Vodafone's response to Ofcom's consultation

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

World Radiocommunication Conference 2015 Agenda item 1.1

April 2013

Future demand for mobile broadband spectrum: WRC-15 Agenda item 1.1

1. Introduction

Vodafone welcomes the opportunity to respond to this Call for Input by Ofcom on future demand for mobile broadband spectrum and consideration of potential candidate bands by WRC-15. The decisions to be taken by WRC-15 under agenda item 1.1 will be fundamental to the future development of mobile broadband – and therefore to almost all citizens and consumers, as mobile broadband services become ubiquitous.

Vodafone also welcomes Ofcom taking a long-term view - up to 2030 - in its preparations for WRC-15, because the decisions taken then may need to ensure the availability of spectrum until around that date. If decisions are not taken by WRC-15, there may not be another opportunity until the WRC in around 2023[1], and these decisions would be unlikely to lead to licence awards much before 2030.

Many studies have found that public mobile is the wireless application that creates by far the greatest economic benefit to citizens and consumers of the UK[i], and this is supported by many other studies. This will continue to be the case for the foreseeable future. Agenda item 1.1 should therefore have the highest priority for the Ofcom in its preparations for WRC-15 and at the Conference.

2. Spectrum requirement forecasts: Vodafone view

The forecasting of any market for more than fifteen years into the future is complex task, particularly a market as recent and rapidly developing as mobile broadband. It involves considering many factors; technical, demand prediction, market, economic and societal. Ofcom has undertaken a number of studies of this nature, most recently by Real Wireless for the Ofcom consultation on the long-term future of the UHF band[ii].

Most studies, including the one by Real Wireless, provide a range of predictions, depending on the assumptions and sources of input data used. Given that mobile is by far the most valuable extensive use of radio spectrum, it would be prudent for Ofcom to ensure that the decisions of WRC-15 will enable it to accommodate the higher predictions for growth in spectrum demand, if these are found to be the case in the future. However, at the same time, Ofcom will need to ensure that these decisions do not lead to unnecessary disruption to incumbent users, if the growth is lower than this. To maintain global harmonisation, it will be important that administrations release spectrum bands in largely the same order. To achieve these objectives, the spectrum release needs to be phased; in section 2.1, we suggest a way to achieve this.

The ITU developed a methodology in advance of WRC-07 for estimation of spectrum requirements for mobile broadband, which has been revised for WRC-15[iii]. However,

[1] World Radiocommunication Conferences (WRCs) are reluctant to include the same topic on the agendas of successive conferences, so mobile broadband might not be considered by the next WRC in around 2019.

because of the way that this was developed, it is only able to address technical and demand factors. As a result, this approach has some shortcomings[iv].

In this consultation, Ofcom says that it has commissioned an external study:

> "to obtain as robust an estimate as possible for long-term demand for spectrum for mobile broadband applications in the UK. This study will use the ITU-R spectrum estimation methodology specified in Recommendation ITU-R M.1768-1 …"

The two halves of this statement are contradictory; the ITU-R methodology is not capable of providing the most robust estimate, because it does not consider market, economic and societal factors. If Ofcom feels the need to produce a UK-specific spectrum estimate, we would recommend it to use a more economically-focussed approach, such as the one used by Real Wireless; we believe that this is generally sound but is capable of further refinement, and would be happy to work with Ofcom and Real Wireless to achieve this.

2.1 Phasing the release of spectrum

As we discuss above, it would be prudent for Ofcom to ensure that the decisions of WRC-15 are capable of supporting the upper range of predictions for demand for spectrum for mobile broadband, up to around 2030. This creates a number of challenges for regulators around the world:

1) If there is no guidance, regulators in individual markets will be tempted to initially release the bands which are easiest in each market. If these bands differ between markets, this will undermine global harmonisation.
2) Incumbent users will have no clarity in the timescale in which there might be a change in use of their spectrum.
3) Predictions so far into the future inevitably have a significant spread in their conclusions.
4) In the past, there has been a tendency for regulators to release spectrum to market as soon as the regulatory provisions are defined.

