Crown Recognised Spectrum Access in 3400 to 3600 MHz

Consultation on spectrum policy and on terms of new grants and licences

Consultation

Publication date: 25 September 2009

Closing Date for Responses: 20 November 2009

Contents

Section 1

Summary

1.1 This document consults on our proposal to enable the granting Recognised Spectrum Access (RSA) in the 3400 to 3600 MHz band and on the key conditions that we would include in the grants of RSA in the band, notably those relating to the technical limits for use of the spectrum.

1.2 The government, supported by Ofcom, has committed to a programme for improving the efficiency with which public bodies manage and use their spectrum holdings. A key element of this policy is to enable public bodies to trade spectrum where this is beneficial and, by so doing, allowing them to engage in the same market-led environment that is open to commercial users of spectrum. However, government departments are outside the scope of the licensing provisions of the Wireless Telegraphy (WT) Act and therefore cannot hold WT licences which can be traded. To address this impediment, a grant of RSA formalises the rights of such bodies over the spectrum they manage and defines the rights and obligations that may then be traded.

1.3 The Ministry of Defence (MOD) has recently stated its plans to reform the way it manages its spectrum in line with the government programme. The MOD has indicates that it wishes to apply for a grant of RSA for the 3400 to 3600 MHz band, of which it is the manager and part user, with the intention of releasing part of the band to the market.

Proposal for frequency coverage of RSA regulations

1.4 This consultation proposes that we extend the RSA regulations to include the 3400 – 3480 MHz and 3500 – 3580 MHz frequency ranges. This would cover all of the 3400 to 3600 MHz band with the exception of the frequency ranges currently licensed to UK Broadband.

1.5 In particular, it would cover the frequencies currently used by emergency services for air to ground video links in the 3440 – 3480 MHz range. Emergency services will continue to use this band for airborne video links, but our proposals will allow for this use to be covered by RSA and thereby provide flexibility over changes in spectrum requirements.

1.6 It would also cover the frequencies currently used for PMSE in the 3400 – 3440MHz and 3500 – 3580MHz ranges by agreement with MOD. MOD has already signalled to the PMSE community that it intends to release spectrum in this range to the market but that the PMSE community will be able to continue using the band until this happens.

1.7 We have considered our policy in the light of the recent European Commission Decision on harmonisation of 3400 to 3800 MHz for terrestrial communications systems. This Decision seeks to provide impetus to the emergence of a European-wide market for Broadband Wireless Applications in the band. We consider that the grant and trading of RSA will provide a mechanism to enable the MOD to transfer spectrum to new users that will be required to operate in accordance with the harmonised technical conditions to the benefit of citizens and consumers.

Terms and conditions of grants and licences

1.8 This consultation also sets out proposals for technical conditions that we would plan to apply to grants of RSA and to the WT licences arising from trade:

Minimum Spectrum Trading Units (STU)

1.9 STUs are the smallest unit of geographical coverage or frequency bandwidth that will be allowed to be transferred in a partial trade of RSA. We currently think that a minimum STU would impose unnecessary restrictions on how the RSA grants and WT licences may be traded and therefore we do not propose one.

Technical limits

1.10 The objective of the technical limitations included in a RSA grant is to avoid undue interference to the neighbouring users. We propose emissions limits for the 3400 – 3480 MHz block and the upper boundary of the 3500 – 3580 MHz block, but it will be for the MOD to specify conditions at the lower boundary i.e. 3400 MHz (as MOD itself is the adjacent user below 3400MHz). Our technical proposals are as follows:

3500 MHz to 3580 MHz.

1.11 Because of the Commission Decision we expect broadband wireless applications to be deployed following a trade of RSA. The proposed in block emissions limits for base and terminal stations, and the out of block emissions limits for base stations are taken from the technical annex to the Commission Decision on harmonisation.

1.12 The Decision does not set out requirements for out of block emissions limits for terminal stations. We have assessed several scenarios and we propose and consult on four alternatives for these limits.

Table. 1.1: Technical limits for base stations in the 3500 – 3580 MHz block

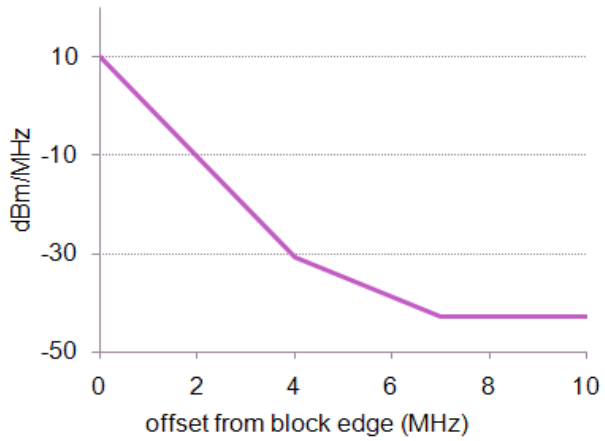
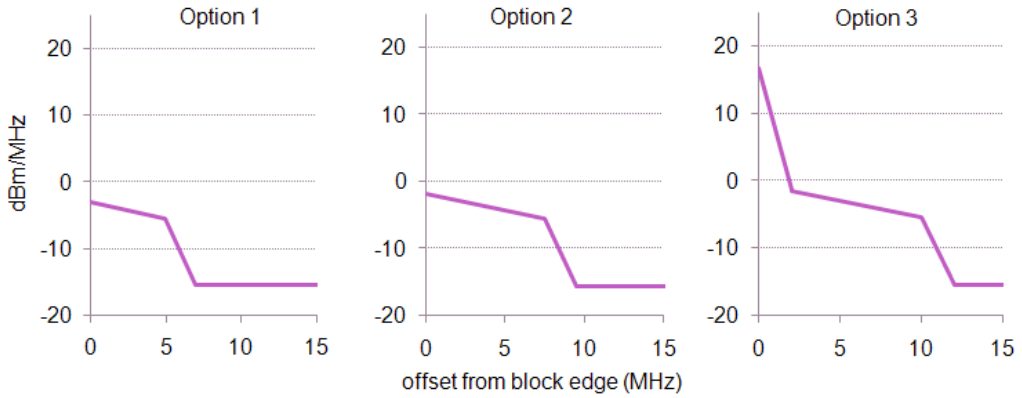
Base station in block limits: 53 dBm/MHz EIRP
Base station out of block limits: 

Table. 1.2: Technical limits for terminal stations in the 3500 – 3580 MHz block

Terminal station in block limits:

Fixed and nomadic terminal station outdoor	+ 50 dBm/MHz EIRP
Fixed and nomadic terminal station indoor	+ 42 dBm/MHz EIRP
Mobile terminal station	+ 25 dBm/MHz EIRP

Terminal station out of block limits:



Option 4:
No regulatory requirement, only ETSI standards apply

3400 MHz to 3480 MHz

1.13 The use immediately below 3480 MHz, after a trade of the RSA, could be emergency services air-to-ground videolinks (which is the current licensed service in this band) or, potentially, broadband wireless (if the emergency services videolinks are moved elsewhere in the band). This is to be decided by the MOD and the government departments sponsoring emergency services. We present technical conditions at 3480 MHz for the three alternative scenarios that, following discussions with the departments, we think may appear in the band:

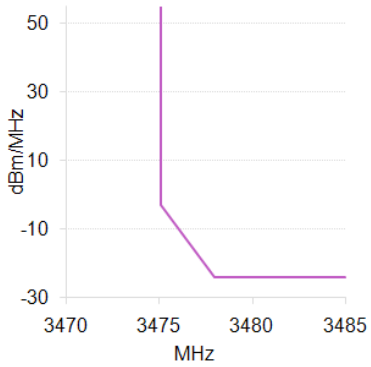
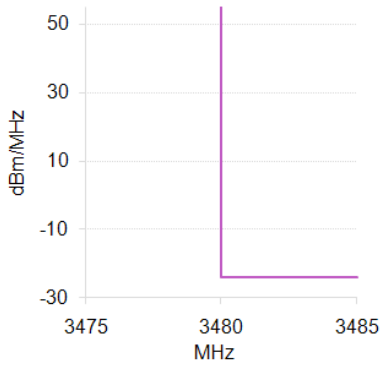
1) Broadband wireless applications are deployed immediately below 3480 MHz after trade of the RSA and the emergency services block is moved down in frequency from its current allocation at 3442 – 3475 MHz.

