Issue 1

BT's response to Ofcom's call for input on:

Future demand for mobile broadband spectrum and consideration of potential candidate bands

(World Radiocommunication Conference 2015, Agenda item 1.1)

(Issued by Ofcom on 18 March 2013)

1. INTRODUCTION

BT welcomes Ofcom's call for input on the future demand for mobile broadband spectrum and consideration of potential candidate bands. The ITU World Radiocommunication Conference 2015 (WRC-15) outcome will potentially have profound long-term impact on the interests of UK consumers. It is important that the UK position going in to the conference is based on solid analysis and evidence and we therefore welcome this opportunity to contribute our views on these important questions.

The WRC-15 conference Agenda Item 1.1 will address additional primary allocations to the mobile service and identification of frequency bands for International Mobile Telecommunications (IMT). We understand that Ofcom is therefore interested in receiving views on both the future demand for mobile spectrum and the potential candidate bands in which future demand may be accommodated and which may be identified in the ITU Radio Regulations for the IMT application.

BT is uniquely placed to respond to Ofcom's call for input as we are the new entrant to the UK 4G mobile industry; we operate the largest WiFi network in the UK with more than 4.5 million hotspots; and we are the leading provider of consumer voice and broadband services in the UK. Our unique perspective on the issue of mobile broadband spectrum embraces licenced as well as licence-exempt spectrum and is founded on our view that there is an ever increasing convergence of fixed and mobile telecommunication services from the customers' perspective. Our view of network techno-economics suggests that mobile data capacity and mobile broadband services will increasingly be delivered using small cells in buildings connected to fixed broadband networks, rather than simply building more conventional cellular network capacity with additional spectrum and more spectrally efficient technologies.

2. FUTURE SPECTRUM REQUIREMENTS

BT notes the past work done in the ITU and elsewhere to forecast mobile broadband spectrum requirements and welcomes the currently on-going study commissioned by Ofcom to forecast future requirements addressing the dimensions of network coverage, capacity and performance. The growth in mobile data traffic, driven mainly by video consumption, is widely reported and is apparent on both fixed and mobile networks. Within homes fixed broadband is mostly consumed and shared via WiFi. In most cases WiFi is the mobile broadband data connection of choice within the home, given the available connection speeds and costs.

Existing licence-exempt WiFi using shared spectrum at 2.4GHz and 5GHz provides sufficient capacity for the foreseeable future and additional use of licenced spectrum within homes and offices can provide improved coverage and enhanced quality of service. WiFi operating in the 2.4GHz band can provide better coverage than 5GHz, but with fewer channels available may have greater risk of congestion/interference in some circumstances. Availability of more 5GHz spectrum as mentioned in the European Radio Spectrum Policy Programme would provide additional capacity that would be useful in some circumstances, but would address capacity rather than coverage.

Most mobile data is consumed inside buildings. The proportion of this traffic that is offloaded to small cells connected to fixed broadband networks (WiFi or 3G/4G technologies) will substantially impact the amount of spectrum that is needed to serve consumers who are outdoors or who are

located beyond the coverage of small cells or access points connected to fixed broadband networks. Consumers may prefer to connect to small cells or WiFi access points, backhauled by fixed broadband, if speeds are higher or more consistent than those available on wide area mobile networks. Also, mobile operators may prefer to see in-building traffic off-loaded to fixed networks to preserve available spectrum resources for users located away from buildings and small cells.

The amount of licensed mobile spectrum required for the future depends primarily on predictions of traffic generated (demand), the assumed network architectures and technology efficiency. Availability of more spectrum will generally lead to lower network costs (if fewer but larger cells can be used) or improved quality and reliability. Estimations of spectrum requirements necessarily start with an assumption of certain network architectures and traffic demand, without regard to the costs of the spectrum which will in practice affect architectural choice. In the real world the cost of spectrum will itself be a key factor that influences the optimum architectural solution and consequently impacts the quantity of spectrum required. Auctions can help determine the market value of spectrum and this is influenced by operators' decisions on balancing the amount spent on spectrum and the choice of bands against costs if other means of delivering increased coverage and capacity are used to meet customer requirements.