It is therefore desirable for there to be a global 'understanding' on the expected phasing of release of frequency bands.

Most decisions of WRCs become effective immediately the amended Radio Regulations come into force but, for decisions looking this far ahead, it would be beneficial for the 'coming into force' to be phased. There are a number of ways to achieve this for specific frequency bands:

1) Delayed date of coming into force of the allocation and/or identification (like WRC-12 No. 5.316B)
2) Inclusion on the agenda of the next WRC.
3) Inclusion on the preliminary agenda of the following WRC.
4) Results of studies to be brought to a future WRC in the Report of the Director of the Radiocommunication Bureau (RB) - probably only appropriate for identification, not allocation (for WRC-15, this is agenda item 9).

We suggest that Ofcom considers these possibilities in developing UK and CEPT positions for WRC-15 agenda item 1.1 - especially the last one, as it has most flexibility to adapt to future developments.

3. Spectrum requirement forecasts: Responses to Ofcom questions:

Q1: 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?

Vodafone expects mobile data demand to grow rapidly in the coming years. Towards the end of the period under consideration these predictions have significant uncertainty, and might be affected by economic and societal factors that are not yet foreseen. Many studies (for example, the Europe Economics report for Ofcom) have found that mobile broadband creates significantly higher consumer benefit from use of spectrum than other significant uses. Ofcom should therefore take into consideration the higher growth projections, although these might be implemented through phasing of implementation (see section 2.1 of this response).

Several respected organisations produce predictions for the trends in future mobile data demand, and we recommend that Ofcom makes use of them.

It is difficult to break down data traffic by device category, especially over a period as far ahead as 2030. Many types of consumer device have only existed for a few years, new ones will certainly emerge by 2030, and some of those listed in para. 4.7 are likely to have faded away by then. For such a forward-looking study, it would be more reliable to consider the ways in which consumers might use mobile data than the categories of device that they would use.

Q2: What evidence do you think is relevant to assessing the extent of consumer benefits associated with meeting the increase in demand for mobile data?

See the response to Q1.

Q3: 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?

This question is based on the current ‘bipolar’ view of mobile data, in which the technology is either cellular or WiFi and the spectrum is either licensed or unlicensed. However, this is already changing, for example with licenced shared access (LSA) and

TV white spaces. By 2030 (and probably before), there is likely to be a much more diverse set of models for shared spectrum use, and a wider range of technologies supporting them (perhaps including an enhancement of LTE).

Q4: 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?

The performance of LTE is already close to the Shannon limit at the individual physical layer. Future improvements in spectrum efficiency are therefore likely to come mainly from developments in multiple antennas and radio network architecture, like MIMO and CoMP (co-operative multiple base station transmission). However, these techniques are often subject to constraints, which are often non-technical or frequency dependent:

- For MIMO, the size of devices, and therefore the number of de-correlated antennas that can be fitted in them.
- For MIMO, planning rules and sites costs for deployment of antennas.
- For CoMP, the cost and availability of high bandwidth backhaul.

Q5: 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?

See the comments in section 2 of this response.

Q6: 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?

See the comments in section 2 of this response.

Q7: 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?

Today, mobile networks are generally dimensioned for downlink capacity, because this is usually the limiting factor. This is likely to continue, although the ratio of downlink to uplink demand is likely to reduce over time. The applications that generate most traffic involve the transfer of high definition moving images and consumers are more likely to want to receive high quality video/programme content on mobile devices while generating shorter and lower resolution clips on the device.

Service categories (Table A5.4): The services categories for streaming are, by their nature, downlink biased. The other service categories are defined according to technical parameters rather than user applications, so it is difficult to give useful information for them.

4. Frequency ranges for consideration: Vodafone view

To maximise the benefits to citizens, consumers and UK companies, Ofcom should have the following objectives for WRC-15 agenda item 1.1:

- Sufficient spectrum for both capacity (to meet demand in urban areas) and coverage (to ensure that the digital divide continues to reduce).
- Global harmonisation (in terms of commonality of terminals)
- Suitability of bands to be implemented ubiquitously in terminals (in particular, new bands should where possible be adjacent to existing bands or within the frequency range of the components already needed in terminals).
- Sufficient spectrum in an individual band to facilitate an efficient licence award process.