2) The upper boundary of the emergency services block is maintained at 3475 MHz.

3) The upper boundary of the emergency services block is moved to 3480 MHz.

1.14 Our proposal in the first case is to copy the requirements for broadband wireless applications at 3500 MHz and 3580 MHz summarised in table 1.1 and table 1.2. In the second and third scenarios, we propose that the technical requirements of existing licences should be maintained although expressed in a different way.

Table 1.3: Summary of technical proposals at the upper boundary of the 3400 – 3480 MHz block

1) Broadband Wireless up to 3480 MHz	2) Emergency Services air to ground videolinks up to 3475 MHz	3) Emergency Services air to ground videolinks up to 3480 MHz
Proposals in table 1.1 and table 1.2. In block emissions limits for base and terminal stations, and out of block emissions limits for base stations from the technical annex to the Commission Decision. Four alternatives for terminal out of block emissions limits.	In block limit: 20 dBW EIRP Out of block limits: 	In block limit: 20 dBW EIRP Out of block limits: 

1.15 We also suggest in this document technical limits that could be used for the boundaries that may appear inside the RSA blocks following a partial trade, although such limits will be for the RSA holder and the parties in the trade to negotiate.

Next steps

1.16 Following completion of this consultation and review of the responses, we plan to publish a statement with our general policy decisions. If we decide to amend the regulations, we would then publish a notice proposing amendments to the necessary Statutory Instruments as soon as practicable, potentially at the beginning of next year.

Section 2

Introduction

2.1 The 3400 to 3600 MHz band is managed by the Ministry of Defence (MOD). In its recent December 2008 statement on UK Defence Spectrum Management[1] (the MOD statement), the MOD declared its intention to formalise its rights over the band as a precursor to releasing parts of it to the market for commercial use through spectrum trading. This can only be put in place with the mechanism know as Recognized Spectrum Access (RSA), since Crown bodies cannot be granted Wireless Telegraphy (WT) licences.

2.2 For the MOD to release parts of the band to the market, Ofcom first needs to complete the following:

1) **Decide on those parts of the 3400 to 3600 MHz band where the grant of RSA may be made**. The band is currently shared by the MOD with several licensed civil applications. Allowing the Crown to apply and obtain RSA in the band may have an impact on these users.

2) **Make the regulations that provide the legal framework**. RSA is available only where introduced by regulations made by Ofcom. The existing RSA regulations and RSA trading regulations will need to be amended to extend them to the 3400 to 3600 MHz band.

3) **Set out the conditions of the RSA grants and the WT licences that may arise from trade**. These conditions will specify the rights and obligations of the holders, and will include in particular technical limits to avoid undue interference to adjacent users.

4) **Proceed with the issuance and trading of RSA grants**. Ofcom would issue one or more grants of RSA in the band following an application from the Crown. The RSA holder may subsequently apply to Ofcom for a total or partial trade of the spectrum covered by its grant. If Ofcom consents to the trade, we will issue a WT licence to the transferee[2] incorporating the conditions of the grant and, possibly, further conditions that may be required following a partial trade.

2.3 This consultation addresses first the policy issues in step 1). Our proposal is to make it possible for the Crown to apply for RSA in the 3400 – 3480 MHz and 3500 – 3580 MHz blocks for the reasons set out in section 5. We are also consulting now on the main conditions that should apply in the RSA grant(s) and licences, step 3), notably those that relate to the technical limits. We expect to provide further detail on the grant and licence conditions at the time that we issue the notice of the proposed regulations (in step 2) following this consultation process.

2.4 We are still considering the processes involved in step 4) as they impact on existing licensed users in the band, notably the emergency services. Government

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1 Ministry of Defence, "UK Defence Spectrum Management, a statement on an Implementation Plan for Reform", http://www.mod.uk/DefenceInternet/AboutDefence/CorporatePublications/ConsultationsandCommunications/PublicConsultations/UkDefenceSpectrumManagement200812.htm

2 In a spectrum trade, the transferee is the party receiving the rights and obligations and the transferor is the party giving up or sharing the rights and obligations

departments first need to resolve a number of issues regarding existing public sector use in the band, and these issues will have an impact on precisely how this process is managed. We will give more details on the implementation arrangements at a later stage.

2.5 This document is organized as follows:

- Section 3 provides the background of Ofcom's statutory duties and our strategy regarding the management of public sector spectrum, focusing in particular in the mechanism of Crown RSA.
- Section 4 presents an overview of international regulation in the band and the current status in the UK.
- In section 5 we explain the reasons for regulatory intervention and how we arrive at our proposal to introduce in the regulations the 3400 – 3480 MHz and 3500 – 3580 MHz blocks.
- We address some of the non-technical implementation aspects in section 6 and section 7, notably the issues around public sector use in the band.
- Section 8 contains our proposals for the technical limits for the RSA grant and for the licences that may subsequently arise from trade.
- The Regulatory Impact Assessment at annex 5 summarises the risks, costs and benefits of the proposals.

Section 3

Framework for introducing RSA

3.1 In this section we describe the general legal and policy framework in the UK within which we are considering these issues. First, we outline our legal framework including our functions, duties and objectives as they relate to the management of the radio spectrum. Next, we summarise the policy towards the management of public sector spectrum holdings. Third, we explain the concept of RSA and the regulations that we have made to enable its application.

The statutory framework

3.2 Ofcom manages the radio spectrum within a statutory framework created by the Communications Act 2003 (the 'Communications Act') and the Wireless Telegraphy Act 2006 (the 'WT Act'). These Acts, which give effect to European Union requirements[3], set out our duties, functions and powers. Under section 3(1) of the Communications Act it is the principal duty of Ofcom in carrying out its functions:

- to further the interests of citizens in relation to communications matters; and
- to further the interests of consumers in relevant markets, where appropriate by promoting competition

3.3 In doing so, we are required to secure (under section 3(2)), among others:

- the optimal use for wireless telegraphy of the electro-magnetic spectrum;
- the availability throughout the UK of a wide range of services;

3.4 In carrying out its spectrum functions it is the duty of Ofcom (under section 3 of the WT Act) to have regard in particular to:

- the extent to which the spectrum is available for use or further use, for wireless telegraphy;
- the demand for use of that spectrum for wireless telegraphy; and
- the demand that is likely to arise in future for the use of that spectrum for wireless telegraphy.

3.5 It is also our duty to have regard, in particular, to the desirability of promoting:

- the efficient management and use of the spectrum for wireless telegraphy;
- the economic and other benefits that may arise from the use of wireless telegraphy;
- the development of innovative services; and
- competition in the provision of electronic communications services.

[3] Including the Authorisation Directive 2002/20/EC and the Framework Directive 2002/21/EC

3.6 Our duties require us to balance a range of considerations. We have a variety of regulatory tools and market mechanisms at our disposal to manage the radio spectrum and use these to carry out our functions. This is laid out in our Spectrum Framework Review[4] (SFR), which sets out Ofcom's overall strategy for the management of spectrum through a market-based approach.

3.7 We consider that market-based mechanisms, such as trading, liberalisation, administered incentive pricing and auctions are more likely to achieve our statutory objective of securing optimal use of the spectrum than 'command and control' methods based on regulatory and administrative decisions. We have been progressively applying and extending market mechanisms in the commercial and public sectors.

3.8 Under the WT Act, it is an offence to install or use radio equipment without authorisation from Ofcom. However, the WT Act does not bind the Crown, so Crown bodies such as government departments and executive agencies do not need authorisation from Ofcom in order to install or use radio equipment and there is no basis for Ofcom to license them.

Applying market mechanisms to public sector spectrum holdings

3.9 The public sector[5] has extensive spectrum holdings amounting to about half of the spectrum below 15 GHz with a value that could exceed £20bn[6]. In view of the economic and social value of radio spectrum, it is essential that public sector holdings are managed and used as efficiently as possible.

3.10 Following the recommendations of the Independent Audit of Spectrum Holdings[7], the Government, supported by Ofcom, committed to a programme for improving the efficiency with which public bodies manage and use their spectrum holdings. The government agreed in particular that market mechanisms should be extended more widely to public sector in line with Ofcom policy in the commercial sector.

