The future role of spectrum sharing for mobile and wireless data services

British Sky Broadcasting Group plc ('Sky') Response

Executive Summary

Like Ofcom, Sky considers that shared spectrum (whether on a licensed, licence-exempt or dynamic access basis) can play an important role in opening up access to greater amounts of spectrum and supporting innovation. Sky strongly supports any move that ensures more efficient use of spectrum, whether through the use of newer, more advanced and efficient technologies, the application of market forces wherever practical or innovative approaches to allocation and access such as spectrum sharing.

Demand for spectrum use will increase exponentially in the short- to medium-term, driven by mobile data, Wi-Fi usage and content consumption. Sky considers that spectrum sharing will play an important part in meeting these demand challenges. But the evidence suggests that a broader reassessment of spectrum usage and allocation is needed in light of the scale of the anticipated demand – not just in the sectors on which Ofcom is consulting (mobile broadband and machine-to-machine). Such an exercise should, for instance, include an evaluation of existing uses of valuable spectrum, with an examination as to whether such services could be delivered more efficiently (either through spectrum sharing or other innovative approaches).

In the short-term, Sky considers that the continued development of Wi-Fi is the single most important aspect that spectrum sharing can further facilitate. In particular, additional licence-exempt spectrum will be crucial to unlocking the significant benefits that continued Wi-Fi growth can bring. We would urge Ofcom to prioritise extending spectrum availability in the 5 GHz band by adding 5350-5470 MHz (120 MHz) and 5850-5925 MHz (75 MHz) to licence-free use. Other bands should also be explored in parallel – Sky considers that 3.4 GHz in particular may have the potential to be utilised for Wi-Fi.

Sky is strongly of the view that the introduction of white space devices will be of great benefit to the UK – not just in the under-utilised UHF spectrum used by DTT, but across many other spectrum bands in the future. Ofcom has an opportunity to make the UK a world leader in this area, influencing the viability of technology on global scale and becoming the country that others look to as an example of progressive, market-led regulation. As such, the TV white spaces project should be seen as an important first step to dynamic spectrum access being extended to other frequencies, starting with those where there is a prospect of international harmonisation in the near future. Indeed, over time, spectrum sharing should become the default policy for spectrum allocation, with a move away from the more traditional practice of allocating particular bands to specific uses.

1 Introduction

1.1 Sky welcomes the opportunity to respond to Ofcom's consultation on the future role of spectrum sharing for mobile and wireless data services published on 9 August 2013 (hereafter "the Consultation").

1.2 Sky is a heavy spectrum user, with activities ranging across many frequency bands. We use spectrum to deliver our services (via satellite, DTT, Wi-Fi and mobile), to create our content (using wireless microphones and cameras) and to connect our customers (through in-home and public Wi-Fi).

1.3 Our varied use of spectrum makes us well placed to appreciate the tensions between competing applications operating in the same bands, and the role that spectrum sharing may be able to play in accommodating these various uses.

1.4 Sky strongly supports any move that ensures more efficient use of spectrum, through (for example) the use of newer more advanced and efficient technologies, the application of market forces wherever practical and innovative approaches to allocation and access such as spectrum sharing.

1.5 Such an approach is consistent with Ofcom's general duties as set out in statute, including securing the optimal use of the spectrum and encouraging investment and innovation. Ofcom recognises that, in performing its role of determining the future use of spectrum (in both the short and long term), it needs to balance competing demands for this scarce resource, and act in a manner that is consistent with its regulatory duties.

1.6 Ofcom's stakeholder engagement on spectrum sharing is therefore well timed given market developments that point to a heightened demand and increased risk of congestion. Like Ofcom, we consider that spectrum shared on licensed, licence-exempt and a dynamic access basis can play an important role in opening up access to greater amounts of spectrum and supporting innovation.

1.7 In our response we focus on three key areas at a high level – anticipated demand for future spectrum; the growing role of Wi-Fi and developments which are required to facilitate this; and the future of white space devices. We provide short answers to selected consultation questions in **Annex A**.

1.8 Sky is also a member of the Dynamic Spectrum Alliance, and supports the submission made by that organisation in response to the Consultation.

1.9 There are a number of parallel spectrum policy processes ongoing at present, both within the UK (where Government is planning to release its UK spectrum strategy in early 2014) and in Europe (where there are proposals for a common approach to spectrum management). Sky would urge Ofcom to actively promote spectrum sharing as an approach in these discussions.

