techUK response to the Ofcom consultation:

The future role of spectrum sharing for mobile and wireless data services
Licensed sharing, Wi-Fi, and dynamic spectrum access

8 November, 2013

Introduction

About techUK
techUK represents the companies and technologies that are defining today the world that we will live in tomorrow. In a very real sense techUK represents the future.

At the heart of tech in the UK is an ecosystem of 270,000 companies producing digital technologies, products and services. From east to west, north and south, from enterprise class organisations to established medium-sized businesses, growing small businesses and an exciting generation of tech start-ups: the UK is a hotbed of tech talent and techUK exists to represent the sector in its entirety.

Our role as techUK is to ensure that we seize the potential for good and address the disruptive new challenges that change and innovation always present. We work to understand the opportunities that technology provides; to support the companies and innovators that can realise those opportunities.

This underpins our simple vision to ensure that tech is good for the UK, the UK is good for tech and that tech is good for people.

Preamble

techUK is pleased to have this opportunity to contribute to Ofcom's thoughts on how spectrum can be used more efficiently in the future, taking into account technology developments and changes in market demand.

With the rapid growth in demand for wireless connectivity, access to spectrum becomes more important than ever. Opportunities to share spectrum potentially offer an increasingly expedited route to additional spectrum capacity.

It should be noted that certain aspects of this consultation relate directly to the geolocation based shared spectrum use of TVWS and as such should be informed by industry input to the parallel consultation that is underway to consider the coexistence arrangements for WSD service deployment in TVWS. To this end we encourage Ofcom to revisit the relevant contributions and aspects from this consultation in light of the findings from the 'TV White Spaces: approach to coexistence' consultation.

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?
In the next few years, there will be a significant global increase in internet users, networked devices, broadband speed and IP traffic. In May 2013, Cisco released the 'Cisco VNI Global IP Traffic Forecast, 2012 – 2017' which was an updated study highlighting (the following projections) that by 2017 –

- there will be 3.6B global Internet users, up from 2.3B global Internet users in 2012
- there will be 19B networked devices globally, up from 12B networked devices in 2012
- average global broadband speed will grow 3.5-fold, from 11.3 Mbps (2012) to 39 Mbps (2017)
- global IP traffic will reach an annual run rate of 1.4 zetabytes, up from 523 exabytes in 2012

Wi-Fi supports a substantial share of access traffic to the internet and is increasingly used for machine-to-machine (M2M) connectivity. Based on independent studies and forecasts which are widely available, demand for indoor Wi-Fi will continue to increase.

A report released in January 2013 for Cisco by Plum Consulting 'Future proofing Wi-Fi – the case for more spectrum' projected that Wi-Fi will support up to 60% of total internet traffic by 2016. Currently indoor Wi-Fi is predominately using 2.4 GHz but with increased requirement for higher bandwidths (5 GHz) Wi-Fi will become more important. It has already been acknowledged that additional 5 GHz spectrum is likely to be required to satisfy the escalating wireless data volumes.

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?
Yes.

Even with the current data demand, available Wi-Fi networks are often not able to provide sufficient throughput. It is reasonable to assume that the data volume will continue to rise. Ofcom should therefore consider suitable harmonised spectrum to satisfy the growing demand especially for higher bandwidth applications.

According to ABI Research:

- Yearly Wi-Fi shipments will reach almost 3 billion in 2016, nearly doubling 2012's count of about 1.5 billion; growing at a compound annual rate of 14 percent.
- The total number of Wi-Fi shipments increased 29 percent from 2011-2012.
- The consumer electronics category led Wi-Fi sales growth at nearly 42 percent.
- Sales of Wi-Fi enabled handsets grew 32 percent from 2011-2012.