The ability of individual bands to deliver these objectives is addressed in the responses to the following three questions, and these are summarised in a table at the end of this consultation.

5. Frequency ranges for consideration: Responses to Ofcom questions

Q8: 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?

Bands that Vodafone believes should be considered for mobile broadband at WRC-15

470 – 694 MHz

Vodafone envisages that the transition away from DTT may well happen quicker than envisaged by Ofcom in its UHF strategy statement[v] and that at least part of this band is likely to be released for mobile broadband well before 2030[vi]. Vodafone therefore believes that WRC-15 should make a co-primary mobile allocation for the whole of this band and request further studies on identification of part(s) of this band, to be considered by a future WRC under the report of the Director of the RB.

The proposal by Ofcom for deployment of TV White Space devices throughout this band already justifies a secondary allocation to the mobile service.

The Radio Spectrum Policy Group has proposed in its Draft Opinion on Wireless Broadband[vii] that the Commission should study the potential for deploying mobile broadband in the 3800 – 4200 MHz frequency band. Vodafone urges Ofcom to support this work, and to extend it to also address the 4400 – 4900 MHz band.

1452 – 1492 MHz, 1300 – 1400 MHz and 1427 – 1527 MHz

The 1452 – 1492 MHz band is already being considered in CEPT for supplementary mobile downlink. However, the value of this spectrum could be greatly increased if additional spectrum could be found in adjacent frequency bands. Vodafone believes that Ofcom should seek identification of at least 80 MHz by WRC-15 in the frequency range 1300 – 1518 MHz, excluding 1400 – 1427 MHz (plus co-primary mobile allocation if required). The option of using the whole of this wider band for supplementary downlink may have benefits:

- It would provide extra downlink capacity, to accommodate the downlink bias of many traffic forecasts.
- It would avoid the need for an extra PA in terminals (they are already likely to have an antenna and receiver, for GPS).
- It may ease coexistence with passive services in the 1400 – 1427 MHz band.

2700 – 2900 MHz

This band would be valuable for mobile broadband. It is adjacent to the 2.6 GHz band, which means that it would be easy to implement in terminals and base stations would not require extra antennas. The band forms part of the wider band of 2700 – 3400MHz, which is used for various type of radar. It is widely believed that this band is not used very intensively, and new radar technologies[viii] and RF filters[2] will reduce the spectrum needed. It should therefore be possible to accommodate all radar spectrum requirements above 2.9 GHz. The Government is already considering spectrum release in this band.

Vodafone therefore believes that the United Kingdom should propose that WRC-15 should make a primary allocation to the mobile service for this band, and identify it for IMT. Depending on the available bandwidth, the coexistence conditions for services in neighbouring bands and the potential for harmonisation of a bandplan, it might be appropriate for this spectrum to be used for downlink-only.

Future provision of IMT channels of up to 100MHz bandwidth

The predicted growth of mobile broadband traffic is likely to need IMT channel bandwidths of up to 100MHz at some point. The existing bands identified for IMT and the bands that are likely to be identified by WRC-15 are not large enough to support this capability, especially given Ofcom's view on the number of national wholesalers required in the UK.

[2] The use of RF filters has already been shown to improve coexistence between radars and mobile services in the 2.6GHz band; a similar benefit would be expected between two radars.

3800 – 4200 MHz, 4400 – 4900 MHz

Annex 6 of the consultation document suggests that these bands are relatively lightly used in UK, and the geographic usage could well be complementary to the likely deployment of mobile broadband. Both bands already have mobile allocations:

- The 3800 – 4200 MHz band already has a primary mobile allocation in Regions 2 and 3 and a secondary mobile allocation in Region 1.
- The 4400 – 4900 MHz band already has a global primary mobile allocation.

These bands therefore look promising for future identification for IMT, for wider channel bandwidths. If WRC-15 considers it premature to make decisions for developments of IMT to higher channel bandwidths, there needs to be a roadmap towards action at a future conference, as discussed in section 2 of this response.