2 Future spectrum requirements

Demand for spectrum use will increase exponentially in the short- to medium-term, driven by mobile data, Wi-Fi usage and content consumption

2.1 The likely growth of mobile data traffic is well documented, with estimates including Ofcom's prediction that mobile data capacity can be expected to experience an 80-300 fold increase

by 2030[1]. Growth is similarly expected in the more immediate term, with Cisco estimating a 66% compound annual growth rate in mobile data between 2012 and 2017[2].

2.2 Forecasts of other metrics also show rapid and substantial growth. For example Cisco projects that by 2017 there will be 19 billion networked devices globally, up from 12 billion in 2012[3]. Other estimates which take into account an 'internet of things' put the figure as high as 100 billion connected devices[4].

2.3 Increased video traffic will be a key driver in this growth. We are already seeing sharp increases in the consumption of AV content on smartphones and tablets, mirrored by significant increases in ownership of these devices[5].

2.4 The European Commission has noted that European Wi-Fi networks already carry up to 20 times more internet data traffic than all cellular networks combined, and that Wi-Fi traffic growth is around 4-6 times that of cellular data growth, with 4 out of 5 new wireless technologies using unlicensed spectrum[6]. In the UK, Wi-Fi carries around 70% of smartphone data traffic, with many MNOs now either pushing data traffic onto third party Wi-Fi networks or deploying their own Wi-Fi networks[7]. Analysys Mason estimate that the proportion of data traffic attributable to Wi-Fi on connected mid-screens (e.g. tablets and e-readers) is around 80%[8].

2.5 It is evident, therefore, that a number of factors are combining to create a high demand for additional spectrum (especially in the heavily congested bands which are licence-exempt), and that appropriate policy responses need to be developed to meet this rising demand.

Approaches to spectrum allocation and access need to be revisited in light of these expected demands

2.6 The economic benefit of serving this demand is significant. In an independent assessment carried out in 2013, Plum Consulting estimated the economic value of selected applications in the EU which utilise spectrum through to 2023. In keeping with the trends outlined above, mobile services were predicted to grow in value by 77% to €477 billion, while Wi-Fi applications would see an explosion in value from €22 billion to €95 billion, an increase of over 300%[9].

2.7 Other estimates are even higher. A joint report by Wik Consult and Aegis for the EC suggested that the savings in network cost of offloading to Wi-Fi would reach €200 billion by 2016, up from €35 billion in 2012[10].

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1 Paragraphs 1.8, 1.10, 'Securing long-term benefits from scarce spectrum resources', Ofcom, March 2012. Available at: http://stakeholders.ofcom.org.uk/binaries/consultations/uhf-strategy/summary/spectrum-condoc.pdf.

2 Cisco Visual Networking Index, 2013. Available at: http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html.

3 *Ibid*

4 See the report by Richard Thanki "The Economic Significance of Licence- Exempt Spectrum to the Future of the Internet", June 2012.

5 Section 1.5, Ofcom 2013 Communications Market Report

6 Presentation by Pearse O'Donohue, Head of Radio Spectrum Policy Unit, DG Infosoc, April 2012. Available at: http://www.cambridgewireless.co.uk/Presentation/CWS-EC_Pearse%20ODonohue.pdf

7 Thanki report

8 Analysys Mason webinar: 'Too little traffic: strategies for MNOs in developed economies facing weakening mobile data demand', October 2012

9 Plum Consulting, 'Valuing the use of spectrum in the EU', April 2013. Available at: http://www.plumconsulting.co.uk/pdfs/Plum_June2013_Economic_Value_of_spectrum_use_in_Europe.pdf

10 European Commission, 'Study on Impact of traffic off-loading and related technological trends on

2.8 It is apparent, therefore, that policymakers should be adopting approaches to spectrum allocation and access that can facilitate the growth of these applications, in order to realise fully the economic and social benefit of such services.

2.9 Sky considers that spectrum sharing will play an important part in meeting these demand challenges. But the evidence suggests that a broader reassessment of spectrum usage and allocation is needed in light of the scale of the anticipated demand – not just in the sectors on which Ofcom is consulting (mobile broadband and machine-to-machine).

