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

World Radiocommunication Conference 2015
Agenda item 1.1

Call for Input

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Contents

Section 1

Summary

1.1   World Radiocommunication Conferences (WRCs) of the International Telecommunication Union (ITU) set the international regulatory framework for spectrum by amending and agreeing a set of regulations (the "Radio Regulations"[1]) that defines the status of different radio services with respect to neighbouring territories. In addition, WRCs can agree on harmonisation measures for particular wireless applications. These conferences occur every three to four years with an agenda established by the previous conference.

1.2   Ofcom takes the lead for the United Kingdom (UK) in WRC negotiations under direction from the Government. We are therefore actively engaged in UK, European and international preparations for the next WRC in 2015 (WRC-15).

1.3   One of the issues at WRC-15 is agenda item 1.1, which concerns the availability of spectrum for mobile broadband applications over the next 10 to 15 years. It is anticipated that new spectrum ranges are likely to be needed in future to accommodate growing demand for mobile data. WRC-15 will therefore consider options for new frequency allocations suitable for mobile broadband (including Wi-Fi) and identification of frequency ranges as suitable for International Mobile Telecommunications (IMT), the ITU term that encompasses 3G, 4G and 5G wireless broadband systems.

1.4   The purpose of this Call for Input is to give stakeholders an opportunity to state their views and provide evidence on:

• the future spectrum requirements for mobile broadband; and

• the set of potential frequency ranges that WRC-15 could consider for new mobile allocations.

1.5   We are issuing the Call for Inputs now as we want to use the results to inform the development of UK positions and negotiating lines for two key ITU-R[2] meetings in July, which will be prioritising frequency ranges for study and reaching initial conclusions on spectrum requirements for mobile broadband. These positions and negotiating lines will also feed through to the associated meetings of the European Conference of Postal and Telecommunication Administrations (CEPT), specifically the Conference Preparatory Group (CPG) and CPG Project Team D (CPG PTD) which are responsible for co-ordinating European positions for WRCs. In addition to the ITU-R and CEPT activity, there are other initiatives underway to assess the availability of spectrum for mobile broadband, including within the EU, and the results from this call for input will also inform our work in these areas.

1.6   Although there are linkages, the availability of spectrum for mobile broadband in the United Kingdom is a separate matter from the allocations and identifications that may be made by WRC-15. When Ofcom comes to make decisions about how to authorise use of the spectrum bands for any purpose, including for mobile broadband, it must do so in accordance with its relevant statutory duties as set out in the

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[1] http://www.itu.int/pub/R-REG-RR-2012
[2] ITU-R is the sector of the ITU responsible for radiocommunication matters

Communications Act 2003, the Wireless Telegraphy Act 2006, and applicable EU law. If WRC-15 identifies spectrum for IMT this does not necessarily mean that it will be used for that purpose in the UK. On the other hand, if WRC-15 does not identify a spectrum band for IMT then it is somewhat unlikely that it will be used for that purpose in the UK.

1.7   Related work is taking place within the European Union, where the Radio Spectrum Policy Group (RSPG) is undertaking a detailed analysis of spectrum bands between 400 MHz and 6 GHz which could in future become available for wireless broadband. This is in response to last year's Radio Spectrum Policy Programme (RSPP) which requires Member States to make every effort to identify at least 1200 MHz of spectrum for wireless data traffic by 2015. The RSPG work is strategic in nature and aims to provide policy advice to the European Commission, as opposed to the more technically focused work being undertaken within CEPT and ITU. On 7 March the RSPG issued a consultation on a draft Opinion on wireless broadband with responses required by 29 April 2013[3].

1.8   Ofcom intends to provide further opportunities for comment on the full range of issues which will be addressed at WRC-15, and on our approach to responding to the forecast requirements for mobile broadband data. We will be engaging further with stakeholders on these issues, and we also welcome stakeholder views at any point in the WRC-15 preparation process through the appropriate stakeholder groups.

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[3] https://circabc.europa.eu/w/browse/c3655829-2ac1-47fe-93b4-8f47c6da3bfa

Section 2

Introduction

Background

2.1 World Radiocommunication Conferences (WRCs) of the International Telecommunication Union (ITU) set the international regulatory framework for spectrum by amending and agreeing a set of regulations (the "Radio Regulations"[4]) that defines the status of different radio services with respect to neighbouring territories. In addition, WRCs can agree on harmonisation measures for particular wireless applications. These conferences occur every three to four years with an agenda established by the previous conference.

2.2 Ofcom takes the lead for the United Kingdom (UK) in WRC negotiations under direction from the Government. We are therefore actively engaged in UK, European and international preparations for the next WRC in 2015 (WRC-15).

2.3 One of the issues at WRC-15 is agenda item 1.1, which concerns the availability of spectrum for mobile broadband applications over the next 10 to 15 years. It is anticipated that new spectrum ranges are likely to be needed in future to accommodate growing demand for mobile data. WRC-15 will therefore consider options for new frequency allocations suitable for mobile broadband (including Wi-Fi) and identification of frequency ranges as suitable for International Mobile Telecommunications (IMT), the ITU term that encompasses 3G, 4G and 5G wireless broadband systems.

2.4 The ITU's Radio Regulations contain a Table of Frequency Allocations. This table sets out the status of the radiocommunication services (such as Fixed, Mobile, Broadcasting and Satellite) in each frequency band with respect to neighbouring territories. A service may have a primary allocation, a secondary allocation, or no allocation in any given frequency band, and most frequency bands contain allocations to multiple services. Within a frequency band, stations of a service with a primary allocation may claim protection from interference from stations using a service which has a secondary allocation or stations of a service that does not have an allocation in that frequency band in a neighbouring country. Each country will then have its own national allocation table, such as the UK Frequency Allocation Table[5], reflecting the status of services within that country.

2.5 Mobile broadband applications fall within the scope of the Mobile service. The service definitions can cover a variety of applications and systems, and so "identification" is an additional measure that has been used to indicate the bands that are suitable for use for a particular system. Identification of a band as suitable for IMT does not prevent the use of other mobile systems to provide applications of the Mobile service. It gives no elevated status, either with respect to other primary radio services or with respect to other systems within the same radio service and it does not prevent IMT systems from being used in bands without IMT identifications.

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[4] http://www.itu.int/pub/R-REG-RR-2012
[5] http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-policy-area/spectrum-management/ukfat2010.pdf

2.6   Although identification for a system does not elevate its regulatory status, there is merit in this process for particular systems. In the case of mass-market mobile and wireless broadband networks, the frequency bands identified become the bands that administrations around the world are most likely to make available for that purpose. These are the bands where high volumes of equipment are developed and the benefits of economies of scale flow from this, as well as the benefits of inter-operability within and across different countries.

2.7   IMT systems have been the main method of delivering wide area mobile broadband applications for over a decade. Several bands in the Radio Regulations are currently identified as those suitable for IMT.

2.8   Preparatory work for WRC-15 agenda item 1.1 is taking place in Joint Task Group 4-5-6-7 (JTG 4-5-6-7) of the ITU and in Conference Preparatory Group Project Team D (CPG PTD) of the European Conference of Postal and Telecommunications Administrations (CEPT). Ofcom is closely engaged in discussions in the ITU-R and CEPT groups.

2.9   When Ofcom comes to make decisions about how to authorise use of the spectrum bands for any purpose, including for mobile broadband, it must do so in accordance with its relevant statutory duties as set out in the Communications Act 2003, the Wireless Telegraphy Act 2006, and applicable EU law

2.10   Although there are linkages, the availability of spectrum for mobile broadband in the United Kingdom is a separate matter from the allocations and identifications that are made by WRC-15. If WRC-15 identifies spectrum for IMT this does not necessarily mean that it will be used for that purpose in the future in the UK. Ofcom would need to consider such policy decisions at a later point, taking account of any relevant harmonisation measures, such as CEPT ECC Decisions or European Commission Decisions. On the other hand, if WRC-15 does not identify a spectrum band for IMT then it is somewhat unlikely that it will be used for that purpose in the UK.

Spectrum strategy refresh and mobile data strategy

2.11   In Ofcom's draft Annual Plan[6] we outlined that we are now close to completing most of the major tasks set out in the *Spectrum Framework Review (SFR): Implementation Plan*. We also noted that it is seven years since we published our spectrum strategy in the SFR. We are now, therefore, looking to build on the lessons learnt to refresh our spectrum management strategy and develop a new forward-looking work programme to help us implement this refreshed strategy. The strategy will look at our overall strategic approach to spectrum management; the future market, technology and regulatory changes that might affect spectrum use over the next five to ten years; the specific future challenges we, as the regulator, might face; and the priority activities we may need to undertake to meet these challenges. As a result we expect to identify the need for specific spectrum management strategies for some key sectors. In particular, we expect to identify the need for a mobile data strategy to guide the correct mix of spectrum in future.

2.12   As part of this mobile data strategy and in addition to our work to prepare for the possible change of use for mobile of the 700 MHz band, we will review the implications for other spectrum bands of continued growth in mobile data demand. Our objective will be to set out a longer-term road map for the provision of spectrum

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[6] http://stakeholders.ofcom.org.uk/binaries/consultations/annuealplan1314/summary/condoc.pdf

for mobile data to meet the growing demand for wireless services by consumers. We will specifically consider the role of licensed spectrum for the core mobile networks, the associated spectrum requirements and applications to support mobile backhaul and meshed networks, and licence-exempt use.

WRC-15 agenda item 1.1

2.13   WRC-15 agenda item 1.1 will consider possible additional spectrum allocations to the mobile service, suitable for delivery of mobile broadband applications. The rationale for this agenda item is to address future demand for mobile broadband, where terrestrial wireless systems provide a key means of broadband delivery, alongside cable, fibre and satellite. It is forward looking, and considers spectrum that could be suitable for new mobile allocations and/or identification for IMT.

2.14   Technical studies in support of WRC-15 agenda item 1.1 will take the form of:

- forecasts of the spectrum requirements of IMT and other terrestrial mobile broadband applications, taking account of the projected future demand for wireless data;

- studies on potential candidate frequency bands; and

- sharing and compatibility studies with services already having allocations in the potential candidate bands and in adjacent bands, as appropriate.