Making additional spectrum available for mobile broadband makes sense if the market value of the extra spectrum for mobile use exceeds the opportunity cost of using the spectrum for another purpose. Ofcom therefore needs to consider both the amount of spectrum ideally required and what operators are prepared to pay for it. The value for mobile use needs to be greater than the value of the alternative use, which we acknowledge can be hard to quantify (e.g. the value to consumers of public service broadcasting compared to mobile services that could be delivered in the same spectrum).

Our overall assessment is that the presently assigned licensed mobile spectrum at 800MHz, 900MHz, 1800MHz, 2100MHz and 2600MHz, together with other bands that are already identified internationally for IMT but not yet assigned in the UK (e.g. MoD bands at 2.3/3.4GHz), plus the foreseen longer term availability of the 700MHz band and other public sector spectrum releases (table 2 in Ofcom's call for input), should together be able to support foreseeable future demand. This view relies on the appropriate choice of network architectures and off-loading traffic onto small cells and WiFi leveraging the capabilities of the extensive superfast fibre broadband networks available throughout the UK. In general we would advocate wide availability of a limited number of core frequency bands in order to ensure the largest possible economies of scale, simplify roaming and to limit the cost and complexity of devices.

3. CANDIDATE BANDS

Our views on the candidate bands for new mobile allocations and/or IMT identification that are already under discussion in the ITU are summarised in the table below.

Frequency band	BT comments
470-694 MHz	This band is required to maintain a 6 MUX digital terrestrial TV (DTT) platform in the UK and its evolution to more efficient transmission technologies and availability of additional HD programmes. Ensuring the availability of the 470-694MHz band for digital terrestrial TV will enable Ofcom to implement its proposal that the 700MHz band could be freed up for mobile broadband in the longer term. Mobile and broadcasting uses are incompatible and so from a UK perspective, if Ofcom is serious about a ring-fencing this band as a residual amount of spectrum for the future digital DTT platform, avoiding a mobile allocation and identification for IMT in ITU Region 1 will reduce the risk of future European harmonisation leading to an EC requirement to make the band available for mobile. It will also reduce the potential difficulties of international coordination of UK broadcasting stations. A clear position that the 470-694MHz band will be prioritised for the foreseeable future for terrestrial broadcasting (and PMSE/TV White Spaces applications) should enable a long-term plan for release of 700Mhz for mobile to be developed.
1300-1400 MHz	No comments
1427-1527 MHz	No comments
1452-1492 MHz	No comments
1695-1700 MHz	No comments
2700-2900 MHz	No comments
3600-3800 MHz	No comments
3800-4200 MHz	This band is used extensively for satellite services worldwide and is not a good choice of band for global IMT. Studies have shown that mobile and satellite systems cannot coexist in the same geographical area and significant coordination areas would be required around Earth stations to prevent interference.
5350-5470 MHz	This band may be suitable on a licence-exempt basis for wireless access systems including radio LANs, i.e. WiFi.
5850-5925 MHz	This is a candidate band of DA2GC systems under study in CEPT and any identification for mobile broadband would need to take into account this potential use and other existing uses.
5925-6425 MHz	Compatibility with fixed links deployments would need to be considered carefully and mobile broadband would need careful coordination.
4400-4900 MHz	No comments
13.4-14 GHz	No comments
18.1-18.6 GHz	This band is intensively used for fixed links in the UK and Europe which would be incompatible with mobile services.
27-29.5 GHz	This band is widely used for fixed links in the UK and Europe which would be incompatible with mobile services.
38-39.5 GHz	This band is intensively used for UK fixed links which may be incompatible with mobile broadband.

4. RESPONSES TO THE SPECIFIC CONSULTATION QUESTIONS

Spectrum requirement forecasts

Question 1: How much do you expect UK mobile data demand to change in the period 2015-2030? Please provide evidence for the trend and, where possible, please indicate how demand might vary across the device categories listed in paragraph 4.7. How should we account for factors (including pricing) that would constrain demand?