Access to a more continuous spectrum would allow the implementation of a far more efficient band plan for wider bandwidth channels (including 160 MHz channels), thereby facilitating provision of higher data rates to users. If additional spectrum from 5350-5470 MHz were made available for Wi-Fi use, that would enable a more continuous band from 5150 to 5825 MHz. Furthermore, the findings of recent research by Aegis and Wik Consult[1] for the European Commission emphasises the importance of

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[1] European Commission, Directorate-General of Communications Networks, Content & Technology, 2013, 'Study on impact of traffic off-loading and related technological trends on the demand for wireless broadband spectrum' http://bookshop.europa.eu/en/study-on-impact-of-traffic-off-loading-and-related-technological-trends-on-the-demand-for-wireless-broadband-spectrum-

access to additional spectrum above 5 GHz for Wi-Fi services to support the forecast growth in mobile data traffic.

All this evidence leads to a conclusion that additional spectrum suitable for license-exempt is very likely to be required and one of the most suitable bands to assist catering for this demand is at 5 GHz.

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?

Obviously 3G/LTE mobile devices used in an indoor environment require access to IMT frequencies. Taking into account that the majority of these devices also have Wi-Fi capability, smartphones will also utilise Wi-Fi while indoors. This supports the need for greater availability of Wi-Fi capacity and, with video content increasingly being HD, larger channels are required. In the near future this capacity will likely be delivered within the 5 GHz frequency range.

Wi-Fi at 60 GHz will increasingly have a more significant part to play in distribution of content and access to high bandwidth content indoors since devices will be capable of offering more bandwidth than hardwired USB 3.0 connections. Limitations need to be considered – namely the limitations on building penetration, which may lead to 60 GHz to be more ideally suited for in-room distribution. ABI Research forecasts that there will be annual shipments of 1.8 billion devices with both Wi-Fi and WiGig support by 2016.

TV White Spaces could make a contribution to in-home distribution, in-house coverage and possibly outdoor coverage. The combination of 60 GHz, 5 GHz, 2.4 GHz, and TV White Spaces may in future enable devices to balance range, throughput, and power under different usage situations.

Furthermore, Wireless Industrial Automation (WIA) is currently being standardised by ETSI[2] and CEPT[3] for operation in the frequency range 5725 to 5875 MHz. WIA has a strong potential to be a leading M2M technology and is therefore worth consideration for indoor use.

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

Consumer demand for outdoor Wi-Fi hotspot access e.g. cafes, airports and municipalities, is rapidly increasing as mobile smartphone and cloud computing become more mainstream. According to market research study (MarketsandMarkets) the global market for this service will more than double over the next five years: 'Outdoor Wi-Fi is expected to grow from $15.41 billion in 2013 to $37.2 billion in 2018, at a CAGR of 15.82% during this forecast period'.

It is anticipated that outdoor Wi-Fi will be predominately at 2.4 GHz.

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[2] European Telecommunications Standards Institute, Technical Report 102 889-2 [1], 2011, http://www.etsi.org/deliver/etsi_tr/102800_102899/10288902/01.01.01_60/tr_10288902v010101p.pdf

[3] Electronic Communications Committee, Report 206 'Compatibility studies in the band 5725-5875 MHz between SRD equipment for wireless industrial applications and other systems' http://www.cept.org/files/1051/Tools%20and%20Services/Public%20Consultations/2013/ECC%20Rep%20206_SE24.docX

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?

Increased Wi-Fi deployments outdoors are likely to be at 2.4 GHz (less so at 5 GHz due to interference mitigation and lower transmit power constraints).

External Wi-Fi coverage could be deployed in a more carefully planned and managed way providing opportunities to minimise harmful interference between access points. In the future, we anticipate that the development of automatic configuration/coordination techniques (e.g. based on cognitive technologies) could further improve spectrum usage efficiency.

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?

The use of geolocation databases and cognitive technologies could assist additional applications including outdoor broadband access from mobile devices and machine-to-machine applications.

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?