2.15   The consideration of sharing and compatibility in the ITU context will focus on the international impact, i.e. the impact on a neighbouring country's spectrum use or on space services. It does not normally consider domestic matters because these are within the responsibility of the national administrations. It should also be noted that in the past, studies have indicated that sharing would be difficult, or subject to a number of constraints, and new allocations have still been agreed. Studies that reveal considerable difficulties with sharing do not necessarily imply that a WRC would not add a new allocation.

2.16   The outcome of this agenda item at WRC-15 could include:

- new primary mobile allocations, identified as suitable for IMT;

- addition of IMT identification in bands that already have a mobile allocation; and

- new mobile allocations for other mobile broadband applications, such as Wi-Fi and similar systems (Wi-Fi currently has specific primary mobile allocations in the 5 GHz bands and operates in spectrum that is also designated for Industrial Scientific and Medical (ISM) devices in the 2.4 GHz band).

2.17   Allocations could be full entries in the Table of Allocations, or through other means, such as additional allocations by footnote in specific countries. Recent WRC history provides a number of examples in this regard. Allocations might also come with conditions applied through a footnote or a Resolution, with the objective of protecting other services in neighbouring countries. These could include technical conditions and specific timing for an allocation to come into effect.

Related WRC agenda items

2.18   WRC-15 agenda item 1.2 will consider technical compatibility studies resulting from the WRC-12 agreement to introduce a primary mobile allocation and IMT identification in 694-790 MHz in Region 1, effective after WRC-15. The 694-790 MHz band is expected to become a key band for mobile broadband and there is therefore a close linkage between agenda items 1.1 and 1.2.

2.19   WRC-15 agenda item 1.3 is focussed on spectrum for public protection and disaster relief (PPDR). This encompasses spectrum requirements of the emergency services, and is another application that is within the scope of the mobile service in the Radio Regulations. We anticipate that there are likely to be proposals to identify globally or regionally harmonised additional spectrum for this application in response to this agenda item. There could be linkage of this agenda item to agenda items 1.1 and 1.2, not least as this is an application within the mobile service. Moreover, there are discussions about the use of IMT technologies for PPDR and about the scope for commercial networks to provide broadband PPDR services.

2.20   The full agenda for WRC-15 is in Resolution 807[7], which is available on the ITU website.

Related work in the UK and the EU

2.21   Within the European Union, the Radio Spectrum Policy Programme (RSPP) has set out a series of policy objectives, including an obligation on Member States to make every effort to identify at least 1200 MHz of spectrum for wireless data traffic (to consumer devices) by 2015. European Member States and the Commission are currently implementing the provisions set out in the RSPP and the Commission has indicated that it will shortly be publishing a Wireless Action Plan.

2.22   The European Radio Spectrum Policy Group (RSPG) – which provides strategic advice to the European Commission on matters of spectrum policy – is also undertaking work in this area. Of most relevance is the draft RSPG Opinion on strategic challenges facing Europe in addressing the growing spectrum demand for wireless broadband, which is currently being consulted upon[8]. This includes an analysis of bands between 400 MHz and 6 GHz which are currently available, or more significantly could become available in future, for wireless broadband.

2.23   This analysis has some clear parallels with the preparations for WRC-15 and it is likely that the Opinion will influence the European Common Proposals that will be developed in advance of the Conference. Nonetheless the RSPG Opinion is at this stage distinct and different from the work being undertaken for Agenda Item 1.1, not least in that the RSPG work includes those bands which are already identified for IMT in the ITU Radio Regulations. In addition, while the ITU and work in CEPT is focused around technical aspects relating to the WRC Agenda, the RSPG work and in particular the interests of the European Commission tend to be more focused around broader political and strategic discussions. It seems likely that the European Commission may seek to engage more closely in some key policy aspects of the WRC agenda, especially the Agenda Items on wireless broadband, as we get closer to the start of the Conference.

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[7] http://www.itu.int/oth/R0A0600004D/en
[8] https://circabc.europa.eu/w/browse/c3655829-2ac1-47fe-93b4-8f47c6da3bfa

2.24   Additionally, in the United Kingdom, Government issued a Call for Evidence in its March 2011 publication *Enabling UK growth: Releasing public spectrum*[9]. This considered issues of spectrum demand, timing of release and prioritisation of frequency bands. Following this it has set out a programme[10] to release 500 MHz of UK public sector spectrum, which could be suitable for mobile broadband.

2.25   We also recently asked for views on spectrum demand for mobile data in our consultation on a strategy for UHF bands IV and V[11]. As noted in paragraph 2.12 we are working to prepare for a possible change of use of the 700 MHz band, and we will be consulting on aspects of this work in due course.

2.26   In addition to our preparations for WRC-15, we are also undertaking a strategic review of our approach to making spectrum available for licence-exempt use. This work is likely to involve an assessment of whether there is sufficient spectrum available for various licence exempt uses, including Wi-Fi to deliver local area mobile broadband applications, and of options for making additional spectrum available. It is likely that a number of the questions asked in this call for inputs will also be relevant to our strategic review, and we will be engaging further with stakeholders on the issue of licence exempt use of spectrum to inform our broader strategic activities.

Further opportunities to comment on our plans

2.27   This Call for Input is part of our ongoing process of ensuring that our knowledge and approach remains up to date with developments, and there will be further opportunities for stakeholders to comment on our approach to meeting the UK's demand for mobile data and on developments in WRC-15 agenda item 1.1, as well as more generally across the various items on the WRC Agenda.

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[9] https://www.gov.uk/government/publications/enabling-uk-growth-releasing-public-sector-spectrum-march-2011
[10] https://www.gov.uk/government/publications/enabling-uk-growth-releasing-public-spectrum-update-on-progress-to-december-2011
[11] http://stakeholders.ofcom.org.uk/consultations/uhf-strategy/

Section 3

Current mobile broadband spectrum

Current IMT spectrum identified in the Radio Regulations

3.1   Table 1 sets out the spectrum currently identified for International Mobile Telecommunications in the Radio Regulations:

Table 1: International Mobile Telecommunications spectrum

Region 1: Europe, Middle East and Africa	Region 2: The Americas	Region 3: Asia and Australasia	UK national
450-470 MHz	450-470 MHz	450-470 MHz	This is used for other mobile applications (private business radio) and is not currently available in the UK for mobile broadband
694-790 MHz[†]	698-960 MHz	698-790 MHz*	Long-term objective of providing more low frequency spectrum for mobile broadband[12]
790-960 MHz			800 MHz band, awarded in early 2013 900 MHz band, currently in use
1710-1885 MHz	1710-1885 MHz	1710-1885 MHz	1800 MHz band, currently in use
1885-2025 MHz[‡]	1885-2025 MHz[‡]	1885-2025 MHz[‡]	2 GHz band, currently in use
2110-2200 MHz	2110-2200 MHz	2110-2200 MHz	
2300-2400 MHz	2300-2400 MHz	2300-2400 MHz	Planned release of part of this spectrum by MOD
2500-2690 MHz	2500-2690 MHz	2500-2690 MHz	2.6 GHz band awarded in early 2013
3400-3600 MHz*	No spectrum above 2690 MHz has been identified for IMT in Region 2	3400-3600 MHz*	3.5 GHz band, currently in use (2x20 MHz) Planned release of further spectrum in this band by MOD[10]

[†]This allocation is expected to be effective immediately after WRC-15
*The allocation and/or identification is limited to specified countries in the Region
[‡]1980-2010 MHz and 2170-2200 MHz allocated to MSS (satellite component of IMT).

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[12] http://stakeholders.ofcom.org.uk/consultations/uhf-strategy/statement/

3.2   In several cases, the actual spectrum made available by national administrations does not entirely fill the full range of the identification in the Radio Regulations.

3.3   Ofcom recently published a statement on the 700 MHz band in which we said that we have decided to aim to secure the dual long term strategic objectives of providing more low frequency spectrum for mobile broadband whilst also securing the ongoing delivery of benefits provided by digital terrestrial television (DTT). To achieve this we will:

- support the international process and seek to enable a harmonised release of additional low frequency spectrum for mobile broadband; and

- seek to ensure that the DTT platform can access alternative frequencies assuming that some its spectrum will be reallocated for mobile use. This approach will also support services sharing spectrum with DTT including wireless microphone links.

3.4   In the United Kingdom, the 800 MHz band was recently awarded[13] on the basis of the European harmonised channelling arrangement of 791-821 MHz (downlink) and 832-862 MHz (uplink). This frequency band was first identified as suitable for IMT in 2007.

3.5   The 900 MHz band is arranged in a European harmonised channelling arrangement as 880-915 MHz (uplink) and 925-960 MHz (downlink). This spectrum is currently being used for 2G and 3G, and Ofcom recently consulted[14] on liberalisation to allow 4G technology in this band.

3.6   The 1800 MHz band is arranged in a European harmonised channelling arrangement as 1710-1781.7 MHz (uplink) and 1805-1876.7 MHz (downlink). In the UK part of this spectrum is currently being used for 2G/GSM and 4G, and Ofcom recently consulted[14] on liberalisation in further parts of this band. The remainder of the 1800 MHz European harmonised channelling arrangement (1781.7-1785 MHz and 1876.7-1880 MHz) is used for concurrent spectrum access on a shared basis.

3.7   The terrestrial 2 GHz band uses the European harmonised arrangement for paired spectrum as 1920-1980 MHz (uplink) and 2110-2170 MHz (downlink). This spectrum is currently used for 3G, and Ofcom's liberalisation consultation[14] has proposed to liberalise the mobile licences in this band to permit the deployment of 4G services. The 3G auction in the year 2000 also assigned the lower blocks of unpaired spectrum (1899.9-1920 MHz) for use for 3G. The upper blocks of unpaired spectrum (2010-2025 MHz) are not currently available for wireless broadband in the UK, but a number of European countries have assigned spectrum in the upper unpaired blocks to mobile operators. CEPT Working Group on Frequency Management (WG FM) is currently investigating possible alternative uses for the unpaired 2 GHz spectrum, in response to a Commission mandate[15], and in reflection of the low take-up of these bands for mobile to date across the European Union. The 1980-2010 MHz and 2170-2200 MHz portions of the 2 GHz IMT band are allocated to MSS and currently licensed to Inmarsat Ventures Ltd and Solaris Mobile Ltd under EC Decision 2009/449/EC dated 13 May 2009.