Most published industry forecasts, for example the Cisco Visual Networking Index[1], tend to look no more than 5 years ahead and therefore do not directly address the time period that is of particular interest to Ofcom. For the period to 2017 Cisco predicts a 50% CAGR (7.6-fold increase) for mobile data traffic in Western Europe, with the underlying data showing growth rate slowing towards the end of this period. BT has no prediction to share as to how mobile data demand will grow for the period beyond which industry forecasts are available.

Question 2: What evidence do you think is relevant to assessing the extent of consumer benefits associated with meeting the increase in demand for mobile data?

Customers clearly value mobile services as evidenced by the revenues generated and the existence of "consumer surplus" that Ofcom has in the past estimated. If network capacity and coverage does not keep up with customer demand dissatisfaction will result and the "consumer surplus" would reduce. The benefits of meeting the increase in demand for mobile data are in terms of maintaining or improving customer satisfaction and the ability for them to experience the quality of service and speeds they require, especially for bandwidth hungry services such as video delivery. If the increase in demand for mobile data is not met then pricing may have a role in managing demand or customers may increasingly chose or be encouraged to use alternative networks where available to consume content (e.g. WiFi on fixed networks rather than wide area mobile networks).

Question 3: What proportion of mobile data traffic do you expect to be carried over (a) Wi-Fi and similar systems in licence-exempt spectrum and (b) mobile networks in licensed spectrum? How do you expect this to change over the period 2015-2030 and how do you expect total data demand for Wi-Fi and similar systems in licence-exempt spectrum to change over the same period? How might this vary by location, environment etc.?

The aforementioned Cisco study predicts that on a global basis offload of mobile data from cellular networks to WiFi will increase from the 33 per cent in 2012 to 46 per cent in 2017. The same report predicts that the amount of traffic offloaded from tablets will be 71 per cent in 2017.

There is other evidence that most Smartphone data is consumed inside the home and most of that data is consumed over WiFi rather than the public mobile network. For example, Analysys Mason

[1] Cisco Visual Networking Index: global Mobile Data traffic Forecast Update, 2012-207. http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf

has reported in 2012 that their research revealed that in Western Europe at the end of 2011 an estimated 75% of Smartphone traffic was consumed within the home or office, and of this 77% was carried over WiFi on the fixed broadband network connection[2].

Cisco publishes details of the proportion of smartphone traffic carried over cellular networks *vs* WiFi by analysing results from smartphone users who have installed their data meter application on android smartphones[3]. Analysis of this published data for the early part of 2013 reveals that 80% of smartphone data traffic for these users in Western Europe is accessed using WiFi rather than mobile networks. This Cisco survey compares favourably to a similar smaller scale study instigated by BT in 2012 involving 584 UK android smartphone users recruited independently from BT. That study found that 86% of these smartphone users' mobile data traffic was carried over WiFi and that 75% of data traffic was used at home. There are numerous other sources of similar data available, for example Informa telecoms and Media has put the proportion of UK smartphone traffic carried on WiFi in January 2012 at 81%[4]; Arbitron Inc data for Q4/2012 put the figure at 69%[5] (80% for Apple iOS devices, 64% for Android devices); and Nielsen has reported in November 2012 that 78%[6] of UK Android smartphone data is accessed via WiFi.

In the timescales of interest to Ofcom, the Government target of superfast broadband available to *c.* 90% of UK households is likely to have been achieved or exceeded. Given the available speeds and current trends of take up and pricing for fibre broadband it seems highly likely that the current trend of increasing off-load from mobile networks to fixed networks when using mobile devices in buildings will continue.

Question 4: What factors will act to change the spectral efficiency of mobile technologies in the future? What spectral efficiency values are appropriate for consideration in our study for the period 2015-2030?

BT has no firm views on this question, noting this period is a long way in to the future. Inevitably a mix of mobile technologies will be in use leading to an average overall spectral efficiency. The report prepared for Ofcom by Real Wireless in March 2012[7] (see section 3.8) may provide a reasonable prediction at this stage.