2.10 The challenge that is faced is one of an ever-growing demand from a wide range of applications for increasingly scarce spectrum. To meet this challenge, policymakers not only need to look at innovative methods of access such as spectrum sharing, but also more general approaches to allocation and awards. Such an exercise should, for instance, include an evaluation of existing uses of valuable spectrum, with an examination as to whether such services could be delivered more efficiently (either through spectrum sharing or other innovative approaches).

2.11 In the broadcasting sector, for example, there are a number of steps policymakers and industry could take in order to deliver greater efficiency and so free up more valuable UHF spectrum. Spectrum sharing on a geographic basis is already being examined and progressed by Ofcom. But technological developments can provide further efficiencies, be they existing standards used to some extent within DTT such as DVB-T2 MPEG 4, or new delivery mechanisms such as eMBMS that can deliver content on a mobile basis. Similarly, more innovative approaches to network planning such as Single Frequency Networks could be explored as another way of increasing the amount of spectrum available for other purposes. Ofcom should also look to fulfil its duties by incentivise greater efficiency via the prices it sets for DTT spectrum (although the current proposals of cost recovery patently do not achieve this).

2.12 Spectrum sharing as an approach has of course already been implemented successfully for many years across a range of different bands for programme making and special events (PMSE) use. As secondary users in the UHF band, for instance, PMSE users have benefitted from being able to make use of geographically available spectrum at an affordable cost. Sky is acutely aware of the benefits of this approach, as a heavy user of PMSE equipment across all bands.

2.13 In light of squeezes on spectrum that increased demand will bring (and specific Ofcom policies such as the UHF spectrum strategy and MoD spectrum release), Sky considers that in the medium- to long-term more efficient PMSE approaches will need to be developed. There will need to be improvements in the latency and power consumption of digital equipment to allow existing analogue inventories to be replaced by more efficient equipment. In the longer-term, development of cognitive sensing and geo-location technology may facilitate a move towards PMSE being treated as another class of white space device.

2.14 In summary, while Sky welcomes Ofcom's examination of spectrum sharing, we are of the view that this should form only part of a wider process which explores allocation and access for all spectrum bands and uses, given the anticipated future spectrum requirements.

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the demand for wireless broadband spectrum', June 2013. Available at: http://www.acurixnetworks.com/wp-content/uploads/2013/08/EU-Wi-Fi-Study-offload-and-demand-for-spectrum-Jul-2013.pdf

3 Facilitating the further development of Wi-Fi

3.1 In Sky's view, the continued development of Wi-Fi is the single most important aspect that spectrum sharing can further facilitate. In particular, additional licence-exempt spectrum similar to that proposed by the FCC will be crucial in unlocking the significant benefits that continued Wi-Fi growth can bring.

Wi-Fi plays a fundamental role in the wireless data ecosystem, which is only set to increase – but its position is under threat

3.2 As highlighted, Wi-Fi already plays a fundamental role in the wireless data ecosystem as the primary technology which consumers use for data transfer[11]. This role is only anticipated to increase as Wi-Fi helps meet the increased demand for wireless data, and in doing so increases the value of applications which make use of Wi-Fi significantly.

3.3 Indeed, Wi-Fi should be recognised as a significant wireless technology in itself, not merely as an additional method to connect cellular devices. Globally there are expected to be over 3 billion Wi-Fi devices sold in 2013, and it is worth noting that many consumer devices do not have cellular capability, including a significant amount of tablets sold (up to 90%) which are Wi-Fi-only devices.

3.4 Sky operates both in-home and enterprise Wi-Fi. Our 5 million plus broadband subscribers extensively use Sky's wireless routers to access the internet via portable devices. And as a Wi-Fi hot-spot service provider via The Cloud, Sky is acutely aware of the importance of Wi-Fi in catering for consumers' mobile data demands out-of-home.

3.5 Ofcom studies have suggested that congestion and interference are already adversely affecting Wi-Fi performance[12]. Sky would concur with this view, having experienced an increase in congestion in our enterprise Wi-Fi as demand has risen. We anticipate that this will be mirrored in our in-home Wi-Fi, with more and more content being transferred in-home as customers seek greater flexibility, driven through product innovations such as Sky Go.

3.6 Together with recent and forecast increases in data traffic, there will soon be a clear need to increase substantially the amount of unlicensed spectrum available to meet the exponential growth of traffic expected over Wi-Fi for new diverse, innovative uses.