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[13] http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-awards/awards-in-progress/notices/4g-final-results.pdf
[14] http://stakeholders.ofcom.org.uk/consultations/variation-900-1800-2100/
[15] http://www.cept.org/Documents/ecc/7750/ECC(12)INFO11_Mandate-on-unpaired-2-GHz

3.8   The 2300-2400 MHz spectrum is not currently available for wireless broadband. The update[10] from Government on public spectrum release categorised this band as a priority for MOD to release part of this spectrum.

3.9   The 2.6 GHz band was recently awarded[13] on the basis of the European harmonised arrangement of 2500-2570 MHz (uplink) and 2620-2690 MHz (downlink), together with 2570-2620 MHz (unpaired). This frequency band was first identified as suitable for IMT in 2000.

3.10   In the 3.5 GHz, there is currently one wireless broadband network with spectrum at 3480-3500 MHz and 3580-3600 MHz. The update[10] from Government on public spectrum release categorised this band as a priority for MOD to release part of this spectrum.

Wi-Fi

3.11   Wi-Fi operates under specific primary mobile allocations in the 5 GHz bands and also operates in spectrum designated for Industrial Scientific and Medical (ISM) devices in the 2.4 GHz band. Although Wi-Fi is not an ISM application, it is effectively provided security in this band by the regulatory situation applied to shared bands which are used by ISM devices.

Public Sector spectrum planned for release

3.12   In December 2011, Government announced an update[10] on progress with the work on releasing 500 MHz of public sector spectrum. In this update, Government indicated that it had refined its initial list of bands, and prioritised the bands which have the best potential for achieving the 500MHz target, as outlined in Table 2.

Table 2: Potential public sector spectrum releases currently being examined by Government (source: Enabling UK growth: releasing public spectrum - update on progress, December 2011)

Source of release	Potential bands Identified	Potential release
MOD Priority releases & other short term opportunities	2.3 GHz-2.4 GHz 3.4 GHz-3.6 GHz	200MHz
	870-72 & 915-17 MHz	4MHz
MOD & ES Sharing Opportunities	Number of bands	80-120MHz
Longer term releases	2.7 GHz-3.1 GHz	Up to 100MHz
	4.4 GHz-5.0 GHz	50MHz
Total potential		**Up to 474MHz**
Other bands to be explored further	Number of bands below 5GHz (incl. 4.2-4.4GHz and 2.9-3.4GHz) 5.0 GHz-6.0 GHz (outside current target)	

3.13 The December 2012 update[16] from the Ministry of Defence indicated that it was planning to take releases at 2310-2400 MHz and 3410-3600 MHz to market in 2013/14 and 2015/16 respectively.

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[16] https://www.gov.uk/sharing-defence-spectrum

Section 4

Spectrum requirement forecasts

Introduction

4.1   As part of the WRC-15 agenda item 1.1 preparation process, studies on the future spectrum requirements for mobile broadband applications are currently being carried out. These take into account the evolving needs, including user demand, for IMT and other terrestrial mobile broadband applications. ITU-R Working Parties (WPs) 5A and 5D have been tasked with providing a spectrum estimate for mobile broadband applications as an input to overall preparation work being led by JTG 4-5-6-7.

4.2   There had been a number of studies published, including studies[17,18] commissioned by Ofcom, which suggested that growth for wireless broadband traffic is set to rise rapidly in the future, though their forecasts differ widely even in the short term (i.e. five years).

4.3   It is anticipated that the forecast growth in mobile broadband traffic demand will need to be met by a combination of:

* improvements in spectral efficiency from technology developments such as the use of more advanced modulation and coding, advanced antenna techniques and interference management techniques;

* changes in network topology such as offloading to small cells (femtocells or Wi-Fi networks) or increasing the number of base stations; and

* making available additional spectrum.

Spectrum demand parameters

4.4   To inform our thinking on the need for identification of additional spectrum for terrestrial mobile broadband applications, Ofcom has commissioned an external study to obtain as robust an estimate as possible for the 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[19], with the objective of providing a direct read across to the global spectrum estimates being developed in ITU-R under this agenda item. Where necessary, the methodology will be amended to account for the requested details of spectrum requirements specified by JTG 4-5-6-7 in its liaison[20] to WP 5A and WP 5D, namely:

* the amount of the total spectrum requirement needed for coverage, for capacity and for performance;

* how the spectrum requirements might vary between different market settings; and

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[17] http://www.ofcom.org.uk/static/uhf/real-wireless-report.pdf
[18] http://stakeholders.ofcom.org.uk/market-data-research/other/technology-research/2011/4G-Capacity-Gains/
[19] http://www.itu.int/rec/R-REC-M.1768/en
[20] http://www.itu.int/md/R12-WP5D-C-0217/en

- the level of asymmetry between the downlink and uplink for traffic and spectrum requirements.

4.5   We are seeking stakeholder views on some key market and technology-related parameters to inform this study. Specifically we would like views on the following issues for the period from 2015 to 2030:

- future UK mobile data demand;

- offload of UK mobile data to Wi-Fi and other technologies in licence-exempt spectrum;

- spectral efficiency of mobile technologies;

- mobile application data rates;

- the prevalence of small cells; and

- the balance between uplink and downlink traffic.

4.6   We have provided a description of the key parameters and example values in the study that we have commissioned in Annex 5. Responses to the questions in this section of the Call for Input will be used at the end of the study to validate and sense-check the results of the study.

Future UK mobile data demand

4.7   For the purposes of this Call for Input and the external study, we have defined mobile data demand as data generated by a range of consumer devices such as:

- personal mobile devices which are capable of operating in licensed mobile spectrum bands but may offload some traffic to licence exempt bands (i.e. phones, tablets and dongles that can use licensed spectrum);

- home and office routers which make use of licensed spectrum as an alternative to a fixed line connection;

- portable computing devices such as laptops and tablets without support for licensed spectrum;

- fixed computing devices such as desktops;

- home and office networking devices such as smart TVs, networked audio systems, etc.; and

- machine to machine communication devices such as remote monitoring, meters, CCTV, etc.

4.8   We consider demand generated by cellular backhaul to be beyond the scope of mobile data demand in the context of this study.

4.9   We are seeking stakeholder views and evidence on the following questions:

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,

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> *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?*

> *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?*

4.10   We will consider the demand for licensed and licence-exempt spectrum separately.

Future UK data offload to Wi-Fi or other technology in licence-exempt spectrum

4.11   Given the data demand considered previously, one approach which can potentially reduce the level of demand placed on licensed spectrum is by carrying a portion of mobile data over Wi-Fi and similar systems operating in licence-exempt bands.

4.12   This is commonly known as 'offload' and is currently expected to be mainly over Wi-Fi technology. Currently there are two main Wi-Fi offload options:

- carrier Wi-Fi systems, where the operator can directly balance traffic between licence and licence exempt networks; and

- self-provided Wi-Fi where the consumer manually activates the connection to their own or a third party local access point.

4.13   We are seeing stakeholder views and evidence on the expected level of mobile data offload from licensed spectrum to licence-exempt spectrum.

> *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.?*

Spectral efficiency of mobile technologies

4.14   The mobile demand which is not offloaded must be carried over licensed mobile spectrum.

4.15   The quantity of spectrum which is then required on a given cell of a mobile network depends on the spectral efficiency of the mobile technology which that cell supports. Within cellular networks, with the introduction of small cells, there are now a range of cell sizes (macro cell, microcell, picocell and hotspot) to consider when estimating the spectral efficiency density of a given technology (e.g. LTE, LTE-Advanced). Also, as technology evolves over time and latest device penetration improves, the average spectral efficiency for a given technology and cell type combination will also improve over time. Table A5.1 of Annex 5 provides some example values for spectral efficiency, based on the methodology in Recommendation ITU-R M.1768-1.

4.16   We are seeking stakeholder views and evidence on the following questions:

> *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?*

Mobile application data rates

4.17   The quantity of spectrum required will depend not only on the quantity of data demand but also the mean data rate that a user could expect on a given radio access technology in a given cell type (macro cell, microcell, picocell and hotspot). Table A5.2 of Annex 5 provides some example values for mean service bit rates, based on the methodology in Recommendation ITU-R M.1768-1.

4.18   We are seeking stakeholder views and evidence on the following questions:

> *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?*

Small cells

4.19   Mobile networks are increasingly looking to a variety of cell types to complement macrocells and carry traffic efficiently, yielding a 'heterogeneous network' comprising macrocells together with small cells of various types (microcells, picocells, femtocells, etc.).

4.20   The quantity of licensed mobile spectrum required will depend significantly on the practical, technical and economic limits on deployment of different cell types, as well as on the proportion offloaded to licence-exempt systems. Table A5.3 of Annex 5 provides some example values for the proportion of the population in the service area of different cell types, based on the methodology in Recommendation ITU-R M.1768-1.

4.21   We are seeking stakeholder views and evidence on the following questions:

> *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?*

Uplink / Downlink balance

4.22   Spectrum estimates must allow for both the uplink and downlink demand generated by different service types. In the case of conversational voice, the ratio of downlink to uplink traffic may be well balanced. However, for other services like web browsing, downlink traffic will likely be much more dominant with the uplink consisting largely of acknowledgements. This balance may change further in the future, due to the take-up of cloud services, or may be different in particular localised areas such as sports venues, for both of which the uplink may account for a larger proportion of demand.

4.23   We are seeking stakeholder views and evidence on the following questions:

> *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?*

Next steps

4.24   The external study on spectrum requirements that we have commissioned will be taking place in parallel with this Call for Input, in order for it to be in a position to provide results in good time before the ITU-R WP 5D meeting in July. Annex 5 sets out the approach and the main assumptions going into this work; the responses to the questions in Section 4 will be used to validate and refine the output from this study.

Section 5

Frequency ranges under discussion

The current list of frequency ranges in the context of WRC-15 agenda item 1.1.

5.1   The responsible groups, ITU-R JTG 4-5-6-7, ITU-R WP 5D and CEPT CPG PTD have received a number of proposals from national administrations, industry and other organisations that propose further investigation of particular frequency ranges as possible candidate bands for terrestrial wireless broadband. There have also been proposals that several frequency ranges should not be considered because of the importance and/or extent of current and ongoing usage of radio systems in those bands, and the potential impact on those systems of introducing mobile broadband. The current set of bands that have been the subject of such proposals is included in Table A6.1 in Annex 6. This material is based on the ITU-R JTG 4-5-6-7 Chairman's report from the meeting in November 2012 and the draft CEPT brief for this WRC-15 agenda item as at the CPG meeting of January 2013.