3.11 A key element to give public bodies enhanced incentives and opportunities to use spectrum efficiently is to enable them to trade their spectrum holdings. Crown bodies currently use spectrum without individual authorisation from Ofcom; as a result, there is no formal recognition akin to that conferred by a WT Act licence. Hence their spectrum holdings cannot be traded and incentives to release them have been limited to a pro rata reduction in fees paid to Ofcom. Grants of tradable Recognised Spectrum Access (RSA) rights will enable public bodies to release spectrum directly to the market.

Crown RSA

3.12 RSA is a relatively new spectrum management instrument that was introduced by the Communications Act and that is suitable for bodies, such as Government departments, that are outside the scope of the licensing provisions of the WT Act. A grant of RSA defines the rights and obligations that may be traded and that will have to be complied with by any person acquiring a licence created by transferring the RSA.

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4 http://www.ofcom.org.uk/consult/condocs/sfr/

5 This term is used here to include civil aviation and maritime use (even though most airlines, airports, shipping lines and ports are private sector).

6 Source: Independent Audit of Spectrum Holdings at http://www.spectrumaudit.org.uk.

7 Ibid.

3.13 Sections 18 to 26 of, and schedule 2 to, the WT Act contain the principal statutory provisions relating to RSA. The characteristics of RSA may be summarised as follows:

- RSA is available only where introduced by regulations made by Ofcom. The WT Act contains enabling powers and does not operate directly to introduce RSA.
- RSA may be granted in relation to both transmission and reception.
- RSA confers formal recognition but does not authorise spectrum use. Subject to other regulations, it remains lawful for the bodies that do not require a WT Act licence to use spectrum without applying for a grant of RSA in the frequency bands in which RSA has been introduced.
- Ofcom may describe the restrictions and conditions in respect of which RSA is granted, including frequencies, times and places of reception, strength and type of signal.
- Where Ofcom has granted RSA, it is under a duty in planning and managing the radio spectrum to take account of the use of spectrum in respect of which the grant has been made to the same extent as it would have regard to a licence issued in similar terms.
- RSA, may be made tradable and may be converted into a licence, for example where it has been traded to a non-Crown body, in accordance with regulations made by Ofcom.

We made Crown RSA regulations in January this year

3.14 We first made regulations in connection with RSA for radio astronomy in 2007. In January 2009 we made the regulations that allow us to grant RSA to the Crown in the specific frequency bands identified in these regulations, and the regulations that enable the trading of the grants (of RSA and Crown RSA)[8]. These regulations are in the following Statutory Instruments[9]:

- SI No. 16 of 2009, The Wireless Telegraphy (Crown Recognised Spectrum Access) Regulations 2009;
- SI No. 17 of 2009, The Wireless Telegraphy (Recognised Spectrum Access and Licence) (Spectrum Trading) Regulations 2009;

3.15 Associated with these are regulations to add information about assignments in the band to the WT Register, and a Limitations Order.

3.16 For the time being, the Crown RSA regulations referred to above cover certain blocks in the 406.1 to 430 MHz range only. Our proposals to enable the grant of RSA in the 3400 to 3600 MHz band will, if we decide to go forward with these proposals following consultation, be implemented through amendments to extend these regulations.

[8] http://www.ofcom.org.uk/consult/condocs/sfrps08/sfrps_statement/

[9] The Regulations can be obtained through the Office of Public Sector Information. http://www.opsi.gov.uk/

Section 4

Overview of the 3400 to 3600 MHz band

4.1 This section describes the specific circumstances of the 3400 to 3600 MHz band that we need to take into account. It begins with an overview of international regulation relevant to this band, notably the recent European Commission Decision on Harmonisation and our interpretation of the requirements of the Decision in the UK context. It then reviews the current uses of this spectrum in the UK.

International regulatory status of the 3400 to 3600 MHz band

4.2 In Region 1 of the International Telecommunications Union (ITU), which includes Europe, the 3400 to 3600 MHz band is allocated to: fixed services, fixed-satellite services (space-to-Earth), mobile services in a number of countries (including the UK) on a primary basis subject to certain conditions, and in general to mobile services on a secondary basis. The European Common Allocation (ECA)[10] table maintained by the European Conference of Postal and Telecommunications Administrations (CEPT) shows that the 3400 to 3600 MHz band is also allocated on a primary basis to the mobile service.

4.3 The band was identified in 1998 as a preferred allocation for Fixed Wireless Access (FWA) in CEPT countries[11]. In 2004, the Electronic Communications Committee (ECC) issued Recommendation (04)05[12], which provides guidelines for accommodation and assignment for spectrum managers, notably on block characteristics, maximum power and out of band requirements. This regulatory regime was designed for Fixed and Nomadic Wireless Access (NWA) scenarios.

4.4 ECC Decision (07)02[13] from 2007 introduces the concept of flexible usage mode[14] and designates the band for Broadband Wireless Access (BWA). It follows ECC studies showing the feasibility of BWA in the 3400 – 3800 MHz range, and a survey which showed that FWA use in the 3400 – 3600 MHz range was widespread among CEPT administrations.

3400 to 3800 MHz is a WAPECS band

4.5 The 3400 to 3800 MHz band is one of those being considered within the European Union's (EU) WAPECS (Wireless Access Policy for Electronic Communications Services) project. WAPECS is a proposed framework for the provision of electronic communications services within a set of frequency bands to be identified and agreed between EU Member States for communications services that may be offered on a technology and service neutral basis, provided that certain technical requirements to avoid interference are met.

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10 http://apps.ero.dk/ECA/

11 ERC Recommendation 13-04, now withdrawn, and ERC Recommendation 14-03. http://www.erodocdb.dk/doks/doccategoryECC.aspx?doccatid=2

12 ECC Rec. (04)05, "Guidelines for accommodation and assignment of multipoint fixed wireless systems in frequency bands 3.4-3.6 GHz and 3.6-3.8 GHz" http://www.erodocdb.dk/Docs/doc98/official/pdf/REC0405.PDF

13 ECC Dec. (07)02 on "availability of frequency bands between 3400-3800 MHz for the harmonised implementation of Broadband Wireless Access systems (BWA)". http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC0702.PDF

14 Flexible usage mode means licence conditions that allow the deployment of various types of applications: fixed wireless access, nomadic wireless access or mobile wireless access

4.6 CEPT Report 19[15] was produced in response to the European Commission mandate to develop least restrictive technical conditions for a number of WAPECS bands. With regard to the 3400 to 3800 MHz band it concluded that retaining the rights as described in ECC Rec. (04)05 and the annex of ECC Dec. (07)02 was the most appropriate regulatory option for the band at that stage.

European Commission Decision on Harmonisation

4.7 On 21 May 2008 the European Commission published its 2008/411/EC Decision on the harmonisation of the 3400 to 3800 MHz bands for Electronic Communication Services[16] (the Decision).

4.8 The Decision aims at harmonising, without prejudice to the protection and continued operation of other existing use in this band, the conditions for the availability and efficient use of the 3400 to 3800 MHz band for terrestrial systems capable of providing electronic communications services.

4.9 The Decision requires Member States to designate and make available by October 2008, on a non-exclusive basis, the 3400 – 3600 MHz band for terrestrial electronic communications networks, in compliance with the parameters set out in the annex to the Decision. The same requirement applies to the 3600 – 3800 MHz band by January 2012.

4.10 The Decision further clarifies that Member States shall allow the use of the 3400 to 3800 MHz band in accordance with its Article 2 for fixed, nomadic and mobile electronic communications networks.

4.11 Ofcom has considered the obligations of Member States under the Decision in relation to "existing use" and considered that:

- services that currently use the 3400 to 3800 MHz band do not need to be removed from the band either now or in the future;
- the provisions of the Decision relating to existing use do not require Member States to take regulatory action to change existing use but do not prevent them from doing so;
- Member States cannot allow future use by services that do not currently use the 3400 to 3800 MHz band and that do not qualify as "terrestrial electronic communications networks";
- services that do not currently use the 3400 to 3800 MHz band, that qualify as "terrestrial electronic communications networks" and that wish to make use of the 3400 – 3800 MHz band, should, in principle, be allowed to make use of the band. However, Member States may decide not to allow such new uses where they would affect an existing use.

