamental part of self-configuring networks is played by software. As such, it is natural to expect that techniques such as AI and ML will have an increasing importance.

We also would like to mention that some of our members commercially offer Wi-Fi Mesh products with advanced functionalities to provide effective signal coverage at home.

Automated spectrum management tools

These tools have successfully been used in the UHF band to coordinate the access to spectrum for applications such as PMSE and TVWS, and from a policy point of view, there is no reason why they could not be used in other bands too.

For example, we observe that in the U.S. portions of the 6GHz band (U-NII-5 and U-NII-7) use Automatic Frequency Coordinators (AFC) to allow use of standard power Wi-Fi access points. Solutions such as AFC might prove useful to increase the power limits in some bands and therefore enable more use cases.

In general, these tools are useful everywhere there is a partial occupancy of the band. This means that they can be used in support of the Local Access Licences and in IMT identified bands where mobile services would access spectrum on a secondary basis.

Finally, it is worth mentioning that sharing frameworks using automatic tools such as TVWS databases, make the assumption that the primary users do not need awareness of other users in the band as they will be protected at all times. We point out that as technology improves it is likely that primary users will have awareness of other services, and automated tools might make use of this information to further improve (in real time) the efficiency of spectrum use. For example, in the cases where a primary user's occupancy of the band fluctuates during the day, then more spectrum could be made available to other users during the quiet times.

Blockchain

Our membership looks with interest at this technology. However, whilst some spectrum-related applications have been proposed (mainly in academia), all the conditions[1] to make this technology essential do not seem to exist in spectrum management, mainly because the regulator (or a third-party trusted and certified by the regulator) can offer the necessary level of trust.

Terahertz spectrum

None of our members are currently using frequencies above 100 GHz. However, there have been demonstrations of using lasers for satellite connectivity, so there is a cautious expectation that these Terahertz frequencies will become usable in the future.

6G technology

Our members recognise that the requirements for 6G are still in the process of being defined and believe that Ofcom could have a role in raising awareness on the technology.

From a spectrum management point of view, considering that the average lifespan of mobile devices is 2-3 years, it is expected that most of the 6G spectrum would be obtained through refarming the spectrum currently used by 3G, 4G and 5G. Furthermore, the expectation is that 6G devices will be capable of working with both 5G and 6G networks in order to make the transition easier for consumers.

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?

Our members agree that it is expected that the demand for local access to spectrum will increase. We observe that this localised demand will usually foresee the use of 3GPP based equipment, so we expect that mobile bands will accommodate increasing flexibility to meet the growing demand.

During our conversations with the DTG members it was observed that the process for the application to obtain Local Access Licences could be made more automatic and the negotiation more transparent to the applicant. This would ultimately protect all stakeholders.

In the text of the consultation document preceding Question 4 there are some parts that we would like to comment on. In particular, we observe that whilst many of the principles presented in the document can apply to many applications, they do not all apply to all of them, such as TV broadcasting.

[1] Based on Wüst, Karl, and Arthur Gervais. "Do you need a Blockchain?" IACR Cryptology ePrint Archive 2017 (2017): 375.

In Paragraph 4.6 it was said that there is an expectation that certain services such as TV are available to almost everyone wherever they are.

It is worth observing that Public Service Media (PSM) requirements have been developed over many years, often with linear broadcast and fixed reception in mind. Ideally, it would also be possible to meet them across all distribution platforms, including for mobile devices such as smartphones.

However, as of today, DTT coverage reaches 98.5% of UK homes and digital satellite a similar number. Furthermore, people spend around 3 hours a day watching TV in the home and PSM disproportionally attracts non-early technology adopters, such as people with lower income, people with disabilities and the elderly population.

The distribution of broadcast TV is today achieved by different transmission technologies such as DTT and satellite. In the past 10 years, DTG members have significantly helped Ofcom pursuing their goal of increasing efficiency of spectrum. For example, compared to DVB-T, DVB-T2's system spectral efficiency is 40% higher and one third of the spectrum previously used for broadcasting was cleared for mobile use. During this process, PMSE equipment such as wireless microphones have been redesigned through collaboration with manufacturers, studios, and broadcasters to use digital modulation and to operate on multiple bands, making much more efficient use of spectrum.

Furthermore, the DTG has been involved in trials to explore other emerging technologies and architectures, including those that would allow to access to content while mobile.