The best suited bands for spectrum sharing options include –

- Licence-Exempt Sharing e.g. Wi-Fi and 5 GHz radars and/or within 2.4 GHz ISM band
- Licensed Shared Access (LSA); with an initial focus on 2.3 GHz band
- TV White Spaces, subject to appropriate protection of the incumbent licensed services

2.3 GHz – Mobile Capacity Broadband

techUK supports efforts within CEPT to develop a regulatory framework enabling LSA in the 2.3 GHz band where administrations are unable to release exclusive spectrum for mobile broadband, It is reasonable to assume this band is an early candidate for geographical licensed shared access in some countries, as proposed by the EU Radio Spectrum Policy Group in its Opinion on spectrum for wireless broadband, published in June.

TVWS – M2M and Broadband Gap Filling

M2M appears to be one of the initial applications being considered for the TVWS. techUK is aware of Ofcom's efforts to develop regulations and standards to ensure opportunities to access TVWS are realised. This is a clear candidate for geographical shared access, utilising a geolocation database subject to appropriate protection of the incumbent licensed services.

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

Exclusive authorisations, Licensed Shared Access (LSA) and licence-exempt access are all likely to be needed, to meet the wide range of market requirements and allow maximum scope for innovation.

techUK supports the introduction of LSA as an additional tool for spectrum access as defined by ECC in ECC Report 205 on LSA[4].

techUK also supports efforts to secure additional spectrum for licence exempt use. Regulators are encouraged to maximise the advantage of international harmonisation opportunities e.g. licence-exemption in 5 GHz and LSA in 2.3 GHz. Enabling industry to respond to harmonisation trends is likely to lead to greater value from wireless applications. Regulators have a number of options to facilitate access to spectrum through Exclusive Authorisations, Licensed Shared Access and License Exempt as summarised below –

1) *Exclusive Authorisations:* Current exclusive authorizations for 3G and 4G networks allow millions of independent users to 'share' the spectrum in a highly efficient manner. Cleared spectrum via re-allocation/re-farming will allow newer more efficient technologies to reach the market. Wherever possible, government should also implement voluntary mechanisms to encourage commercial and government users to re-farm or release spectrum for higher-value uses and more efficient technologies. Commercial licensees should be

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[4] Electronic Communications Committee Report 205 on Licensed Shared Access (LSA), http://www.cept.org/files/1051/Tools%20and%20Services/Public%20Consultations/2013/Draft%20ECC%20Rep205%20on%20LSA.docx

encouraged to resolve interference problems with their frequency and geographical 'neighbours' through negotiations.

2) *Licensed Shared Access (LSA):* This offers a controlled environment for shared use of spectrum - e.g. between government users and commercial users if harmonised Mobile, Fixed Communications Networks (MFCN) use is desirable.

Sharing on a LSA basis should be enabled wherever possible. It will foster efficient market incentives for high quality of service as well as infrastructure and technology investment, and encourage voluntary, market-driven negotiations between public users and commercial licensees, to increase the value of the spectrum and enable release of harmonised bands (e.g. 2.3 GHz) to market in a timely manner.

3) *Licence Exempt:* Harmonised licence-exemption opportunities should be implemented wherever possible (e.g. 5 GHz band). Government can also look at sharing between public sector and commercial applications on this basis.
   a. Consideration should also be given to enabling efficient long range, wide area network (WAN) uses in line with international harmonisation opportunities.
   b. Geolocation databases, together with network planning and management, power control, listen-before-talk, and autonomous sensing can contribute to improving the quality of service enabling new technologies and service providers to enter the market.

Question 9: Do you believe that tiered shared access to a range of spectrum bands has a role in meeting demand for mobile and wireless data and, if so, which applications and devices do you think will be particularly suited to this access model?
The need for quality of service and availabilities will require exclusive allocations, yet tiered shared access could have a role in helping to meet the future demands of applications of wireless technology. However it should be defined and investigated further and kept as simple as possible. It is well understood that secondary and tertiary services should not be authorised in a way that harms the transmission or reception of primary services. In the example that Ofcom uses this meant that no TV viewers that currently receive the primary licensed DTT service should experience any interference from White Space devices. The harmonisation status and standardisation activities relating to specific frequency bands also need to be taken in to consideration, especially for mass market applications.