We anticipate technological improvements in Wi-Fi, but spectrum developments will need to keep pace with these

3.7 At present, indoor Wi-Fi hotspots using the latest 802.11n dual band access points can offer smartphones a usable service and connect 100+ devices at a time. But the Wi-Fi of tomorrow will be very different. For example:

- Passpoint will enable the automatic network selection and authentication in a similar manner than cellular networks
- Network roaming will be enabled in a similar manner as in cellular networks
- Wi-Fi service providers can potentially offer their customers cheaper data roaming, than the customers MNOs (owning the SIMs will no longer be a necessity)
- New APs such as 802.11ac will be able to handle a far greater number of associated devices
- Efficiency enhancement in the protocol will serve better for voice services, M2M services and growth in data consumption

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11 Indeed, even above Ethernet connections – see Thanki report

12 See http://stakeholders.ofcom.org.uk/binaries/research/technology-research/wfiutilisation.pdf

3.8 But these developments will only advance the consumer experience so far. More licence-exempt spectrum for use by Wi-Fi is still undoubtedly needed.

3.9 There is, for example, urgency in ensuring a greater amount of 5 Ghz is allocated to licence-exempt use. Data from The Cloud demonstrates that 5 GHz is increasingly being used to carry significant levels of data. We expect this trend to continue as consumer devices which are built for the US market become more prevalent in Europe.

3.10 We would encourage Ofcom to take steps toward ensuring spectrum availability, including by extending the 5 GHz spectrum availability to licence free use by adding 5350-5470 MHz (120 MHz) and 5850-5925 (75 MHz) to licence free use. We would further encourage Ofcom to consider if the dynamic frequency selection (DFS) mechanism is absolutely necessary with these bands. We would instead suggest that a dynamic spectrum access approach would be better suited for the task. Furthermore, we are of the view that limiting the allowed channel bandwidth to a maximum of 40 MHz would ensure more efficient spectrum use and minimise co-channel interference in locations where spectrum is highly utilised

3.11 Even increasing the amount of 5 GHz spectrum available for licence-exempt use may not be sufficient to meet the growing demand. Other bands should also be explored in parallel. Sky considers that 3.4 GHz in particular may have the potential to be utilised for Wi-Fi, and would urge Ofcom to take account of international developments in this band when forming its proposals for the award of this frequency (as part of the MOD spectrum release).

3.12 While examining spectrum sharing opportunities for the future, Ofcom should also be mindful of protecting the significant successes that spectrum sharing has already delivered. In particular, Sky is concerned that Ofcom's plans to increase the amount of data available for mobile spectrum use by releasing the 2.3 GHz band will limit data capacity in the adjacent 2.4 GHz band used for Wi-Fi. Given, as outlined above, the crucial role Wi-Fi plays in the current communications market, we would urge Ofcom to work with industry to minimise any potential interference this will cause.

4 Enabling White Space Devices and future dynamic spectrum access

4.1 Sky is strongly of the view that the introduction of white space devices will be of great benefit to the UK – not just in the under-utilised UHF spectrum used by DTT, but across many other spectrum bands in the future. Ofcom has an opportunity to make the UK a world leader in this area, influencing the viability of technology on global scale and becoming the country that others look to as an example of progressive, market-led regulation.

4.2 Ofcom's steps to enable unlicensed access to TV white spaces are an important first step in realising the benefits of dynamic spectrum access. Sky looks forward to working closely with Ofcom as it finalises this work ahead of implementation. In particular, we would stress the importance of the starting conditions being permissive and not unnecessarily onerous. Significant over-protection of other spectrum uses based on the cascading of worst case protection elements should be avoided, when it is clear that doing so would unnecessarily hinder the launch of this dynamic innovation.

4.3 The TV white spaces project should be seen as only the start of the process. As methods for dynamic spectrum access improve, this type of allocation and access can play an increasingly important role in facilitating efficient use of spectrum and realising the full potential of services.

4.4 More intensive dynamic spectrum sharing should be a key regulatory objective, allowing regulators to accommodate the varying demands of different uses of spectrum. Dynamic spectrum access should be extended in future to other frequencies – starting with those

where there is a prospect of international harmonisation in the near future. Indeed, over time, spectrum sharing should become the default policy for spectrum allocation, with a move away from the more traditional practice of allocating particular bands to specific uses.