5.2   In addition, at the ITU-R WP 5D meeting in February 2013, additional proposals were received for consideration of 4.4-4.9 GHz and a set of frequency ranges above 6 GHz, specifically 13.4-14 GHz, 18.1-18.6 GHz, 27-29.5 GHz and 38-39.5 GHz. We expect that there will be further development of this list at the next CEPT and ITU-R meetings, and therefore it is possible that further frequency ranges could be added and the notes against some existing ranges could be modified.

5.3   Stakeholders can find information on the current service allocations and responsibility for these frequency ranges in the UK Frequency Allocation Table[21] on the Ofcom website. Table 3 provides a summary of the proposals received in ITU on frequency ranges for study and on frequency ranges in which study is opposed.

5.4   We would like to highlight that this subject has already received significant interest within the ITU-R. On certain frequency bands, there is a range of views across the different groups of stakeholders. The result is that some stakeholders have made proposals to study the suitability of a particular band for mobile broadband, while a different group of stakeholders has made proposals that the same frequency band should be excluded for consideration. For this reason, some frequency ranges appear in both the left and right columns of Table 3. This is not an editorial mistake, and simply reflects the differing views amongst the participants in JTG 4-5-6-7.

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[21] http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-information/UKFAT_2013.pdf

Table 3: Frequency ranges that have been subject of proposals into ITU under WRC-15 agenda item 1.1

Frequency ranges for which ITU has received proposals for study under WRC-15 agenda item 1.1	Frequency ranges for which ITU has received proposals that study under WRC-15 agenda item 1.1 should not be pursued
470-694 MHz	1400-1427 MHz
1300-1400 MHz	1518-1559 MHz
1427-1527 MHz	1626.5-1660.5 MHz
1452-1492 MHz	1668-1675 MHz
1695-1700 MHz	2025-2110 MHz
2700-2900 MHz	2200-2290 MHz
3600-3800 MHz	3400-4200 MHz
3800-4200 MHz	4500-4800 MHz
5350-5470 MHz	5850-6425 MHz
5850-5925 MHz	
5925-6425 MHz	
4400-4900 MHz	
13.4-14 GHz	
18.1-18.6 GHz	
27-29.5 GHz	
38-39.5 GHz	

5.5   Several contributions to JTG 4-5-6-7 have proposed that studies should not be considered in the 3400-3600 MHz band, which has a primary mobile allocation in Regions 2 and 3 and in specific countries in Region 1, as well as an IMT identification in those Region 1 countries and in specific Region 3 countries. During the course of ITU-R studies, it is possible that for some bands that already have an IMT identification in some countries there could be proposals to change from being a *different category of service* [22] in specific countries into a primary allocation across the Region, or to add new countries to such a multi-country footnote.

5.6   We also observe that the frequency range at 1980-2010 MHz and 2170-2200 MHz, currently licensed to the MSS operators in Europe, does not appear in the current list of proposals into ITU-R, even though it may be of interest to the mobile broadband industry, and it has been included in the draft RSPG Opinion on wireless broadband[8]. This spectrum was awarded to two mobile-satellite service network operators following a pan-European selection procedure organised by the Commission[23]. There is currently a primary mobile allocation (in addition to the primary mobile-satellite service allocation) in this spectrum and an identification for the band as suitable for IMT, so at first sight, no changes to the mobile allocation in this band would be needed if it is to be made available for terrestrial wireless broadband in the future. However, it would be necessary to review any associated Resolutions that are referenced from the Table of Allocations.

5.7   Two of the bands in Table 3 fall within public sector spectrum identified for examination for potential release by Government (see Table 2). The December 2011

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[22] A *different category of service* appears where an allocation to a service in a particular frequency band is secondary in the Table of Allocations but primary in a list of specific countries.
[23] http://europa.eu/rapid/press-release_MEMO-09-237_en.htm

update on progress indicated that the 2.7-3.1 GHz and 4.4-5 GHz frequency ranges were under examination for partial releases of spectrum in the longer term.

5.8   It should be noted that frequency bands other than those in this Call for Input could be proposed during the ITU-R process and be incorporated into the list. For this reason, we also welcome responses on bands that are not in Table 3 or the more detailed Table A6.1 in Annex 6.

5.9   We are seeking stakeholder views and evidence on the following questions:

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?

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?

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

5.10   Annex 6 provides more detailed information on each frequency range, including ITU-R material relevant to the band and information on current UK use.

Section 6

Process in ITU-R, EU and CEPT towards WRC-15

Process in CEPT

6.1   The Conference Preparatory Group (CPG) of CEPT set up Project Team D (CPG PTD) to address WRC-15 agenda items 1.1 and 1.2, and to prepare:

- draft European Common Proposals;

- draft CEPT briefs, including relevant information from outside CEPT;

- preliminary CEPT positions, for the presentation to other administrations or regional bodies; and

- CEPT positions for the Radiocommunication Assembly.

6.2   In general, CPG project teams begin by developing technical compatibility studies in connection with their agenda items with the aim of submitting these to the relevant ITU-R groups as coordinated CEPT contributions. At the same time, they use the emerging information together with the views of administrations to develop the draft CEPT briefs for the agenda items. CPG meets twice a year to review the draft briefs and provide guidance to the project teams as necessary. During this period, administrations will be contributing to technical work alongside industry, and influencing the development of the draft brief.

6.3   In the latter half of the period between WRCs, the results of technical studies have become available and the range of views on the appropriate action to be taken is emerging. Around this time the project teams begin to work on draft European Common Proposals (ECPs), which set out the positions that CEPT administrations will take at the WRC on whether to make changes to the allocations in particular bands and whether additional regulatory measures are required. The development of ECPs reflects the policy positions of administrations, taking account of the technical analysis in CEPT and ITU-R.

6.4   CPG decides whether to adopt ECPs on the basis of the numbers of administrations that support or oppose the draft. Once the ECPs are adopted, administrations have to formally indicate to CEPT whether they will sign up to individual ECPs. Ofcom signs the ECPs on behalf of the UK, based on a recommendation to Government which is considered by the UK Spectrum Strategy Committee. The CEPT process aims to maintain European co-operation and unity at the WRC and to ensure that European nations support the proposals that they have developed. The CEPT process at the WRC is therefore focussed on the involvement of countries that have signed the CEPT ECP. It is therefore important that we are involved and that we influence the development of the ECPs, with the objective of ensuring that we can sign up to the final versions.

Process in ITU-R

6.5   The ITU-R set up a Joint Task Group (JTG 4-5-6-7) to prepare for WRC-15 agenda items 1.1 and 1.2 to encourage participation by the relevant experts in the potentially affected services and the mobile service. There are also roles for the other ITU-R Working Parties in the agenda item 1.1 process. Working Party 5D was required to study spectrum requirements for the mobile service (focussing on IMT), including suitable frequency ranges. Working Party 5A also has to provide spectrum requirements for other terrestrial mobile broadband applications. Other concerned Working Parties were required to provide technical and operational characteristics, spectrum requirements and performance objectives or protection requirements of other services. JTG 4-5-6-7 will conduct technical studies on sharing and compatibility between mobile/wireless broadband and the services currently allocated in the candidate bands and will then summarise the results of these studies and set out possible options in draft text for the Conference Preparatory Meeting (CPM) report. Meetings of JTG 4-5-6-7 are scheduled for July and November 2013, and February and July 2014.

6.6   CPM will meet in spring 2015 to consider the draft text for its report, alongside new material, and will finalise the CPM Report. The CPM Report is a key document on which administrations will base proposals for action at WRC-15. WRC-15 is scheduled to be held in autumn 2015 and will consider the outcome of the work on agenda item 1.1 and make changes to the Radio Regulations, including modifications to the Table of Allocations and its footnotes, modification of Resolutions and development of new Resolutions.

EU input

6.7   The European Commission is closely following the preparations for WRC-15. The Radio Spectrum Policy Group (RSPG) is currently developing an Opinion to identify the main areas of EU policy relevant to the WRC-15 agenda and associated common policy objectives. We can expect further engagement from the European Commission as we get closer to the start of the Conference.

Interactions between the groups

6.8   The CEPT and ITU-R processes are taking place alongside each other, and Figure 1 provides a simplified illustration of the interactions between the CEPT and ITU-R groups:

- CPG PTD has the role of coordinating CEPT contributions on agenda items 1.1 and 1.2 to ITU-R WP 5D and JTG 4-5-6-7, and developing the CEPT brief for these two agenda items.

- ITU-R JTG 4-5-6-7 is taking input from the ITU-R Working Parties as it works to develop its technical studies on sharing and compatibility, and these will ultimately result in material being developed for consideration by CPM, which will produce a report to the WRC.

- CPG will consider the developing CEPT brief from CPG PTD and any ECPs that CPG PTD develops. These ECPs will be direct CEPT contributions expressing the European view into WRC-15.