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?
DSA, within the framework of an LSA or LE sharing, could play an important future role to assist in meeting market demand for bandwidth. However, careful consideration to DSA definition and the impact that DSA may have upon ongoing WRC-15 discussions on current and future allocations (e.g. for broadcast, mobile and IMT) needs to be taken into account.

Furthermore, whilst DSA has the potential to increase the utilisation of spectrum through the introduction of tertiary services there is also the risk that if this not managed effectively then the aggregate value of the services delivered may be reduced as a result of interference into the high value generating incumbent licensed service. DSA therefore needs to be developed and implemented to avoid any disruption to incumbent licensed services. Ofcom should bring the trials currently underway to a

satisfactory conclusion and identify formal arrangements to capture and deal effectively with instances of interference where they to arise.

Question 11: What barriers still remain to the realisation of cost-effective sensing appropriate for low-cost consumer devices and what activities are ongoing to try to address them?

Cost-effective sensing technology continues to be actively developed to support consumer devices, and Ofcom should consider how to best develop a suitable regulatory environment to facilitate this. However, for many frequency bands, the 'hidden node' problem for receivers of the primary user of the spectrum remains a fundamental challenge. Generally speaking for mass market applications, the focus of sensing technology may need to be balanced with the harmonisation of frequency band identification.

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

Views amongst techUK members vary significantly in reference to timescales. Some techUK members believe that regulation is well in hand to enable access to the TV White Spaces, and therefore expect penetration of the TVWS technology to accelerate to the point where it has the potential to become UK mass market within around 3-5 years. Other techUK members believe that a time scale would be 10-20 years from now.

Further techUK members expect additional bands may be added to the geolocation databases and hence increase the spectrum capacity subject to arrangements being possible. Only then will DSA capable devices be made available to the market and hence DSA as a mass market proposition may not be realised until the latter part of this decade.

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

Ofcom should proceed with finalising its work on enabling licence exempt access to the TV White Spaces. It should do so in such a way that ensures that it does not impact any TV viewers that currently have access to DTT services. It can assist the development of DSA by making spectrum usage data as fully available as possible, to enable better understanding of the scope for spectrum sharing. Ofcom should then consider making suitable spectrum available for DSA, LSA and LE - with priority being given to those bands where there is a prospect of international harmonisation in the near future.

Question 14: Do you have any other views on any of the issues discussed in this consultation?

No.

Supporting innovation through short-term access to shared spectrum

Question 15: What are the frequency bands that would be of most value for R&D purposes?

techUK suggests there could be interest in many different frequency bands and would find it difficult to prioritise bands which would be of most interest for R&D purposes. It is also important that any frequency bands identified are subject to appropriate protection of the incumbent licensed users to avoid the risk of interference.

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?

techUK believes that using a geolocation database for more flexible and quicker short-term access to spectrum would boost R&D. Without such flexibility, it takes a relatively long time to prepare new hardware that can make use of any given opportunity; however some believe the scope for this is limited and could be addressed through bi-lateral negotiations with the incumbent and/or regulator. However, this database needs to be limited to specific bands, otherwise it could become more complex than Ofcom's current spectrum management systems.

Question 17: What characteristics do you view as important to researchers in arrangements to facilitate temporary access to spectrum for research and development purposes?

techUK believes that there is a need to bring Ofcom's Test and Development licensing process up to date. This includes enabling online application processes and investigating the use of spectrum innovation parks (although it is important that this does not sterilise valuable spectrum for commercial use). Furthermore, clarity and certainty on the available frequencies as well as constraints (emission power levels etc.) are important. Users should be allowed to charge for prototype services and applications, to enable market as well as technology testing, although it is important that this does not create 'squatters' rights.