[15] CEPT Report 19, "Report from CEPT to the European Commission in response to the Mandate to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS", http://www.erodocdb.dk/Docs/doc98/official/pdf/CEPTREP019.PDF

[16] Commission Decision of 21 May 2008 on "the harmonisation of the 3400 – 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community" (2008/411/EC). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:144:0077:0081:EN:PDF

4.12 In relation to Member States' obligations in respect of technical conditions, we consider that:

- when a Member State allocates spectrum in the 3400 to 3800 MHz band to new users (terrestrial electronic communications networks), it should to do so in conformity with the technical parameters set out in the annex to the Decision, unless the specific circumstances provided for in that annex are in place;
- in relation to current users of the 3400 to 3800 MHz band, Member States are not obliged to amend the terms of use to reflect the technical parameters set out in the Decision's annex;
- the parameters for out of block emissions are derived from a scenario where two broadband wireless networks sit in adjacent frequency blocks. These parameters will not necessarily be suitable where the adjacency is between a broadband wireless network and a different use.

4.13 The Decision itself refers generally to "terrestrial electronic communications networks" (Article 2(1) and (2)). On the other hand, the preambles seem to focus more specifically on (wireless) broadband applications. For example, preamble (2) states that "the services provided in this frequency band should mainly target end-user access to broadband communications".

4.14 The Decision does not constrain new uses in the band to broadband wireless applications. Accordingly, all new services which qualify as terrestrial electronic communications networks should be allowed in the band provided they comply with the technical conditions set out in the annex to the Decision. However, we base our discussion of the scenarios for technical analysis in this document on the assumption that the most likely new usage will be broadband wireless.

Implementation of the Decision in the UK

4.15 The UK implemented the Decision through the 3400 – 3800 MHz Frequency Band (Management) Regulations 2008[17]. These regulations impose a duty on Ofcom to carry out their functions so as to give effect to the requirements in the Decision.

4.16 We consider that current usage of the band in the UK is fully compliant with the terms of the Decision as required by the 2008 regulations. However, we also need to ensure that new assignments are made in a way that accords with the Decision's requirements, including the technical parameters in the annex to the Decision. In practice, we propose to do this by ensuring that grants of RSA and new licences in the band include suitable technical conditions.

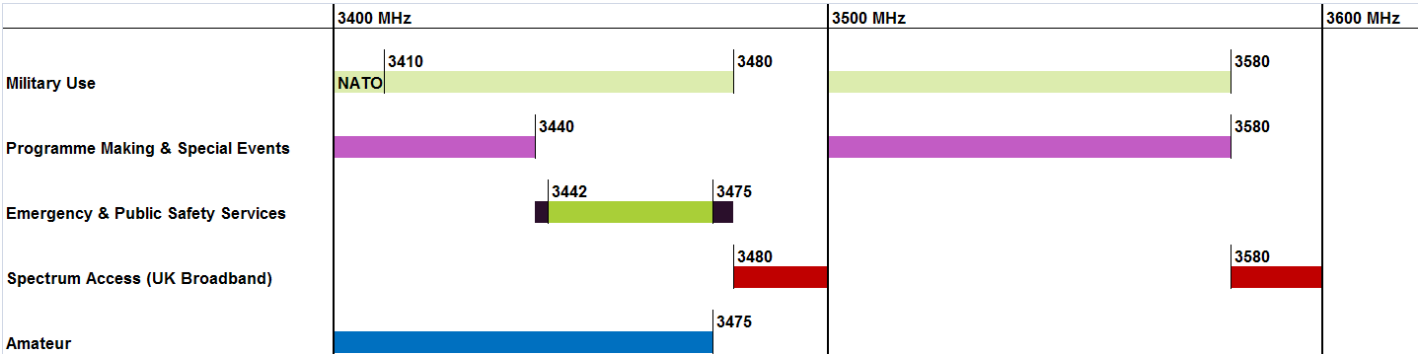
Status of the 3400 to 3600 MHz band in the UK

4.17 The 3400 to 3600 MHz band is managed and used by the Ministry of Defence, but it has also extensive shared civil use as outlined by the UK Frequency Allocation Table[18] (UK FAT) and the UK Plan for Frequency Authorisation[19]. Ofcom licenses several civil applications in the band following various arrangements with the MOD, which remains ultimately responsible for the band. Figure 3.1 shows the block allocations for the military and licensed civil uses in the 3400 to 3600 MHz range. We

[17] Statutory Instrument 2008/2794 http://www.opsi.gov.uk
[18] http://www.ofcom.org.uk/radiocomms/isu/ukfat/
[19] http://spectruminfo.ofcom.org.uk/spectrumInfo/ukpfa

describe briefly below these uses, those in adjacent bands and the satellite services that may be operating in the band without the need of a licence.

Figure 4.1: Current use of the 3400 to 3600 MHz band in the UK



Ministry of Defence

4.18 The MOD use of the band is described in the MOD statement and the defence spectrum demand study[20] published alongside. Essential NATO use of this band extends from 3400 MHz to 3410 MHz and there is some residual MOD requirement for spectrum around 3500 MHz, in total amounting to around 14% of the 3400 to 3600 MHz band. In practice the MOD current use of this band is sparse, and this has allowed the progressive introduction of the various civil uses.

4.19 The defence study assesses the MOD's current and mid term i.e. 2015 needs for spectrum in the band to amount to a total of 56 MHz. The study notes that the actual use of equipment could be restricted on a geographic basis, or may have the potential to be moved into other bands, and that there is potential for economic gains from the release of spectrum and from savings on the amounts the MOD pays to Ofcom for spectrum without significantly impairing military capabilities.

Broadband Wireless Access

4.20 UK Broadband holds a licence for the frequency ranges 3480 to 3500 MHz and 3580 to 3600 MHz. The licence comprises the 15 regions for which the Radiocommunications Agency auctioned Public Fixed Wireless Access Operator licences in June 2003 and provides coverage across the whole of the UK. The licence term of five years started in 2003 and has been extended for a further five years. One further five year extension may be made i.e. until 2018.

4.21 In 2007, following a public consultation, Ofcom varied UK Broadband's licence to allow technology and application neutrality, i.e. remove the limitation to fixed applications, and to increase the permitted power limits.

Programme Making and Special Events (PMSE)

4.22 This application corresponds to wireless links used to relay video from both fixed and mobile cameras at events of limited duration and whose location is known in

[20] Ministry of Defence, "Final Report Defence Demand for Spectrum: 2008 – 2027" http://www.mod.uk/DefenceInternet/AboutDefence/CorporatePublications/ConsultationsandCommunications/PublicConsultations/UkDefenceSpectrumManagement200812.htm

advance, principally outdoor broadcast events such as motor racing, horse races, golf tournaments and festivals.

4.23 JFMG grants licences for PMSE use of this band on behalf of Ofcom. These licences have a validity of a few days and are for specific locations. The licences can be obtained for any location in the country with the exception of certain areas reserved for military use. JFMG uses a digital channel plan covering the 3400 – 3440 MHz and 3500 – 3580 MHz blocks and based on 10 MHz and 20 MHz channels, potentially resulting in twelve 10 MHz channels. It is worth noting that in addition to these blocks, there are other bands where PMSE video links are authorised[21]:

- 2 GHz low (2025 – 2110 MHz and 2200 – 2300 MHz). This is the most popular band for video links. Broadcasters have annual licences for certain channels and the rest are allocated on a first come first served basis.
- 2 GHz mid (2390 – 2400 MHz) and high (2400 – 2500 MHz). Lightly used due to interference from licence exempt devices, with the exception of 2483 – 2500 MHz which is suitable for PMSE.
- 2500 – 2690 MHz. Available on a short-term licensing basis only and will be withdrawn for PMSE use on three months' notice, subject to the timing of the award of this band.
- Several channels in the 5 GHz, 7 GHz, 8 – 12 GHz and 24 – 48 GHz ranges, shared with various primary services and FWA, although largely unused by PMSE.

4.24 There are around 20 organisations requesting licences for the channels in the 3400 to 3600 MHz band, mainly the public-service broadcasters and other production companies. Some of these companies also hold annual licences for PMSE channels at 2 GHz.