Figure 1: Interactions between ITU-R and CEPT groups involved in WRC-15 agenda item 1.1
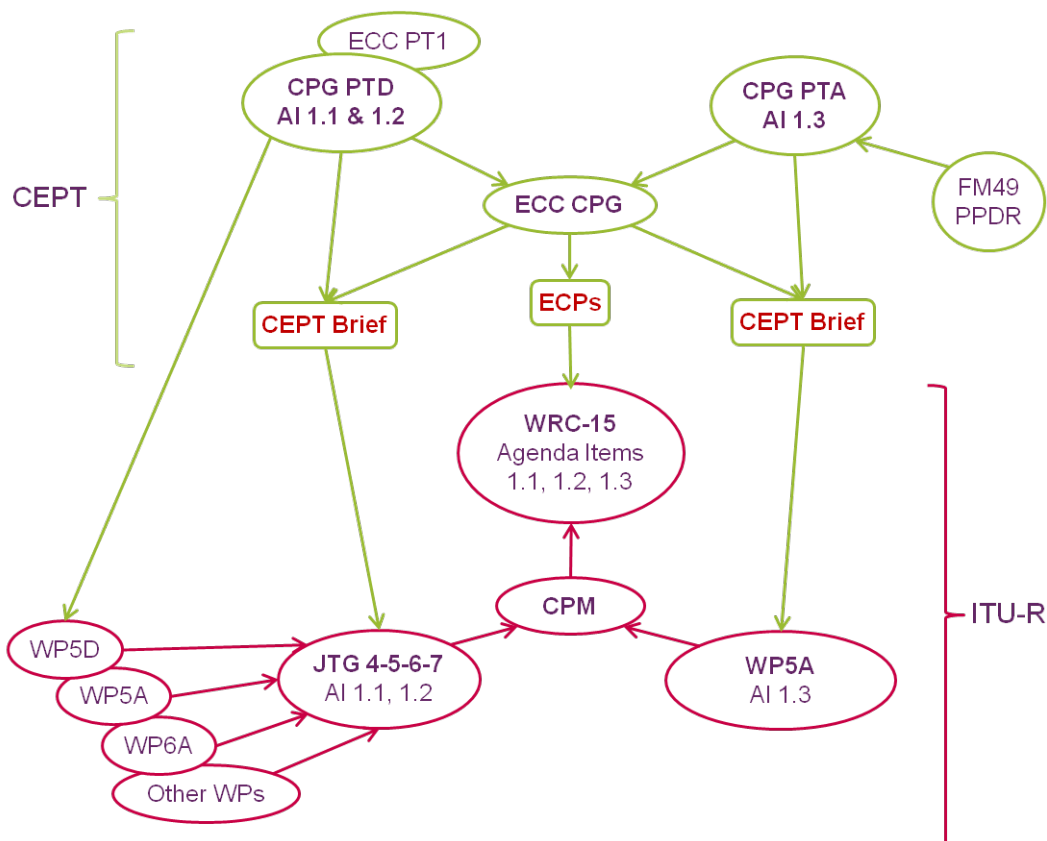
6.9 Alongside the work on agenda items 1.1 and 1.2, which both appear in CPG PTD and ITU-R JTG 4-5-6-7, WRC-15 agenda item 1.3 also has potential linkages. The work on agenda item 1.3 is managed through CPG PTA and Project Team 49 of the CEPT Working Group on Frequency Management, and in ITU-R WP 5A. Any formal interaction of agenda item 1.3 with agenda items 1.1 or 1.2 in CEPT would be managed through CPG.

UK briefing

6.10 The International Frequency Planning Group (IFPG) is an Ofcom chaired sub-committee of the Government Official Committee on UK Spectrum Strategy (UKSSC) with the principal role of managing the UK preparations for WRCs. The working groups of the International Frequency Planning Group (IFPG) manage the UK stakeholder briefing process for WRC agenda items. Figure 2 shows the working group responsibilities, and these are broadly categorised as

- WGA: science services and regulatory matters;

- WGB: satellite matters;

- WGC: aeronautical and maritime matters; and

- WGD: mobile broadband.

6.11 Ofcom arranges meetings of IFPG Working Group D (IFPG WGD) in advance of the meetings of CPG PTD and ITU-R JTG 4-5-6-7, where we review the draft UK brief for

WRC-15 agenda items 1.1 and 1.2, consider UK contributions to the international meetings and agree positions in relation to other contributions to the meetings.

Figure 2: IFPG Working Groups
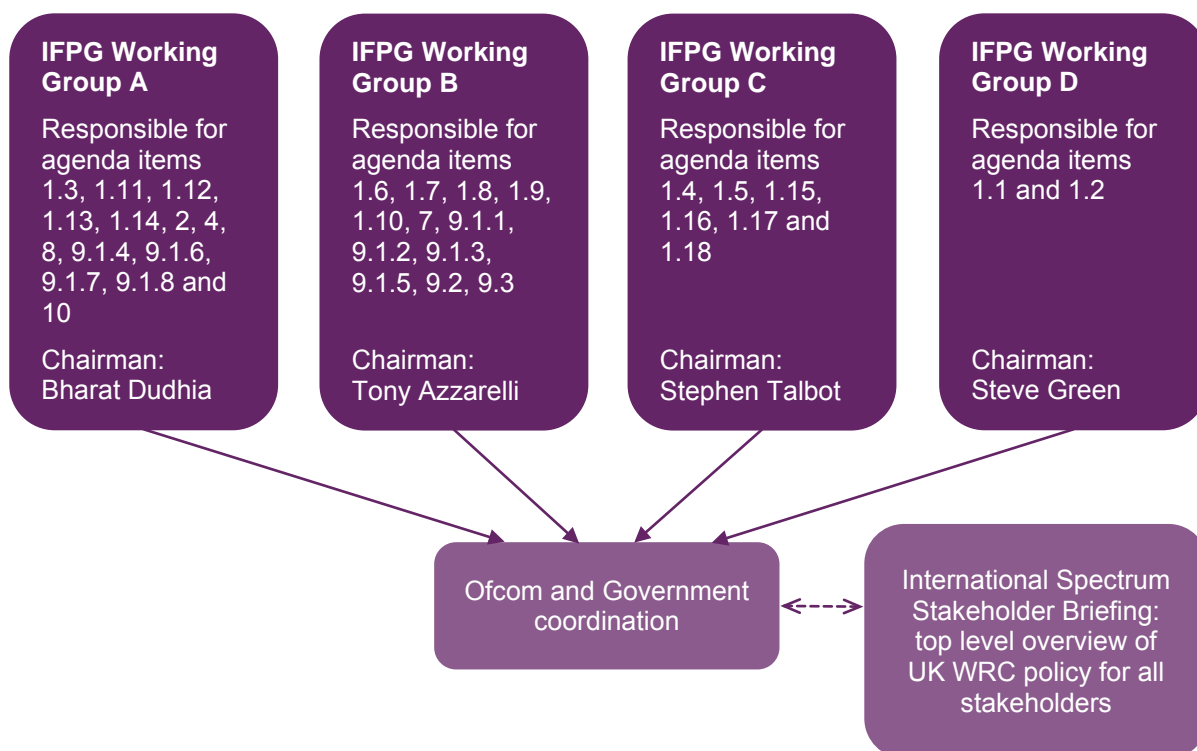
6.12 Stakeholders can get involved in the IFPG working groups by contacting the Chairman of the relevant groups:

- IFPG WGA: bharat.dudhia@ofcom.org.uk

- IFPG WGB: tony.azzarelli@ofcom.org.uk

- IFPG WGC: stephen.talbot@ofcom.org.uk

- IFPG WGD: steve.green@ofcom.org.uk

6.13 Ofcom intends to provide further opportunities for comment on the full range of issues which will be addressed at WRC-15 and welcomes stakeholder views at any point in the preparation process through the appropriate stakeholder groups.

Time line and key linkages in lead up to WRC-15

6.14 Figure 3 illustrates the time line for meetings of ITU-R and CEPT groups in the run-up to WRC-15. The remaining four meetings of JTG 4-5-6-7 take place over the next year, while in parallel the CEPT will be coordinating European views on the agenda item, and continuing this process right up to the WRC.

Figure 3 : Time line of meetings leading to WRC-15
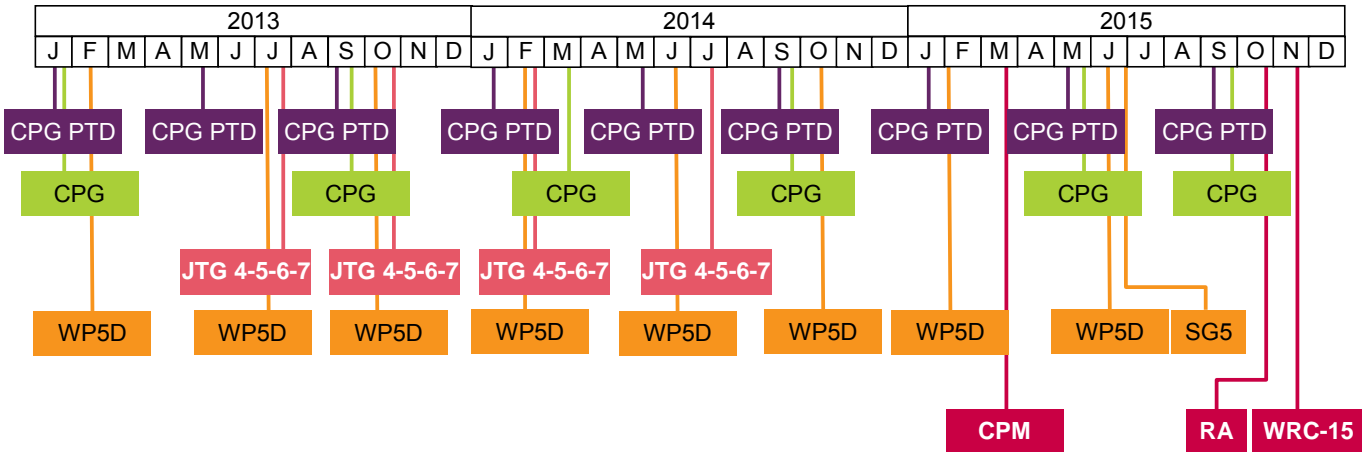
6.15   CPG PTD can contribute on behalf of CEPT to meetings of JTG 4-5-6-7. It will also develop the draft brief (subject to approval by CPG) for CEPT representation on agenda item 1.1 at JTG 4-5-6-7, CPM and WRC-15.

6.16   A key focus of this Call for Input is the negotiating lines for the meetings of WP 5D and JTG 4-5-6-7 in July this year. The UK position will continue to develop over the next two years, to WRC-15, informed by our ongoing engagement with stakeholders on WRC-15 agenda items and on our approach to responding to the forecast requirements for mobile broadband data, and on the emerging picture in the ITU-R and CEPT on the potential bands that might be considered for mobile allocations.

Section 7

Next steps

7.1   This Call for Input closes on 29 April 2013. Our plan is to use the information to develop negotiating positions and draft UK contributions for the July meetings of ITU-R JTG 4-5-6-7 and WP 5D, which we will clear through the normal consultation process in IFPG, as well as the CEPT CPG/PTD meetings in September.

Responding to this Call for Input

How to respond

A1.1   Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 29 April 2013**.

A1.2   Ofcom strongly prefers to receive responses using the online web form at http://stakeholders.ofcom.org.uk/consultations/cfi-mobile-bb/howtorespond/form, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.

A1.3   For larger responses - particularly those with supporting charts, tables or other data - please email steve.green@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.

A1.4   Responses may alternatively be posted or faxed to the address below, marked with the title of this Call for Input.

Steve Green
Spectrum Policy Group
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.5   Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.