However, there are a number of considerations that make the membership believe that in the medium term at least, the preferred way to consume TV content will remain in the house:

- The number and diversity of players offering TV content is increasing, and the availability of high and super high-definition content is better consumed on larger monitors.
- The Smart TV market is significantly growing (16.52 % CAGR global according to Mordor Intelligence)
- The average size of TV monitors in the house is increasing[2].
- People currently spend more time online with their wireless device connected via Wi-Fi to a fixed network, than to a public mobile network (Ofcom report, "Mobile Matters" published in November 2020).

The membership observes that DTT is still the largest platform in UK, France, Mediterranean countries and East Europe, and that it is expected to remain the same for some years to come. Similarly, Satellite DTH is the largest TV distribution platform in some countries (e.g. Germany) or an essential platform in many others, which is also due to remain the case for years.

We believe that TV services will move in time towards IP delivery, but there is no firm date for a change, and we expect the change to present some complexity not only from a technical point of view, but from social and economic point of view also.

The above uncertainties (typical of innovation) require time to be properly studied and addressed and the current spectrum will be key to provide broadcasters with the necessarily flexibility to innovate and

[2] Analysing the BARB establishment data (https://www.barb.co.uk/resources/establishment-survey/) over the years we observe that the percentage of UK households with main TV sets with size between 50'' and 59'' has grown from 14% in 2017 to 21% in 2020. Over the same period, the percentage of TV sets with size of at least 60'' has grown from 1.4% to 4%.

potentially execute the technological transitions required without disappointing the expectations of the millions of people watching TV.

In Paragraph 4.16 Ofcom says that the number of connected devices is also increasing. We agree with the statement and observe that in terms of connectivity at home, most of the traffic is and will most likely continue to be carried over licence-exempt spectrum. Indeed, as the use of connected devices in the home grows, the demand for spectrum will increase. We therefore believe that Ofcom should ensure enough licence-exempt spectrum is available to allow the consumer market to grow.

We agree with Ofcom's approach to balance the use of nationwide licences with coverage obligations with the opportunity to enable localised access to spectrum to other users. Indeed, notwithstanding the presumably low number of TVWS deployments to date, the TV white space framework has allowed multiple users to share the band without risk of interference to incumbent users.

We also recognise that there is not a one-size fits-all in issuing licences based on geographic size. In some cases, economic and social dynamics might vary across the country and a flexible spectrum management strategy should build around diversity.

Finally, in Ofcom's proposal it is noted that the strategy does not affect the decisions made in relation to the 700 MHz and 3.6-3.8 GHz bands. Whilst we understand this decision, as there is unlikely to be enough time for a review of the approach before the forthcoming auctions take place, we observe that the approach does not seem to align with the strategy set in this proposal.

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 that licence exemption, whilst supporting innovation, can also pose some barriers in particular cases. For example, very small equipment manufacturers might not have the structure and budget to go through the necessary certification processes. Nevertheless, spectrum harmonization across countries allows economies of scale to be developed where licence exemption can be an incentive to innovation. Indeed, the membership is concerned about of the cost impact of making policies in isolation without a thorough coordination with other countries.

We agree with placing greater emphasis on promoting technology and service neutrality and that flexibility of generic technical conditions can lower barriers to innovation. We also observe that the more generic the technical conditions are, the more difficult it will be to have coexistence rules that allow efficient spectrum sharing. It is therefore important that Ofcom coordinates with other international bodies and the industry to build a reliable and up to date repository of coexistence studies to be referred to when discussing spectrum sharing in any band.

Question 6

Do you agree with Ofcom's proposals to improve our outreach and reporting activities, and spectrum information tools?

a) Are there additional ways that Ofcom could better engage with existing and future users and providers of wireless communications?

b) Please explain any specific areas where you believe more or better provision of information could provide value to stakeholders.

We appreciate Ofcom's engagement with private and public sector organisations in the UK through a series of workshop. Indeed, we believe that these events are especially useful to entities which would otherwise rarely engage with the regulator and other spectrum stakeholders.

We also agree with Ofcom's engagement with funding bodies and venture capital bodies as we recognise that the telecoms market is too often considered difficult to understand by those entities, thus reducing the availability of capital for innovation.

We believe that it would be useful to stakeholders to have access to the information collected by Ofcom's remote spectrum monitoring systems. However, we agree with Ofcom's cautious approach towards sharing some information due to commercial confidentiality and security reasons.