4.25 Usage of the 3400 to 3600 MHz band has been so far relatively low. Data from the PMSE licensing database for 2008 shows that there were 213 assignments in the band. This compares with 3515 assignments in the 2 GHz low band despite there being only 50% more bandwidth in that spectrum. The 3400 to 3600 MHz band is also licensed for shorter periods (an average of 2.1 days) than the 2 GHz low band (an average of 7.3 days).

4.26 In practice it appears that PMSE demand for spectrum in the 3400 to 3600 MHz band typically occurs where an event has a high demand for wireless cameras and the favoured channels in the 2 GHz bands are insufficient, on their own, to meet the elevated spectrum demand. Otherwise, demand for spectrum at 3400 to 3600 MHz is usually limited to one or two channels for each event.

Emergency and Public Safety Services (EPSS)

4.27 EPSS currently have access to 33 MHz at 3442 – 3475 MHz pursuant to an arrangement between MOD and the EPSS sponsor departments[22]. This allocation is

[21] See the "Digital dividend: band manager award" consultation and related documents http://www.ofcom.org.uk/consult/condocs/bandmanager09/

[22] Policy responsibility and sponsorship of the civil emergency services is shared between a number of departments including Home Office (for police), Department of Communities and Local

available to the emergency services on an exclusive basis and recognised in the UK FAT by footnote UK3. The sponsor departments have, among others, communications policy responsibility for the individual services. The WT licences are held by the end users – police forces and fire brigades – and specify the individual channels and the relevant conditions of use.

4.28 The block is bordered by two guardbands, 2 MHz at the lower edge and 5 MHz at the upper edge. The band plan in use has three 8 MHz wide channels although an alternative band plan with 4 MHz channels is also specified.

4.29 The band is used by police forces, fire brigades and other government departments for air-to-ground video applications. Typically, there will be an airborne transmitter operating between 10000 and 300 ft (normal operation is at 800 ft) and several receivers at fixed locations in the area covered by the force. In some cases there may also be mobile receivers. The up link is not operated in this band.

4.30 Only a fraction of the UK police forces use this band so far since many of the forces are still using analogue links operating in the 2.3 GHz band. There is however a migration programme in place to move them out of 2.3 GHz and into the 3.4 GHz band. The migration programme is linked to the national upgrade from old analogue technology to digital. These are the only bands allocated to emergency services airborne video links, and the NPIA[23] considers that more capacity could be needed.

4.31 Ofcom has granted 101 WT licences for this service. The licences include one or two 8 MHz channels[24], are renewed annually and authorise usage in the geographical areas where each police force or fire brigade operates.

Amateur use

4.32 Amateur radio users have access to the 3400 – 3475 MHz band on a secondary basis. The ITU Radio Regulations[25] define secondary status in the following terms:

- Stations shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date.
- Stations cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date.
- Stations can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.

4.33 According to the band plan of the Radio Society of Great Britain, the body that represents a significant number of the UK Radio amateur population, UK amateurs appear to favour usage below 3410 MHz, possibly because the European common allocation for amateur use in this band is restricted to 3400 – 3410 MHz.

Government (for fire) and Department of Health (for the ambulance services). The Scottish Executive has similar responsibilities in respect of services in Scotland.

[23] National Policing Improvement Agency

[24] The licences also include several 4 MHz channels overlapping with the 8 MHz channels but it appears that this configuration is normally not used.

[25] ITU Radio Regulations 2008, article 5.28

Satellite Services

4.34 Although fixed satellite (space-to-earth) services have primary status in all ITU regions in 3400 to 3600 MHz, the band is not allocated to satellite services in the UK. In practice transmissions from several international satellites reach the UK, and Ofcom is aware of Earth stations in the country receiving these transmissions. This usage is not recognised by Ofcom, and there is currently no formal mechanism in place for us to protect it.

Adjacent bands

4.35 The 3600 to 3800 MHz band is allocated to fixed satellite downlinks. In addition, fixed point to point terrestrial links are licensed in the 3650 to 3800 MHz range. Also, Freedom 4 holds a Fixed Wireless Access (FWA) licence for the frequency range 3605 to 3689 MHz. Freedom4 has recently asked Ofcom to vary its licence to increase the central station maximum power and to allow mobile use of low power terminals. We consulted on this request in June 2009 and we are considering the responses that we have received.

4.36 The 3300 to 3400 MHz band is also managed by the MOD but has no licensed civil use. The military use here is mainly radiodetermination. Further down in frequency, civil and military maritime and aeronautical radars operate in the 2900 to 3300 MHz range. Following our work for the 2.6 GHz award, we are aware of the possibility of blocking and interference of these radars by mobile networks operating in bands hundreds of MHz away. We are currently investigating the extent of this effect, the scenarios in which it would occur and the potential mitigation measures.

Section 5

Extension of RSA to the 3400 to 3600 MHz band

5.1 The 3400 to 3600 MHz band is managed and used by the Ministry of Defence. The MOD December 2008 Statement explains how the MOD plans to reform UK defence spectrum management and to extend market principles to its use of the radio spectrum. In particular, the MOD Statement said that it planned to apply for RSA in this band and release some spectrum from it to the market by November 2010. Ofcom noted in our response to the consultation that preceded the MOD statement that we consider this band as a priority for release or sharing.

5.2 In this section we present our approach to support MOD's plans with regards to the introduction of RSA in the band. We address this in two steps: first, we consider the generic policy question of whether RSA should be made available to the Crown in this band, and secondly we determine the parts of the band where RSA would be available.

RSA in the 3400 to 3600 MHz band

5.3 We consider in this section the general principle of whether RSA should be introduced in the 3400 to 3600 MHz band. We look first at the Commission Decision on Harmonization which sets out requirements regarding how Member States should make the band available. We evaluate how this Decision may affect our capacity to grant RSA. Secondly, we consider the introduction of RSA in this band against our statutory duty to secure optimal use of the radio spectrum to promote the interests of citizens and consumers.

Effect of the Commission Decision 2008/411/EC

5.4 The 3400 – 3800 MHz Frequency Band (Management) Regulations 2008[26] requires Ofcom to carry out our functions under the WT Act so as to give effect to the obligations of the United Kingdom under the Commission Decision.

5.5 The Decision seeks to harmonize the conditions for the availability and efficient use of the 3400 – 3800 MHz band for terrestrial systems capable of providing electronic communications services, without prejudice to the protection and continued operation of existing users. The Decision requires Member States to designate and make available, on a non-exclusive basis, the 3400 – 3800 MHz band for terrestrial electronic communications networks, in compliance with the parameters set out in the annex to this Decision.

5.6 We explain in paragraphs 4.11 and 4.12 our view that the Decision does not require us to impose the harmonisation requirements on existing users. However, if we make the band available for new licences, these licences need to be harmonised with the Decision requirements.

5.7 We consider that this does not constrain our ability to amend the RSA regulations so as to enable the grant of RSA covering all or parts of the band. However it does

[26] Statutory Instrument 2008/2794, http://www.opsi.gov.uk/

affect the technical conditions that can be attached to the grants of RSA (as opposed to the regulations themselves).

5.8 In particular, these conditions must be in line with the technical parameters in the annex to the Decision and with the Decision mandate that the band is made available for terrestrial electronic communications. In practice, the technical conditions of the RSA would be transferred to the WT licences that Ofcom would grant when a trade takes place, giving effect to the Decision requirement that spectrum licensed in the band is made available in compliance with the Decision.

5.9 Therefore, the grant and trading of RSA will provide a mechanism to enable the MOD to transfer spectrum to the harmonised use advocated by the Decision.

Optimal use of spectrum

5.10 We now consider whether the grant of RSA in the 3400 to 3600 MHz band would be consistent with our statutory duty to secure optimal use of the radio spectrum so as to promote the interests of citizens and consumers.

5.11 If we were not to extend the RSA regulations to cover this band then the current regulatory conditions would be preserved. Public sector users already pay administered incentive pricing (AIP) for this spectrum. Where AIP is applied to public sector spectrum holdings, users will have an incentive to return surplus spectrum to Ofcom or to allow Ofcom to award licences that share spectrum as they will then pay a reduced fee. However, the incentive would be greater if public sectors users were able to trade the spectrum directly to commercial sharers and receive the proceeds.