A1.6   It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

A1.7   If you want to discuss the issues and questions raised in this Call for Input, or need advice on the appropriate form of response, please contact Steve Green on 020 7783 4384.

Confidentiality

A1.8   We believe it is important for everyone interested in an issue to see the views expressed by respondents to a Call for Input. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

A1.9   If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.10   Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at http://www.ofcom.org.uk/about/accoun/disclaimer/

Next steps

A1.11   Following the end of the period allowed for responding, we will develop negotiating lines and contributions for the July meetings of ITU-R WP 5D and JTG 4-5-6-7, which we will clear through the normal consultation process in IFPG.

A1.12   Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see: http://www.ofcom.org.uk/static/subscribe/select_list.htm

Ofcom's consultation processes

A1.13   Ofcom seeks to ensure that responding to a Call for Input is easy as possible. For more information please see our consultation principles in Annex 2.

A1.14   If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.

A1.15   If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Graham Howell, Secretary to the Corporation, who is Ofcom's consultation champion:

Graham Howell
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email Graham.Howell@ofcom.org.uk

Annex 2

Ofcom's consultation principles

A2.1   Ofcom has published the following seven principles that it will follow for each public written consultation:

Before the consultation

A2.2   Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

During the consultation

A2.3   We will be clear about who we are consulting, why, on what questions and for how long.

A2.4   We will make the consultation document as short and simple as possible with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5   We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6   A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7   If we are not able to follow one of these principles, we will explain why.

After the consultation

A2.8   We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 3

Cover sheet for responses

A3.1   In the interests of transparency and good regulatory practice, we will publish all responses to this Call for Input in full on our website, www.ofcom.org.uk.

A3.2   We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.

A3.3   The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.

A3.4   We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at www.ofcom.org.uk/consult/.

A3.5   Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

Cover sheet for response to an Ofcom Call for Input

BASIC DETAILS

Call for Input title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing	☐	Name/contact details/job title	☐
Whole response	☐	Organisation	☐
Part of the response	☐	If there is no separate annex, which parts?	

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here. ☐

Name   Signed (if hard copy)

Annex 4

Summary of questions included in this Call for Input

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?

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?

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.?

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?

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?

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?

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?

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?

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?

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

Annex 5

Additional information on the spectrum demand study

A5.1   Our external study of spectrum demand will use the ITU-R spectrum estimation methodology specified in Recommendation ITU-R M.1768-1[24]. Where necessary, the methodology will be amended to account for the requested details of spectrum requirements specified by JTG 4-5-6-7 in its liaison[25] to WP 5A and WP 5D, namely:

- the amount of the total spectrum requirement needed for coverage, for capacity and for performance;

- how the spectrum requirements might vary between different market settings; and

- the level of asymmetry between the downlink and uplink for traffic and spectrum requirements.

A5.2   The study will examine both high and low market settings around a central estimate which is similar to the mid demand scenario used in the modelling for our consultation on strategy for UHF bands IV and V[26].

A5.3   Clearly these represent a very wide range given the intrinsic uncertainties of long-term demand forecasting and will lead to a wide range of potential spectrum requirements.

A5.4   Figure A5.1 compares example of potential sources[27] of UK mobile demand that may be used as inputs to this study:

- Cisco 2010 UK converted: 22% of the Cisco forecasts[28] for Western Europe from 2010, as an estimate of UK demand;

- Cisco 2013: Cisco forecasts[29] for the UK from 2013;

- Real Wireless mid, low, high 2012: The mid, low and high demand scenarios from Real Wireless' 2012 study for Ofcom[30]; and

- UMTS Forum UK converted: 20% of the UMTS Forum forecasts for ITU-R[31].

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[24] http://www.itu.int/rec/R-REC-M.1768/en
[25] http://www.itu.int/md/R12-WP5D-C-0217/en
[26] http://stakeholders.ofcom.org.uk/consultations/uhf-strategy/
[27] Real Wireless estimate focuses on demand from personal mobile devices only whereas the Cisco and UMTS Forum forecasts includes all mobile traffic that may be carried in licenced spectrum and so as well as personal mobile devices also include M2M devices
[28] Reference Cisco VNI 2010, http://ciscovni.com/vni_forecast/advanced.html
[29] "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017", February 2013., http://ciscovni.com/vni_forecast/advanced.html
[30] http://www.ofcom.org.uk/static/uhf/real-wireless-report.pdf

Figure A5.1: UK mobile demand forecasts for licensed spectrum (petabytes per month) (note change in scale beyond 2017, and M2M included in Cisco and UMTS forecast but not Real Wireless forecast)

	2012	2013	2014	2015	2016	2017	2020	2025	2030
Cisco 2010 UK converted	78	145	237						
Real Wireless High 2012	25	56	112	185	285	411	1057	3126	7443
Real Wireless Mid 2012	25	48	81	117	163	216	489	1169	1984
Real Wireless Low 2012	25	38	60	84	109	134	237	397	575
Cisco 2013 UK	39	62.3	100	156	234				
UMTS Forum UK converted				183			513		
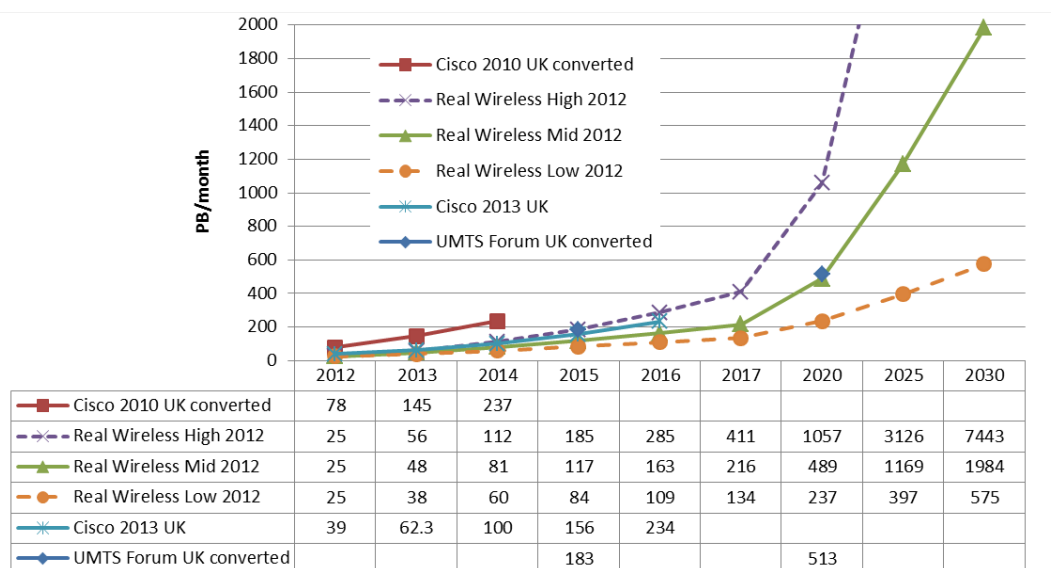
A5.5   The study will consider offload traffic to be only traffic which would otherwise have been carried on mobile networks operating in licensed spectrum and which originates from personal mobile devices supporting licensed mobile spectrum (as it is this category of devices using licensed spectrum which will have the opportunity to offload traffic – traffic from others such as machine to machine (M2M) will need to go over a wide area network at some stage).

A5.6   Most studies include both licensed and licence-exempt spectrum offload in their offload forecasts, so that for example the offloaded traffic includes the combination of both Wi-Fi offload and femtocell traffic. Three examples are shown in Figure A5.2, defined as follows:

- Real Wireless Mid: The mid case offload scenario from Real Wireless' 2012 study for Ofcom[32];

- Cisco 2012 UK: Cisco's 2010 offload forecast for the UK; and

- Cisco 2013 Global: Cisco's 2013 global offload forecast[33].

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[31] UMTS Forum, "Mobile Traffic Forecasts 2010-2020" IMT update workshop, March 2011.
[32] http://www.ofcom.org.uk/static/uhf/real-wireless-report.pdf
[33] "Cisco Visual Networking Index: Global Mobile DataTraffic Forecast Update, 2012–2017", February 2013, inferred from Figure 8.

Figure A5.2:Percentage of mobile traffic offloaded (to both Wi-Fi and femtocells)

	2012	2013	2014	2015	2016	2017	2020	2025	2030
Real Wireless 2012 Mid	42%	42%	43%	43%	44%	44%	45%	48%	50%
Cisco 2010 UK	35%	35%	35%						
Cisco 2013 Global	40%	42%	43%	45%	46%	46%			
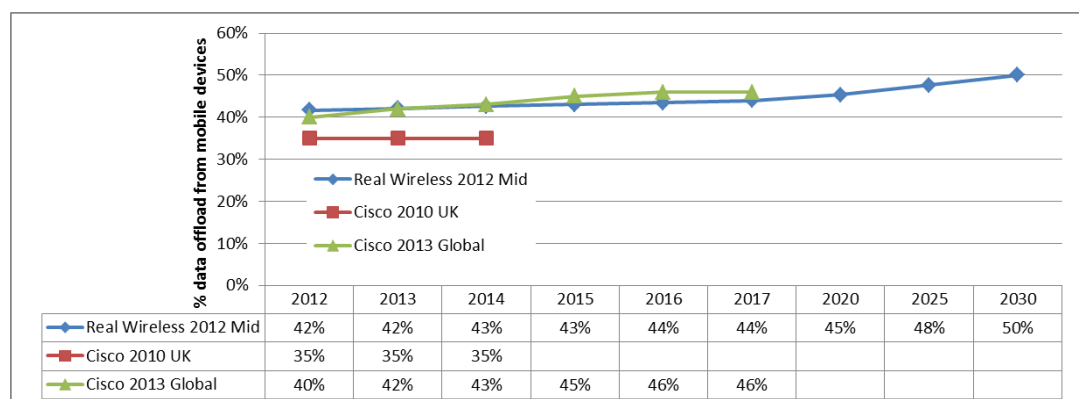
A5.7   The study will also consider values for spectral efficiency which vary according to the cell type, the technology used and the time period. An example of values suggested in the ITU-R spectrum estimation methodology (Recommendation ITU-R M.1768-1[24]) is summarised in Table A5.1. These figures are provided up to 2020 only and exclude radio LANs, including Wi-Fi and similar technologies.