13.4 – 14 GHz, 18.1 – 18.6 GHz, 27 – 29.5 GHz, 38 – 39.5GHz

Studies on these bands are at an early stage, in terms of both technology and propagation in the mobile environment. The parameters needed for coexistence studies will not have been developed in time for WRC-15. It would therefore be premature for WRC-15 to identify these bands for IMT.

The 18.1 – 18.6 GHz, 27 – 29.5 GHz and 38 – 39.5GHz bands already have a co-primary allocation to the mobile service, so no regulatory change is needed in order for them to be used for IMT (an identification of a band for IMT is not considered to represent a change of regulatory status). These bands would therefore be suitable for the 'Report to the Director of the RB' approach, as described in section 2 of this response.

The 13.4 – 14 GHz band does not at present have a mobile allocation, and co-existence with the current Primary services in this band might be problematic.

Comments on other bands

1400 – 1427 MHz, 1518 – 1559 MHz, 1626.5 – 1660.5 MHz, 1668 – 1675 MHz, 1695 – 1700 MHz, 5850 – 6425 MHz

Vodafone would be content for these bands not to be considered for mobile broadband.

Q9: 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?

We believe that Ofcom should work jointly with Government departments to consider the potential for releasing the following bands for mobile broadband:

2090 – 2110 MHz and 2200 – 2215MHz

These bands would create considerable consumer benefit, by pairing them with 1900 - 1920MHz and 2010 – 2025MHz. They are immediately adjacent to the 2GHz UMTS band that was awarded in 2000, and they could be ubiquitously implemented in terminals at negligible cost. The lower bands for pairing are either already licenced for mobile broadband or are vacant throughout the EU.

We appreciate that CEPT has decided not to consider these pairings further, but the decisions were made without any real consideration of the benefits and costs. We would therefore urge Ofcom to undertake a proper study, together with the relevant Government departments, of the potential for these bands to be released for mobile broadband. We appreciate that the nature of the current uses of these bands may mean that the results cannot be made public, but stakeholders need to be given assurance that a proper study has been carried out.

1980 – 2010 MHz paired with 2070 – 2200 MHz

This band was awarded in EU to two companies[3] under Commission Decision 626/2008/EC and 2011/667/EU, but there is no evidence of plans to offer commercial services using this spectrum. The Decision required the licence holders to meet milestones for the launch of satellites and offering of commercial services, which have all now passed.

The EU Committee COCOM has established a Working Group on MSS issues[ix] which, inter alia, will examine "any alleged specific breach of the common MSS authorisation conditions in accordance with Article 9(2) of Decision 626/2008/EC" and "facilitating and coordinating … the application of Member States' rules on enforcement to any authorised operator of mobile satellite systems … including rules for suspension or withdrawal of authorisations".

Vodafone urges Ofcom and DCMS to ensure that this spectrum is brought into use that will benefit citizens and consumers, if not for MSS then for mobile broadband. It should be pro-active in taking the steps that are contemplated in the terms of reference of the Working Group, to ensure that this spectrum is brought into productive use at the earliest opportunity.

Q10: What are your views on bands which should be a priority for consideration for mobile broadband?

There are two dimensions to priority of a band; the importance of the band for delivering mobile broadband and the timescale in which it would be needed. As discussed above, the decisions taken by WRC-15 on agenda item 1.1 need to be capable of ensuring the orderly release of sufficient spectrum for mobile broadband until around 2030.

[3] Inmarsat Ventures Limited and Solaris Mobile Limited.

Vodafone therefore believes that the priorities of the United Kingdom for WRC-15 agenda item 1.1 should be:

1) Co-primary mobile allocation of the 470-694MHz band by WRC-15 and further studies on identification of part of this spectrum, to be considered by a subsequent WRC through the report of the Director of the RB.
2) Review of Resolution ITU-R SA.1154 for the bands 2090-2110MHz and 2200-2215MHz.
3) Primary mobile allocation (if needed) and identification for IMT of at least 80MHz of spectrum (and preferably more) within the frequency range 1300-1518MHz
4) Global alignment of regulatory status of 3400-3800MHz.
5) A roadmap towards availability of spectrum to support individual IMT channels of up to 100MHz bandwidth.