5.12 A second key advantage of RSA over the status quo is that it can facilitate faster release of spectrum to the market. At present, if a public body identifies an opportunity to release or share spectrum with commercial users, it returns it to Ofcom to award or assign. This process can be cumbersome and time-consuming. A tradable RSA would allow the public body to engage in a trade with interested commercial parties in the same way private sector stakeholders trade their spectrum holdings.

5.13 We explored these and other benefits of the direct engagement of the public sector with the market in our Spectrum Framework Review for the Public Sector[27]. We concluded that the introduction of tradable RSA would be effective in promoting spectrum release and would benefit citizens and consumers provided that effective measures are in place to avoid unacceptable effects on public safety and national security. The Government has undertaken that public safety and national security will remain paramount. Our RSA regulations support this by placing decisions on spectrum release or sharing in the hands of the public bodies responsible for such matters.

5.14 We therefore consider that a decision not to extend the RSA regulations to cover this band would be less advantageous as it would not allow the benefits of public sector spectrum trading to be realised. As a general principle, we also consider that it would be preferable to introduce RSA in as much as possible of the 3.4 to 3.6 GHz band as this would maximize the potential gains from trade, provided that public safety and national security are not impacted.

Question 1: do you agree that we should introduce RSA in the 3400 to 3600 MHz?

[27] http://www.ofcom.org.uk/consult/condocs/sfrps/

In what parts of the 3.4 to 3.6 GHz band should RSA be enabled?

5.15 In this section we look in more detail at which parts of the band should or should not be included in the RSA regulations, taking account of the different circumstances affecting particular frequency ranges within the band. We have described in section 4 how this band is exploited in the UK by several different services. We examine here if and how RSA may be introduced in the frequency blocks where these services operate, in the light of government plans and the impact that introduction of RSA would have on the existing users.

5.16 We consider first the effect of RSA on two particular uses: MOD's own use for military purposes, and satellite use which, although recognised by the ITU, is not licensed in the UK in this band. None of these uses is licensed by Ofcom. We then consider the impact on licensed civil users of introducing RSA in their spectrum blocks:

- 3400 – 3440 MHz and 3500 – 3580 MHz: Programme Making and Special Events (PMSE).
- 3440 – 3480 MHz Emergency and Public Safety Services (EPSS).
- 3480 – 3500 MHz and 3580 – 3600 MHz: Spectrum Access (UK Broadband).
- 3400 – 3475 MHz: Amateur use.

5.17 We conclude this section with a proposal for the block that we think should be introduced in the RSA regulations.

Impact of the introduction of RSA in 3400 to 3600 MHz on military use in the band

5.18 The amendment of the RSA regulations to include the 3400 to 3600 MHz band or parts thereof, in the RSA regulations does not place any obligation on the MOD, as the band manager, to apply for a grant of RSA. It merely creates the option for it to do so. Moreover, if it decides to do so, the grant of RSA does not impose limitations on the MOD's own use of spectrum, current or future. Its purpose is to define the rights and obligations that may be traded. This means, in particular, that the MOD is not constrained by the technical parameters in the grant when it uses the spectrum for military applications.

5.19 The grant of RSA formalises the rights of MOD to trade the spectrum. Once those rights have been established, the MOD may or may not decide to trade the spectrum depending on its appraisal at that time of the market, value for money and present and future operational requirements. For example, the MOD may decide in the light of defence requirements to limit its spectrum releases to certain frequencies or geographical areas and to retain the rest for its own use. For these reasons, the introduction of these frequency bands to the RSA regulations will not adversely impact the ability of the MOD to use this spectrum as it wishes.

Impact of the introduction of RSA in 3400 to 3600 MHz on satellite use in the band

5.20 The 3400 to 3600 MHz band is has a co-primary allocation for fixed satellite, space-to-earth services in the ITU Radio Regulations across all ITU regions. However, the

UKFAT does not list this allocation in the UK. The MOD and Ofcom are aware of a limited number of satellite receive-only Earth stations in the band in the UK, but we do not know their exact number or locations.

5.21 Since this service is currently not recognised in the UK for this band, the use of these receivers is not and cannot currently be protected from interference. This would continue to be the case following the extension of the RSA regulations. Should the operators of the satellite Earth stations wish to secure a degree of protection in the event of spectrum release by the MOD, they would need to approach the MOD as manager of the band. For example, the MOD might agree to limit its release programme to geographical areas where interference with satellite reception could be avoided.

5.22 Therefore, we do not consider that the presence of satellite earth stations receiving in the 3400 to 3600 MHz band is a reason not to extend the relevant regulations to allow Crown bodies to be granted and to trade RSA in the band.

Impact of the introduction of RSA in 3400 to 3600 MHz on existing licensed users

5.23 The introduction of a band in the RSA regulations enables a Crown body to request RSA for that band or parts thereof. If the band has existing licences, the RSA grant would need to be compatible with these licences. “Compatible” here means that the existing licensed use can co-exist with the usage recognised by the RSA grant. If that were not the case, we would not be able to grant the RSA unless the existing licenses had first been withdrawn or surrendered.

5.24 We analyse this situation in detail below for each of the civil services in the band that are licensed under the WT Act by Ofcom today: amateur, PMSE, EPSS and spectrum access (UK Broadband). In this context, we test the scope for co-existence of services against the assumption that any traded RSA spectrum will be used for the broadband wireless applications advocated by the Commission Decision.

Programme Making and Special Events (PMSE)

5.25 Current PMSE use is authorised in the 3400 – 3440 MHz and 3500 – 3580 MHz blocks through licences that are short term i.e. a few days, and localized. PMSE use of these frequencies is by agreement with the MOD. The MOD has been reconsidering this arrangement in the light of its new strategy for managing spectrum. Once the RSA regulations are in place, the MOD will take a decision whether to offer parts of the spectrum for release to commercial users.

5.26 The MOD has informed PMSE licensees in the band that it has agreed that, following grant of an RSA, PMSE users would continue to be able to access this spectrum under the same terms and conditions as at present (and Ofcom has agreed to enable this in view of the very short term nature of individual PMSE licences in this band). However, MOD has also informed PMSE users that this arrangement is unlikely to continue if and when the MOD decides to release the spectrum to the market.

5.27 This means that the making of regulations and the granting of RSA to the MOD, which are the steps that would take place before the MOD is in a position to release spectrum, would not, of themselves, have a direct effect on PMSE access to the band. But as the MOD may decide to release the spectrum once it obtains the RSA grant, new users could acquire the rights to deploy broadband wireless services as

set out by the Commission Decision, leading to a situation where broadband wireless and PMSE videolinks co-existence would have to be considered.

5.28 This co-existence scenario has been analysed by the ECC in its ECC Report 100[28]. The report contains the study of interference from broadband wireless to terrestrial ENG/OB[29] videolink systems, and concludes that co-channel sharing between BWA services of the type envisaged by the Decision and terrestrial ENG/OB is not feasible. Therefore continued PMSE usage would not be compatible with incoming broadband services in the same frequencies.

5.29 In conclusion, introduction of this spectrum in the RSA regulations would make PMSE access in the future uncertain. The MOD has made clear that it would only be able to offer the PMSE sector security of access in the period until it releases spectrum to the market. It is worth noting that there is currently relatively light use of this band by wireless cameras, and that the PMSE sector is free to negotiate any subsequent access with the MOD, or to acquire spectrum rights subsequently through the market[30].

5.30 Therefore, we are minded to extend the relevant regulations to allow Crown bodies to be granted and to trade RSA in the 3400 – 3440 MHz and 3500 – 3580 MHz blocks.

Emergency and Public Safety Services (EPSS)

5.31 ECC Report 100 also studied coexistence of airborne ENG/OB and broadband wireless and concluded that co-channel sharing is not feasible. This result is applicable to the EPSS use of the band which is technically very similar to the airborne ENG/OB studied. Therefore, it would not be possible, without risking serious interference, to authorise a BWA use in line with the Commission Decision requirement in a band where EPSS airborne videolinks are licensed.