Table A5.1: Spectral efficiency according to Recommendation ITU-R M.1768-1 methodology

Pre-IMT, IMT-2000, and its enhancements: including but not limited to 2G, 3G, LTE and Mobile WiMAX (IEEE 802.16e)

Area spectral efficiency (bit/s/Hz/sector)

	Macro cell	Micro cell	Pico cell	Hot spot
Yr 2015	1.5	3	3	-
Yr 2020	2	4	4	4

IMT-Advanced: LTE Advanced, WiMAX Release 2 (IEEE 802.16m), and their enhancements

Area spectral efficiency (bit/s/Hz/sector)

	Macro cell	Micro cell	Pico cell	Hot spot
Yr 2015	4.25	5.5	7	8.25
Yr 2020	4	5	5	7.3

A5.8   One potential source of spectral efficiency that goes beyond the ITU 2020 figures is a project for Ofcom where Real Wireless considered the evolution of mobile technologies including LTE, LTE-Advanced and beyond in the UK context. This included consideration of the practical evolution of the capabilities of mobile devices to support advanced antenna technologies (MIMO). The resulting mid-case forecast for downlink spectral efficiency is shown in Figure A5.3[34] for various configurations of macrocells (number of sectors, number of transmit antennas per sector) and for outdoor small cells (similar to the microcells considered by ITU-R).

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[34] Note that this chart shows total spectral efficiency per *site*, whereas the ITU-R figures in Table 2 are spectral efficiencies per *sector*.

A5.9   Note that this graph presents spectral efficiency per site and so would need to be divided by the assumed number of sectors per site type to obtain the equivalent ITU-R spectral efficiency per sector figures. Also this study reports spectral efficiency for macrocells with different numbers of transmit antennas and so some assumptions on the likely mix of macrocell capabilities in the UK would be needed. However, this does give some indication of the range of spectral efficiency estimates that will need to be considered in the spectrum estimation study.

Figure A5.3: Site downlink spectral efficiency (mid scenario) for UK cell sites
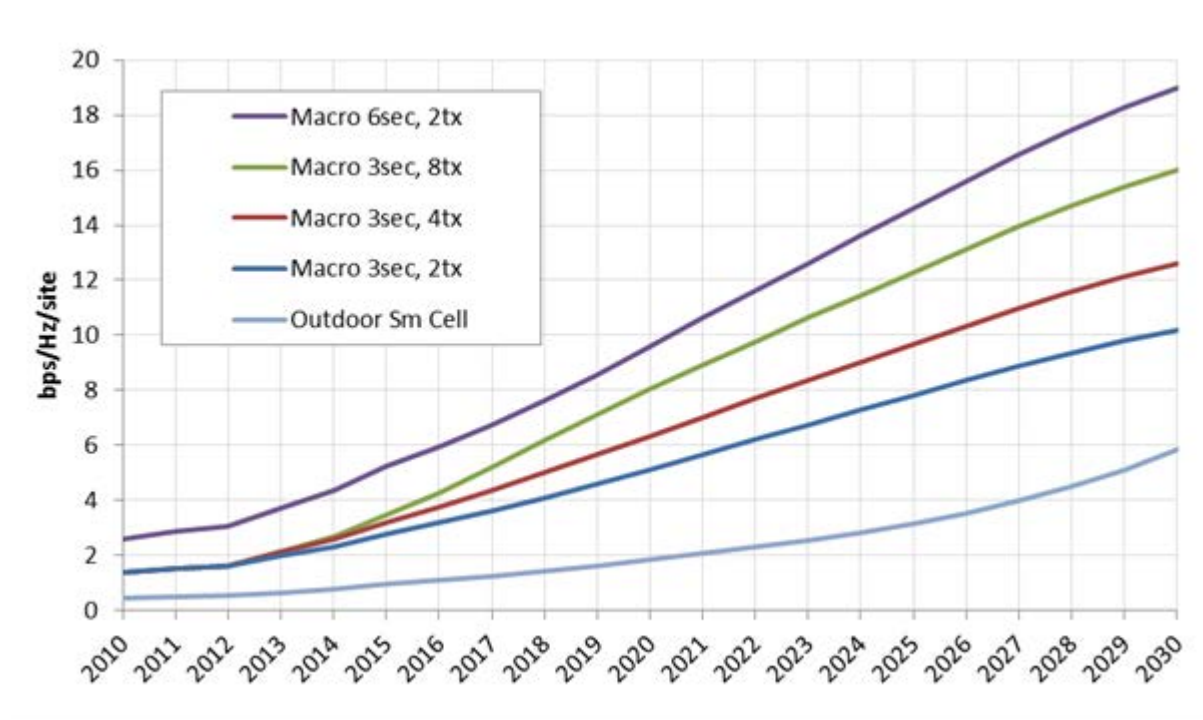
A5.10   The quantity of spectrum required will depend not only on the quantity of data demand but also the mean data rate that a user could expect on a given radio access technology in a given cell type). Example values as suggested by the Recommendation ITU-R M.1768-1 methodology for this bit rate vary by technology as shown in Table A5.2.

Table A5.2: Mean service bit rates suggested by Recommendation ITU-R M.1768-1 methodology

Pre-IMT, IMT-2000, and its enhancements: including but not limited to 2G, 3G, LTE and Mobile WiMAX (IEEE 802.16e)

Application data rate (kbit/s)

Macro cell	Micro cell	Pico cell	Hot spot
20,000	40,000	40,000	N/A

IMT-Advanced: LTE Advanced, WiMAX Release 2 (IEEE 802.16m), and their enhancements

Application data rate (kbit/s)

Macro cell	Micro cell	Pico cell	Hot spot
50,000	100,000	1,000,000	1,000,000

Radio LANs and their enhancements

Application data rate (kbit/s)

Macro cell	Micro cell	Pico cell	Hot spot
N/A	N/A	50,000	500,000

A5.11   Small cells will impact on the quantity of licensed mobile spectrum required. To assess this, the study will consider the proportion of traffic that can be carried over small cells in a given environment. Table A5.3 shows example values suggested in the ITU-R spectrum estimation methodology of the proportion of the population using mobile devices within the service area of each cell type.

Table A5.3: Proportion of population in service area of differing cell types according to Recommendation ITU-R M.1768-1 methodology

2015

Service environments		Radio environments supporting service environment			
		Macro cell	Micro cell	Pico cell	Hot spot
Urban	Home	100%	90%	10%	80%
	Office	100%	90%	20%	80%
	Public area	100%	95%	30%	25%
Suburban	Home	100%	35%	0%	80%
	Office, Public area	100%	50%	35%	20%
Rural	Home, Office, Public area	100%	0%	10%	50%

2020

Service environments		Radio environments supporting service environment			
		Macro cell	Micro cell	Pico cell	Hot spot
Urban	Home	100%	90%	20%	80%
	Office	100%	90%	20%	80%
	Public area	100%	95%	40%	25%
Suburban	Home	100%	35%	0%	80%
	Office, Public area	100%	50%	35%	20%
Rural	Home, Office, Public area	100%	0%	10%	50%

A5.12   In the ITU-R spectrum estimation methodology, uplink and downlink demand is defined in terms of a series of service categories representing different traffic types as shown in Table A5.4. The demand for each of these service categories is also set up to reflect to mix of services within these service categories in different so called "service environments" i.e home urban deployments, office urban deployments, public area urban deployments, home suburban deployments, etc.

Table A5.4: Service categories as defined by Recommendation ITU-R M.1768-1 methodology

Service Type	Traffic Classes			
	Conversational	*Streaming*	*Interactive*	*Background*
Super-high multimedia (above 30Mbps)	Service category 1	Service category 6	Service category 11	Service category 16
High multimedia (below 30Mbps)	Service category 2	Service category 7	Service category 12	Service category 17
Medium multimedia (below 2Mbps)	Service category 3	Service category 8	Service category 13	Service category 18
Low rate data multimedia (below 144kbps)	Service category 4	Service category 9	Service category 14	Service category 19
Very low rate data (below 16kbps)	Service category 5	Service category 10	Service category 15	Service category 20

A5.13 The responses to the questions in Section 4 will be used to validate and refine the output from this study.

Annex 6

Summary of frequency ranges under discussion under WRC-15 agenda item 1.1

A6.1   Table A6.1 sets out the frequency ranges that are under discussion in ITU-R JTG 4-5-6-7 and WP 5D at the time of publication of this Call for Input. We have reproduced the first four columns from Annex 8 the JTG Chairman's Report[35] of the November 2012 meeting.

Table A6.1: frequency bands under discussion in ITU-R in the context of WRC-15 agenda item 1.1

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
470-694 MHz	Proposals that the JTG should undertake studies in the band	Report ITU-R BT.2247 Report ITU-R M.2110 Report ITU-R M.2241	The provisions of the GE06 Agreement apply to countries of Region 1 (except Mongolia) and to IRN. This band is extensively used for broadcasting in many countries.	Digital terrestrial Television This is part of the spectrum used for digital terrestrial television (DTT). DTT currently uses spectrum in the range 470-790 MHz. Programme making and special events (PMSE) Typically used for wireless microphones and in ear monitors
1300-1400 MHz	Proposes that the JTG should undertake studies in the band		The 1 400-1 427 MHz range has been avoided since it is recognised that this is a passive band according to RR provision No. 5.340.	Civil UK Fixed Wireless Services (FWS) 1.4GHz band (1350-1375 MHz // 1492-1517 MHz) Heavily used band for point-to-point FWS links spread around the UK. FWS uses: Public Safety, Utilities (Oil, Gas, Water, Electricity), Fixed Networks, Broadcasters, Local Authorities and MNOs.