We fully endorse the development of Application Programming Interfaces (APIs) to Ofcom's access spectrum management data.

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?

DTG members are very familiar with the opportunities and challenges of automated spectrum management tools as the TV band has been the first (and currently) only portion of the spectrum with this authorisation system. We believe that in bands with a more developed ecosystem, these tools might prove more successful, although we are mindful that regulatory requirements might directly or indirectly determine the financial sustainability of such tools.

We agree with the principle of making spectrum available for innovation when its future is uncertain. The combination of test & trial licences and light licences can certainly help to provide enough flexibility to foster innovation.

At the same time, we believe it is important to provide assurances for continued access to existing users of spectrum. Indeed, we are concerned about the practical difficulty of allowing new users with not-yet-established demand in a band. In fact, if the demand does not materialise, then it might result in a loss of spectrum efficiency. On the other hand, if the demand grows more than expected, then there might be repercussions on the original users of the band that affect their businesses.

We strongly support Ofcom's approach to promote international harmonisation whilst retaining flexibility where possible. This flexibility will allow Ofcom to open up bands which have not been initially considered internationally or for which national applications are appropriate. The challenge could however be that if the band becomes of great interest and is harmonised internationally, then the operation of the users in the

UK would need to be opportunely safeguarded if the UK regulations considerably diverge from the international approach.

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?

We agree on the importance of ensuring efficient use of spectrum, but we have some reservations about some of the proposals.

Coexistence studies are usually performed in advance to inform how spectrum can be shared among different users. It is often the case that products, if available, have characteristics and performance very close to the ones indicated in the standards. Over time, as technology and products improve, more equipment will likely perform better than what is mandated by the standards.

It is possible to periodically update coexistence studies if it is observed that the UK market is significantly different than the original standards used for the initial coexistence studies. We also observe that in order to be successful, this approach would need to overcome some challenges:

- It would require deep and up-to-date knowledge of the UK market.
- The process of updating coexistence studies requires personnel and budget that Ofcom would have to make periodically available to successfully deliver this operation.
- It would be simpler (although it might take longer) to push for tightening the standard limits rather than periodically evaluating and updating coexistence studies.

We therefore recommend that standards be used as a basis of coexistence studies and that flexibility is offered in implementation.

It is also worth noticing that the EU has established processes to benchmark compliance of products with standards. Where the UK's alignments are close to the EU compliance standards, we encourage Ofcom and the government to adopt them. Indeed, we are concerned about the potential for additional costs and process that divergence might cause to the ecosystem.

We agree that encouraging users to be more resilient to interference is a good principle, and as we have seen with broadcast receivers and PMSE, devices can and have been improved in this regard. We however acknowledge that some applications are more susceptible to interference (such as live video streaming and PMSE or satellite receivers) and that in such cases adopting a "good neighbour approach" entails additional challenges.

Similarly, whilst the use of differential pricing could be interesting, we are worried about the practical impact of this policy would have on the objectives set by Ofcom. Indeed, setting the prices might be quite complex as many factors would need to be taken into consideration and the document does not provide enough information about whether and how this approach could be introduced and applied. We also observe that if differences in pricing are noticeable, this approach might have unexpected consequences on the ecosystem operating in the band. On the other hand, if price differences are too low, then the effect of this measure would disappear. Ultimately, without safeguards for existing users, it could be envisioned a case where a newcomer in the band might pay to obtain more protection than incumbent users have, which would most likely affect the business case and operation of the incumbent users.

Question 9

Are there any other issues or potential future challenges that should be considered as part of this strategy?

In Paragraph 7.17 Ofcom says that "[..] the administrative process for spectrum trades is straightforward".

We observe that one problem with the process to obtain a Local Access Licence is that the prospective applicant does not have a simple way to know whether spectrum is available before sending the application and that the process could be automated.

In addition, some of our DTG membership would like to use this licencing process in IMT bands for shorter periods. For example, in the case of TV production, it would be useful to have a Local Access Licence that lasts a couple of days or weeks instead of the default three years. It appears that the current process does not support this type of application and anyway it is too cumbersome for this purpose. The application takes more time to be processed than this application would permit. Also, as the number of these licences might significantly increase, automation would avoid staffing implications.

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?

The DTG membership agrees with Ofcom. Additionally, we foresee the use of automatic tools for spectrum sharing in various IMT identified bands to become more and more important over time.

Question 11

Is there anything else we should be considering doing, or doing differently, to promote our objectives?

No.