4.5 The evidence from pilots that have been conducted and deployment in other countries indicates that dynamic spectrum access by white space devices across a multitude of bands is workable and comes with significant associated benefits. The use of geolocation databases and, in time, the development of cost-effective sensing technologies will enable co-existence issues to be managed, and mitigate the risk of a 'tragedy of the commons' emerging.

Annex A – responses to consultation questions

The future role of Wi-Fi in helping to meet the demand for wireless data services

Question 1: How is demand for indoor wireless data connection speeds and capacity likely to develop over the next 5–10 years?

We address this question in Section 2.

Question 2: Will an extension of the 5 GHz band be required if Wi-Fi is to play a sustainable role in meeting the growing demand for indoor wireless connectivity?

We address this question in Section 3.

Question 3: Are there other types of indoor wireless applications will require access to alternative spectrum other than that provided by the licence exempt 2.4 and 5 GHz bands used by Wi-Fi?

In home connectivity more explicitly, more and more content & traffic hearted and transferred in home as customers seek flexibility and we are going to only drive this up through future product releases.

Question 4: What role do you think Wi-Fi will play in providing wireless broadband connectivity outdoors over the coming 5-10 years?

Outdoor Wi-Fi is likely to play an increasingly significant role in the provision of low-cost bandwidth and efficient nomadic access to data services in the medium-term. The worldwide market for outdoor Wi-Fi services is expected to grow from $15.41 billion in 2013 to $37.2 billion in 2018, at a CAGR of 16% during this forecast period[13]. Allowing licence-exempt use of TV white spaces, with the improved propagation characteristics associated with these frequencies, will enable better outdoor Wi-Fi coverage to be deployed.

Question 5: Will the increased deployment of Wi-Fi access points outdoors create a risk of reduced quality of service performance over the longer term and, if so, will approaches to co-ordinate access point performance be able to mitigate this risk?

Sky believes that technological advances will mitigate this risk naturally.

Question 6: Will improved approaches to accessing spectrum in licence exempt bands be needed in the longer term to maintain the quality of service achievable for outdoor public mobile broadband and/or M2M services? If so, which approaches are most likely to be adopted and how likely do you think they are to be successful in improving access to spectrum?

In the long term, when the usage and network density on the 5 GHz band grows, the DFS mechanism will become a problem, as the Wi-Fi networks will see false DFA triggers from other APs in dense Wi-Fi network deployments. If this is not addressed, there will be very little usable spectrum on the 5 GHz band and we suggest the adoption of dynamic spectrum access approach. Out of home Wi-Fi with relatively small bandwidth per user need with relatively high number of users would benefit from the use of narrow band (5-10 MHz) channels rather than wide (80-160 MHz) channels. The DSA mechanisms should, where necessary, allow the use of the licence free with narrow bands only.

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[13] Markets and Markets, Outdoor Wi-Fi Network Worth $37.2 Billion By 2018 http://www.marketsandmarkets.com/PressReleases/outdoor-wi-fi.asp

Increasing spectrum supply and better managing its use

Question 7: Which frequency bands are most likely to be best suited to providing geographical shared access, including via a geolocation database approach, for use by mobile broadband, for example small cells and M2M applications?

In addition to the additional 5 GHz spectrum, sub-1 GHz spectrum and 3.4 GHz should be the focus of immediate priority, but all frequency bands should be given due consideration.

Question 8: Would access to these bands best be realised through licensing or licence exemption?

A licence-exempt approach will drive the greatest spectrum efficiency and offer potential operators low barriers to entry.

Question 10: Do you believe DSA could play an important future role in the future in enabling a better quality of service and low barriers to spectrum access alongside conventional licensed and LE spectrum approaches?

We address this question in section 4.

Question 12: Over what timescales could DSA become a mass market proposition?

The success of TVWS will dictate this, with a conservative estimate of between 5 and 10 years. We would note that if DSA were to be adopted in other bands such as the 5 GHz then this process would speed up.

Question 13: What role should Ofcom play, if any, to support the development of DSA and relevant technologies?

We address this question in section 4.

Supporting innovation through short-term access to shared spectrum

Question 16: What are the potential benefits of using a geolocation database approach for short-term access to spectrum for R&D and how would you see this working from a practical perspective? Are there alternative approaches that could deliver similar benefits?

We have experienced significant delays with some applications and would hope that a database would expedite the processes.