5.32 This means that if we were to grant an RSA which could later be traded for broadband wireless use in the EPSS spectrum block, we would have to revoke the existing licenses first. However, we note that the MOD and the government departments sponsoring emergency services agree that EPSS usage should continue in this band. This may be implemented in one of two ways:

a) The EPSS block is left out of the RSA regulations. The current arrangement continues i.e. existing licences are not altered. The EPSS block remains under the MOD's management but it is not included in a grant of RSA or made tradable. It will not be possible for the Crown bodies involved to formalize their rights or to trade the spectrum.

b) The block is introduced in the RSA regulations and a government department (or more than one concurrently) seeks RSA for it. The RSA would be traded and converted into new licences that replicate the existing ones held by EPSS users. This would be done in such a way as to maintain continuity of use as explained in section 6.

5.33 The preference of the MOD, Ofcom and the departments with policy responsibility over emergency services spectrum is for option b). This is because the RSA

[28] ECC Report 100 Compatibility Studies in the Band 3400- 3800 MHz between Broadband Wireless Access (BWA) Systems and other Services

[29] Electronic News Gathering and Outside Broadcast. This is another way of referring to PMSE.

[30] Digital dividend: band manager award – second consultation on detailed award design http://www.ofcom.org.uk/consult/condocs/bandmanager09/

mechanism gives the MOD and the EPSS sponsoring departments the opportunity to formalise their rights over the spectrum in the way they see fit. In particular, EPSS access is now based on the MOD agreement but, following granting and trading of the RSA, EPSS end users would hold licences not conditioned by MOD agreement. In addition, it provides greater flexibility for changes to the way that EPSS spectrum holdings are managed, notably it keeps open the possibility of trading spectrum in the future, should the EPSS stakeholders deem this to be in their best interests.

5.34 A further specific advantage of this flexibility is that it would enable MOD and EPSS stakeholders to move the EPSS users from where they are currently to a new position within the band, should this prove to be a more optimal use of the spectrum. We explain this option in more detail in section 6.

5.35 We have considered the question of continued EPSS access under the requirements of the Commission Decision. Since the EPSS are existing users of the relevant spectrum in this band, Art. 1 of the Decision exempts their continued operation from the obligations set out in this Decision. As a result, we do not consider that any licences for the continued operation of the EPSS are required to contain the technical conditions set out in this Decision.

5.36 On the basis of these arguments, we think that regulations should be extended to allow Crown bodies to be granted and to trade RSA in the 3440 – 3480 MHz block.

Spectrum access licensed to UK Broadband

5.37 Pursuant to an agreement with the MOD, our predecessor, the Radiocommunications Agency, granted a licence to UK Broadband to exploit 3480 – 3500 MHz and 3580 – 3600 MHz. This licence runs to 2013 but may be extended to July 2018 at UK Broadband's request.

5.38 If we were to amend the RSA regulations to include these spectrum blocks, and if MOD were to apply for RSA, then we would have a situation where there were incompatible authorisations in place (unless MOD and UK Broadband agreed to go through a process whereby the latter surrendered its licence and the current position was re-created via a RSA trade).

5.39 However, MOD indicated in its spectrum management consultation that it does not have an intention to apply for RSA for these blocks. On this basis, there does not appear to be an immediate benefit in introducing the 3480 – 3500 MHz and 3580 – 3600 MHz blocks to the RSA regulations at this point, and we are minded not to do so.

5.40 We do recognise that the future of the 3480 – 3500 MHz and 3580 – 3600 MHz bands post 2018 (or post 2013, if UK Broadband were not to renew its licence) will need to be addressed before the current licence expires. In this context, if the MOD decided to apply for RSA in these bands in the future we would be able to amend the RSA regulations accordingly at that time.

Amateur use

5.41 Amateurs' access to the 3400 – 3475 MHz block is on a secondary basis i.e. they are required to avoid interfering with, and have no protection from, primary users. On this basis we consider that the amateur use currently licensed by Ofcom can co-exist with the RSA grants and with the licensed use that may arise once the RSA is traded. We

note however that amateurs' freedom to operate could be affected by an increase in spectrum use by primary users.

5.42 We note also that the MOD indicated in its May 2008 consultation[31] that the basis for sharing between the MOD and radio Amateurs is a regular dialogue with the Radio Society of Great Britain, the representative body for radio Amateurs on radio spectrum matters and that it is expected that this constructive relationship will continue.

5.43 Therefore, we do not think that the presence of amateurs as secondary users should prevent the extension of the regulations to allow Crown bodies to be granted RSA in the 3400 – 3475 MHz block.

Our proposal

5.44 For the reasons explained above, we think RSA regulations could be extended to cover the spectrum blocks currently used by PMSE and emergency services (the spectrum used by amateurs overlays these blocks). We do not think that the spectrum currently licensed to UK Broadband should be included in the RSA regulations at this point. Therefore, our proposal is to extend the RSA regulations to allow Crown bodies to be granted and to trade RSA in the 3400 – 3480 MHz and 3500 – 3580 MHz blocks. The table below summarises the key issues affecting each of the spectrum blocks in the band.

Table 5.1: Summary of the impact of RSA in the 3400 to 3600 MHz band

Spectrum block	Proposal
Military use 3400 – 3480 MHz and 3500 – 3580 MHz	• The grant of RSA does not impose limitations on the MOD's own use of spectrum, current or future • MOD may decide to trade the parts of the band that defence does not need.
Satellite services	• Fixed satellite, space-to-earth services are not recognised in the UK FAT in 3400 to 3600 MHz. This situation does not change with the introduction of RSA. • Earth stations wish to secure a degree of protection would need to approach the MOD as manager of the band.

[31] UK Defence Spectrum Management A Consultation on: An Implementation Plan for Reform http://www.mod.uk/NR/rdonlyres/8B9CFFD1-6C36-476A-A6C3-8A3E5635DC55/0/dsm_consultation_report.pdf

Spectrum block	Proposal
Programme Making and Special Events 3400 – 3440 MHz and 3500 – 3580 MHz	• Our proposal is to include this spectrum in the RSA regulations • PMSE use of these frequencies is by agreement with the MOD. The MOD has been reconsidering this arrangement in the light of its new strategy for managing spectrum. • If RSA is granted in the block, the MOD may decide to release the block to commercial users that would be incompatible with PMSE. Therefore, PMSE access in the future is uncertain. • PMSE will have temporary security of access in the period after the MOD is granted RSA and until the MOD releases the spectrum. • PMSE may negotiate subsequent access with the MOD or acquire rights through the market.
Emergency and Public Safety Services 3440 – 3480 MHz	• Our proposal is to include this block in the RSA regulations • The MOD and the government departments sponsoring EPSS have agreed that this service will continue in this band • The departments agree that RSA is the preferred route. It formalises the rights over the spectrum and provides greater flexibility in the management of emergency services spectrum holdings
Spectrum Access (UK Broadband) 3480 – 3500 MHz and 3580 – 3600 MHz	• Our proposal is not to include this spectrum in the RSA regulations • These blocks are licensed to UK Broadband until July 2018 (provided UK Broadband requests the licence extension) • MOD has indicated that it does not have the intention of applying for RSA in this block
Amateur use 3400 – 3475 MHz	• This allocation overlaps with the PMSE and the EPSS blocks, our proposal is to include the spectrum used by amateurs in the RSA regulations. • Amateur use has secondary status in this band. This status will be maintained with the granting and trading of RSA

Question 2: do you agree that we should extend the relevant regulations to allow Crown bodies to be granted and to trade RSA in the 3400 – 3480 MHz and 3500 – 3580 MHz blocks? If not, which frequency ranges do you think the RSA regulations should cover and why?

Section 6

Implementation of RSA in the EPSS spectrum block

6.1 Our proposal in the previous section is that RSA should be available to the Crown in the 3400 – 3480 MHz and 3500 – 3580 MHz blocks. We explained that emergency services air-to-ground videolinks are currently licensed in that spectrum in the 3440 – 3480 MHz range and that there is an agreement between government departments that this application will continue in the band. In this section we touch on two issues concerning the manner in which RSA might be implemented in the frequency ranges currently used by EPSS:

- the question of which Crown body would apply for, and be granted, RSA in these frequency ranges, and
- the process for handling the existing licensees in the 3440 – 3480 MHz band.