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[2] See Slide 4 of "LTE strategies and the challenge of mobile data growth", Analysis Mason, October 2012. http://www.analysysmason.com/PageFiles/35474/Analysys_Mason_LTE_strategies_Oct2012.pdf

[3] See http://ciscovni.com/data_meter/

[4] See http://www.informatandm.com/wp-content/uploads/2012/02/Mobidia_final.pdf

[5] http://www.nasdaq.com/article/wi-fi-is-the-data-beast-of-burden-among-smartphone-panelists-20130304-00912?sf11780037=1#.UWbny1fm-Ad

[6] http://www.nielsen.com/uk/en/insights/press-room/2012/wi-fi-delivers-over-three-quarters-of-all-uk-smartphone-data.html

[7] "Techniques for increasing the capacity of wireless broadband networks: UK, 2012-2030", report by RealWireless for Ofcom, March 2012. See http://www.realwireless.biz/realwireless/wp-content/uploads/2011/11/Final-report-Capacity-Techniques-for-Wireless-Broadband-v1_15.zip

Question 5: What service bit rate values are appropriate for consideration in our study for the period 2015-2030? What evidence do you have of changing needs for service bit rates?

For indoor small cell solutions and WiF,i backhauled by fibre based NGA (superfast broadband), customers may experience peak download speeds of up to c. 80Mbit/s based on technologies currently being widely deployed. However, required speeds will depend on what content is being accessed. For example, in the case of video to individual mobile devices and tablets this is likely to be much less than 10Mbit/s.

Question 6: What proportion of traffic do you consider should be assumed to be carried on each cell types for the period 2015-2030? How will this vary with service environment i.e. between home, office, public areas, rural, suburban and urban? What evidence do you have of the factors affecting the uptake of small cells in licensed spectrum in the future?

The majority of mobile data traffic is already consumed indoors and carried over fixed broadband networks; we expect this to continue to be the case. We anticipate that the proportion of mobile data traffic carried over fixed broadband networks will continue to increase as the volume of data grows, given that small cells (including WiFi) have substantially greater capacity per unit area than larger outdoor cells for a given amount of spectrum. We anticipate extensive deployment of small cells in the 2015-2030 timeframe as availability of additional spectrum and more efficient technologies will be insufficient alone to service the ever increasing mobile broadband data volumes. Small cells (e.g. 4G/WiFi) will use a mix of licence-exempt and licensed spectrum, the exact overall proportion will depend on market developments and the strategies of UK operators.

Question 7: Given the current mix of services on cellular networks what is the ratio of downlink to uplink capacity currently dimensioned for and how would you expect this to change over time by 2015, 2020, 2025 and 2030? How do you expect the ratio of downlink to uplink demand to vary for the service categories given in Table A5.4 of Annex 5, and what factors might affect this? How does this ratio of downlink to uplink capacity change (if at all) with network radio access technology and offload to licence-exempt systems?

BT's current fibre broadband consumer products typically have a 1:4 ratio of peak uplink/downlink speeds. Where WiFi access points or femtocells are used for mobile connectivity backhauled by fibre broadband products, the available speeds are unlikely to be a limitation to the services that are consumed on mobile devices, whether they are connected to a home femtocell in licensed spectrum or to a home WiFi access point using licence-exempt spectrum.

Frequency ranges under discussion

Question 8: What are your views about the pros and cons of the frequency ranges in Table A6.1 in Annex 6 for mobile broadband and for existing applications using this spectrum? Do you have views on other bands that are not in Table A6.1?

Please see the table in section 3 of our response above.

Question 9: Are there any other bands that are not in Table A6.1 for which you think we should be considering their pros and cons for mobile broadband and for existing applications using this spectrum?

No

Question 10: What are your views on bands which should be a priority for consideration for mobile broadband?

The priority should be to make available within the UK those bands already identified for mobile/IMT in the ITU and for which CEPT harmonisation activities are underway or completed. This should be initiated when there is a clear requirement to access additional licensed spectrum beyond that which is already available.