Vodafone Ltd
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Summary of Vodafone views on bands to be considered for Mobile Broadband				
	Frequency band (MHz)	VF View	Portion to be considered	Comments
1	470 - 694	HIGH	All	Mobile allocation at WRC-15; identification at a subsequent conference.
2	1300 - 1400	HIGH	At least 80MHz and preferably >100MHz, from 1300 - 1400MHz and 1427 – 1518MHz	
3	1400 - 1427	**X**		
4	1427 - 1527	HIGH		
5	1452 - 1492	HIGH		Do not award until after WRC-15, to avoid prejudicing implementation of the outcome
6	1518 - 1559	**X**		
7	1626.5 - 1660.5	**X**		
8	1668 - 1675	**X**		
9	1695 - 1700	**X**		
10	1900 -1920 (paired with 2090 - 2010)	HIGH		No action needed by a WRC Provides high consumer benefit
11	1980 - 2110 paired with 2170 - 2200	HIGH		No action needed by a WRC Provides high consumer benefit
12	2010-2025 (paired with 2200 – 2215)	HIGH		No action needed by a WRC High consumer benefit
13	2025 - 2110	HIGH	2090 - 2110	See table row 10
14	2200 - 2290	HIGH	2200 - 2215	See table row 12
15	2700 - 2900	HIGH		Possibly downlink-only
16	3400 - 3600	✓		Global (or, if not, then Region 1) primary allocation and identification
17	3600 - 3800	✓		Primary mobile allocation and identification
18	3800 - 4200	✓		Needs the mobile allocation upgrading to primary in Region 1. Studies on identification for IMT required.
19	4400 - 4900	✓		Studies on identification for IMT required (already has a global primary mobile allocation).
20	5350 - 5470	✓		To provide a continuous 5GHz band for wideband RLANs
21	5850 - 6425	**X**		
22	13.4 -14 GHz			
23	18.1 - 18.6GHz	Longer term		Dependent on alternative solutions for mobile network backhaul.
24	27 - 29.5GHz			
25	38 - 39.5GHz			
	KEY: HIGH	High priority band for Vodafone at WRC-15		
	✓	Vodafone supports allocation and/or identification of this band		
	X	Vodafone would be content for this band not to be considered further.		

[i] For example, Economic impact of the use of radio spectrum in the UK; Europe Economics, 16 November 2006
http://stakeholders.ofcom.org.uk/market-data-research/other/spectrum-research/economic_spectrum_use/

[ii] Techniques for increasing the capacity of wireless broadband networks: UK, 2012-2030; Real Wireless on behalf of Ofcom; March 2012.

[iii] ITU-R Recommendation M.1768, Methodology for calculation of spectrum requirements for the terrestrial component of International Mobile Telecommunications; March 2006, revised April 2013.

[iv] Forecasting the need for new spectrum allocation, Jonathon Sandbach; Reforming Spectrum Policy – Vodafone Policy Paper no. 5; October 2006;
http://www.vodafone.com/content/dam/vodafone/about/public_policy/policy_papers/public_policy_series_5.pdf

[v] UHF strategy statement : Securing long term benefits from scarce low frequency spectrum; Ofcom, 16 November 2012

[vi] See the Vodafone response to the Ofcom consultation: Award of the 600 MHz spectrum band, 6 Februrary 2013.

[vii] Draft RSPG Opinion on Strategic Challenges facing Europe in addressing the Growing Spectrum Demand for Wireless Broadband; RSPG-511 Rev1, 20 February 2013.

[viii] Study into Spectrally Efficient Radar Systems in the L and S Bands - Report; BAE Systems for Ofcom, July 2006
http://stakeholders.ofcom.org.uk/market-data-research/other/technology-research/research/spectrum-efficiency/sers/

[ix] Terms of Reference of the Working Group on the implementation of the framework for pan European systems providing mobile satellite services (MSS) for 2013; COCOM13-05 Final