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[35] http://www.itu.int/md/R12-JTG4567-C-0113/en

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
				Radio Astronomy (RAS)
				UK radio astronomy use (see UKFAT Annex D) (1) 1350-1380MHz (on no protection basis) (2) 1380-1400MHz.
				Earth Exploration Satellite Service (EESS)
				Note: There is UK interest in EESS soil moisture and ocean salinity (SMOS) satellite and radio astronomy in the adjacent band 1400-1427 MHz.
				Amateur service
				The UK FAT indicates that 1300-1325 MHz is managed by Ofcom for the Amateur Service
				Radiolocation
				The frequency band 1300-1350 MHz is part of a wider UK allocation (1215-1350 MHz) for radar, which is managed by the CAA (Directorate of Airspace Policy (DAP)) for a network of primary radars, and subject to coordination with MOD.
				MOD
				The UK FAT indicates that 1300-1375 MHz is also used by MOD for the Radiolocation service.
				1375-1400 MHz is MOD managed spectrum (UK2) and licence exempt video links (1389-1399 MHz)

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
1400-1427 MHz	Passive band – not to be considered	Report ITU-R SM.2092		Radio Astronomy (RAS) Recognised Spectrum Access grants issued for UK radio astronomy sites Earth Exploration Satellite Service (EESS) Significant UK interests in SMOS Earth observation satellite for soil moisture and ocean salinity measurements.
1427-1527 MHz	Proposes that the JTG should undertake studies in the band		The 1 400-1 427 MHz range has been avoided since it is recognised that this is a passive band according to RR provision No. 5.340.	MOD The UK FAT indicates that 1427-1452 MHz is for military use (footnote UK2). Civil UK Fixed Wireless Services (FWS) 1.4GHz band (1350 - 1374.5//1492.5-1517MHz) Heavily used band for point-to-point FWS links across the UK. • FWS uses: Public Safety, Utilities (Oil, Gas, Water, Electricity), Fixed Networks, Broadcasters, Local Authorities and MNOs. Earth Exploration Satellite Service (EESS) Note: There is UK interest in EESS SMOS satellite and radio astronomy in the band 1400-1427MHz. Mobile Satellite Service (MSS) Licence-exempt mobile-satellite service (MSS) Satellite launches for 2013 will include the use of the band 1518-1525 MHz. Programme making and special events 1517-1525 MHz: PMSE- audio links and wireless microphones

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
1452-1492 MHz	Proposes that the JTG should undertake studies in the band			Spectrum Access This band was licensed on a technology-neutral basis in the UK, following spectrum award in 2008.
1518-1559 MHz	Proposes that studies should not be considered in this band		Extensive use by MSS RR Footnote 5.356 restricts use of the band 1 544-1 545 MHz to safely and distress communications.	Mobile Satellite Service (MSS) Licence-exempt mobile-satellite service (MSS) Satellite launches for 2013 will include the use of the band 1518-1525 MHz. The rest of the bands 1525-1559 MHz are used for MSS worldwide for MSS including GMDSS and aeronautical safety MSS Programme making and special events 1517-1525 MHz: PMSE- audio links and wireless microphones
1626.5-1660.5 MHz	Proposes that studies should not be considered in this band			Licence-exempt MSS Extensive use throughout the world for MSS. Part of GMDSS and also a 1 MHz Search and rescue bands, includes NGSO and GSO usage. MOD extensive user of Inmarsat and Iridium Radio Astronomy (RAS) UK radio astronomy interests in 1660-1660.5 MHz and covered under Recognised Spectrum Access (RSA) grants for UK radio astronomy sites.

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
1668-1675 MHz	Proposes that studies should not be considered in this band		Extensive use by MSS RR Footnote 5.356 restricts use of the band 1 544-1 545 MHz to safely and distress communications.	Radio Astronomy (RAS) Recognised Spectrum Access (RSA) grants issued for UK RAS sites, covering the band 1668-1670 MHz. Meteorological Satellite Service (MetSat) METSAT (s-E) has an allocation in UK FAT in 1670-1675 MHz. Mobile-satellite service Licence-exempt MSS 1670-1675MHz (UK/CEPT) Satellite launches for 2013: this pairs with the use of the band 1518-1525 MHz. Fixed wireless service Some legacy civil point–point FWS links in the 1670-1690 MHz. FWS uses: Public Safety, Oil, Local Authority. Emergency services UK3.15 1668-1670 MHz - Emergency Services use – access retained for ES in Scotland.
1695-1700 MHz –	Proposes that the JTG should undertake studies in the band			Meteorological Satellite Service (MetSat) Recognised Spectrum Access (RSA) grant issued for receive-only satellite earth station. Emergency services UK3.18 1698 -1700 MHz – Emergency Services use – access retained for ES in Scotland.

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
2025-2110 MHz 2200-2290 MHz	Proposes that studies should not be considered in this band	Annex 1 to Recommendation ITU-R SA.1154	RR 5.391 requires that "*administrations shall not introduce high-density mobile systems*" in these two bands. Recommendation ITU R SA.1154 refers (Incorporated by Reference in the RR).	<u>MOD</u> UK FAT: MOD for the Space Operations service and the mobile service. UK88 MOD may operate Aeronautical Mobile (OR) services in the band 2200 – 2290 MHz. This is to be on a self-coordinated basis. <u>Space sciences</u> Civil earth stations licensed by Ofcom <u>Programme making and special events</u> PMSE: Video links and cordless cameras <u>Fixed wireless service</u> Some legacy civil point–to-point FWS links in the 2100-2210 MHz range • FWS uses: Fixed Networks.
2700-2900 MHz	Proposes that the JTG should undertake studies in the band	Report. ITU-R M.2112		<u>Aeronautical radionavigation</u> Used in the UK for aeronautical radar: primary long range object detection, surveillance radar. Also a number of bird strike radars. Includes civil and military systems, managed by both NATS and MOD. In addition, some individual airfields manage their own independent radars, outside this arrangement. Spectrum within this band has been included in the Government programme to release 500 MHz of public sector spectrum. <u>Meteorological radiolocation</u> The UK FAT indicates (footnote UK97) usage for

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
				meteorological radars.
3400-3600 MHz	Existing studies demonstrate that co-frequency, co-coverage sharing is not feasible, and therefore proposes that studies should not be considered in this band.	Recommendation ITU-R F.1706 Report ITU-R M.2109 Report ITU-R S.2199	Band is extensively used by the FSS.	MOD MOD managed spectrum Spectrum within this band has been included in the Government programme to release 500 MHz of public sector spectrum. Broadband wireless systems 2x20 MHz to broadband wireless. Fixed-satellite service No UK Fixed-satellite service allocation in 3400-3600 MHz
3600-4200 MHz				Fixed Satellite Service (FSS) (s-E) Fixed-satellite service (permanent Earth station, PES) usage Fixed-satellite service (receive-only Earth stations) usage Fixed wireless service UK FWS 4GHz band (3.6-4.2 GHz) • Lightly used band for P-P FWS links.
3600-3800 MHz	Proposes that the JTG should undertake studies in the band			• FWS uses: broadcast fixed network, mobile network operators.
3800-4200 MHz	Proposes that the JTG should undertake studies in the band			• (Note Broadband Wireless Access use: 3605-3689//3925-4009MHz)

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
4400-4900 MHz	Proposes that the JTG should undertake studies in the band	Recommendation ITU-R F.1706 Report ITU-R M.2109 Report ITU-R M.2119	Use of this band is subject to the provisions of AP30B.	<u>MOD</u> MOD managed spectrum (UK2) <u>Fixed Satellite Service (FSS)</u> No UK satellite Earth stations <u>Radio Astronomy (RAS)</u> Some UK radio astronomy interests but this is on a no protection basis.
4500-4800 MHz	Existing studies demonstrate that co-frequency, co-coverage sharing is not feasible, and therefore proposes that studies should not be considered in this band.			
5350-5470 MHz	Should this band be considered for any "nomadic RLAN type", to derive relevant conditions of protection of EESS (active) based on Resolution 229 (WRC-12).		Recommendation ITU-R RS.1632 contains information on a similar issue in the adjacent lower band.	<u>MOD</u> MOD managed spectrum (UK2) <u>Earth Exploration Satellite Service (EESS)</u> There is significant UK investment/interests in Earth exploration-satellite missions
5350-5470 MHz	Proposes that the JTG should undertake studies in the band		Use of the band by RLANs.	
5850-5925 MHz	Proposes that the JTG should undertake studies in the band		Use of the band by RLANs.	<u>Programme making and special events</u> PMSE: 5850-5925 MHz - Video links and wireless cameras <u>Fixed Satellite Service (FSS)</u>
5850-6425 MHz	Proposes that studies should not be considered in this band.	Report ITU-R M.2119	Band is extensively used by the FSS.	

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
5925-6425 MHz	Proposes that the JTG should undertake studies in the band			Fixed-satellite service (PES) usage in 5850-6425 MHz: <u>Fixed wireless service</u> UK FWS L6GHz band (5925-6425 MHz) • Heavily used band for P-P FWS links. • FWS uses: fixed networks, broadcasters, oil/gas industry
13.4-14 GHz	Proposes that the JTG should undertake studies in the band			<u>EESS</u> UK interests in current EESS (active) missions and future missions are planned. <u>Fixed Satellite Service (FSS)</u> (13.75-14GHz) Fixed-satellite service (permanent Earth station, PES) usage Fixed-satellite service (temporary Earth station, TES) usage <u>MOD</u> 13·4-14GHz: MOD for the Radiolocation service

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
18.1-18.6 GHz	Proposes that the JTG should undertake studies in the band			<u>Fixed wireless service</u> Part of UK FWS 18 GHz band (17.7 – 19.7GHz) • Extensively used band for P-P FWS links. • FWS uses: fixed networks, MNOs, public safety, Local Authorities, broadcasters, and utilities. <u>Fixed Satellite Service (FSS)</u> (E-S & S-E) • PES sites (E→s), is limited to BSS feeder links use. • PES sites (s→ E). • Uncoordinated FSS user terminal (s→ E)
27-29.5 GHz	Proposes that the JTG should undertake studies in the band			<u>Fixed wireless service</u> The bands 27.8285-28.4445 GHz and 28.8365-29.4525 GHz have been awarded by Ofcom by auction <u>Licensed Fixed Satellite Service</u> PES sites <u>Licensed exempt Fixed Satellite Service</u> (i.e. High Density Fixed-Satellite Service, HDFSS etc) 27.5 – 27.8185 GHz, 28.4545 – 28.8265, 29.4625-29.5 GHz are licensed exempt for high density fixed satellite application.

Frequency band	Nature of proposal within ITU-R	Reference to existing ITU-R compatibility and/or sharing studies relevant to WRC-15 Agenda item 1.1	ITU-R JTG 4-5-6-7 remarks	Current UK use
38-39.5 GHz	Proposes that the JTG should undertake studies in the band			Fixed wireless service Part of UK FWS 38 GHz band (37-39.5 GHz) • Extensively used band for P-P FWS links. • FWS uses: MNOs, fixed networks, broadcasters, utilities, public safety and Local authorities. Fixed Satellite Service (FSS) No current use