RSA holder for the 3440 – 3480 MHz range

6.2 RSA for this frequency band could be granted to one (or more) government departments (technically, RSA is held by the relevant Secretary of State). The choice of RSA holder(s) is still under consideration within an interdepartmental committee, the Spectrum Strategy Implementation Group (SSIG), which reports to the UK Spectrum Strategy Group (the cabinet Office committee responsible for spectrum policy in the UK). The SSIG is developing an interdepartmental Memorandum of Understanding that will identify the principles guiding the decision on which Secretary of State should hold the RSA for spectrum in shared bands.

6.3 A number of possibilities for the EPSS block in 3.4 GHz are being explored. These include the MOD as the sole RSA holder, a concurrent RSA held by the MOD and other departments, or one of the departments with responsibility for Emergency Services as sole holder.

6.4 One of the key factors relevant to this decision is the possibility that the current 3442 – 3475 MHz block may be migrated elsewhere within the 3400 – 3480 MHz band and that it may be either enlarged or reduced. There are two drivers for these changes:

a) The future spectrum needs of the emergency services are currently being assessed by a sub group of the ACPO Association of Chief Police Officers (England, Wales and Scotland) in conjunction with the technical expertise of the NPIA[32]. A result of the assessment may be that the capacity requirement of the air-to-ground videolink application is larger or smaller that the current allocation.

b) Spectrum efficiency considerations. If the EPSS block is moved to the bottom end of the 3400 – 3480 MHz range, MOD would be in a position to release to the market a contiguous block of spectrum between the EPSS allocation and the UK Broadband block.

[32] National Policing Improvement Agency

6.5 These are matters for the government departments to decide and are, therefore, out of the scope of this consultation. We note however that the answers to these questions do not affect our proposals in this consultation, as our proposals allow the MOD, and other departments, to apply for RSA and to trade the RSA grants into licences when the issues above are resolved.

Handling of existing EPSS licensees

6.6 We explain in section 5 that existing EPSS licences would be incompatible with a grant of RSA in the same spectrum. Before Ofcom is able to grant RSA, the current licences held by police forces and fire brigades would need to be withdrawn or surrendered. Then, following the grant of RSA from Ofcom, the departments holding the RSA would have to trade the rights back to the existing end users – the police forces and fire brigades – so that there is an effective continuity of use. Although we are not yet in a position to set out the precise details for this process, we anticipate that it would involve the following steps (once the MOD and the departments with policy responsibility for emergency services agree on which department(s) will hold the RSA for the block and on frequency allocation issues):

1) Current EPSS licences are amended to remove the frequency assignments in the 3440 – 3480 MHz range.

2) The MOD or other government department apply for RSA for 3400 – 3480 MHz.

3) Ofcom grants this RSA.

4) RSA holder(s) apply to trade the relevant spectrum to the emergency services end users and to convert that part of the RSA grant to WT licences (these replicate the usage rights in the existing EPSS licences).

5) Ofcom consents to the trade and grants the new WT Act licences to the EPSS users.

6.7 It is important to note that Ofcom, the departments and the holders of EPSS licenses will have to coordinate this process carefully to ensure continuity of licence cover. One option could be a form of authorisation that allows for the EPSS end users to utilise their applications during the changeover period. In any case, it will be preferable that all the steps take place in a very short time frame (or simultaneously). This means, in practice, that we would not embark on 1) until there is certainty over the subsequent steps.

6.8 It should be noted that we do not intend to adopt the same approach for PMSE following the grant of RSA in this band. This is because PMSE use will be temporary only and is expected to cease when MOD release spectrum to the market. In contrast, government departments agree that EPSS air-to-ground service should continue in the band in the long term, and thus a formalisation of the access conditions is appropriate.

Section 7

Terms and conditions of RSA grants and WT licences

7.1 The RSA grants made following the amendment of the RSA regulations, and the WT licences that are issued following subsequent trades, will need to include a number of terms and conditions. For the most part, we expect that these terms and conditions would be similar to those used in the case of RSA grants in the 406.1 – 410 MHz band or in the case of WT licences that we normally issue. We comment on a few of these matters below and expect to provide more detail at the same time that we publish a notice of the draft regulations for extension of RSA to the 3.4GHz band. However, there are two specific aspects on which we are consulting now: the technical conditions, and the size of the minimum trading unit.

Technical limits

7.2 The objective of the technical limitations included in a RSA grant is to avoid unacceptable interference with the neighbouring users. To define limitations that achieve this objective we have to consider the potential uses that introduction of RSA could bring to the 3400 – 3480 MHz and 3500 – 3580 MHz blocks proposed, and all the possible combinations that might appear at the boundaries of the blocks. We go through this in detail in section 8, with supporting technical material in annex 8.

7.3 Protection of future users in the RSA spectrum is governed by the technical conditions already applicable to the users in the adjacent spectrum. In particular, UK Broadband licence contains limits for in block and out of block emissions for broadband wireless applications.

Spectrum trading

7.4 The RSA grants and the licences will be tradable in accordance with the RSA trading regulations. Regulations specify the types of transfer that are authorised. These may be ‘total’ or ‘partial’ and ‘outright’ or ‘concurrent’. This provides a wide measure of flexibility for the parties to arrange transfers in ways that meet their wishes and requirements.

7.5 Partial transfers are transfers of the rights and obligations relating to parts of the range of frequencies or parts of the geographical coverage. The RSA or licence may be subdivided by frequency, by area or by both. This will enable the RSA holder to retain frequency blocks or geographical areas for its own use while releasing others to the market, or to trade different blocks or areas to different parties.

7.6 We would anticipate that the following partial frequency trades may arise in the 3400 to 3600 MHz band:

- The 3400 – 3480 MHz RSA block may be partitioned into a block for emergency services and a second block released totally or partially to the market. This is likely to happen given that there is agreement between departments that emergency services use will remain in the band, but it is unlikely that the whole 3400 – 3480 MHz will be reserved for it.

- The 3500 – 3580 MHz RSA block may be partitioned into several smaller sub-blocks that may be released and traded with different organisations. This will be for the RSA holder to decide based on its own market assessment.

7.7 The transfer procedure in the current RSA trading regulations establishes that the RSA holder will notify Ofcom a description of the rights and obligations transferred[33]. In particular, the parties may seek a variation from Ofcom of those rights and obligations at the time of the trade to give effect to partial transfers. These may require new geographical or frequency boundary conditions that would be added to the licences by way of variation at the time of the trade.

7.8 We note that the technical parameters for new licences in the band will need to be compatible with the requirements of the Commission Decision, in particular the technical parameters included in its annex. These impose restrictions on the scope for negotiation by parties to a trade.

Minimum Spectrum Trading Units

7.9 It is necessary to consider whether or not to impose limits on the smallest unit of geographical coverage or frequency bandwidth that will be allowed to be transferred in a partial trade. This minimum amount is referred to as the spectrum trading unit (STU) and is reflected in the trading regulations. Therefore we need to decide on this parameter before making regulations.

7.10 A minimum frequency bandwidth unit may be justified when all uses in the band are based on a common bandwidth. This is the case for example in the business radio bands where channels are always 6.25 kHz wide or a multiple of 6.25 kHz. Secondly, a minimum geographical trading area may be put in place in bands in which licences for smaller areas would be difficult to administer or to price.

7.11 Neither is the case of this band. We think that a minimum STU will impose unnecessary restriction on how the RSA grants and WT licences may be traded. We consider it preferable to give parties full flexibility to sub-divide holdings by coverage area or frequency as they wish. Therefore, we do not propose a minimum STU for the RSA spectrum in 3400 to 3600 MHz.

Question 3: do you agree that there should be no minimum trading unit for the RSA grant and the WT licences arising from trade in the band?

RSA grant and WT licence fees

7.12 The fees that government departments pay for their spectrum use are out of the scope of this consultation. Government departments are Crown bodies so are not licensed by Ofcom and do not pay licence fees. Instead, the departments pay an amount to Ofcom by agreement under section 28 of the WT Act. The government's policy is that this amount should be comparable to the AIP that a commercial user would pay.

7.13 We are not considering at this stage what fee should be paid by a commercial user that holds a WT licence arising from a trade of RSA. Following release of spectrum by the RSA holder to a commercial user, two scenarios may be envisaged. In the

[33] Spectrum Framework Review for the Public Sector. Notice of Ofcom's proposal to make regulations on Recognised Spectrum Access for public bodies and consultation on technical conditions. http://www.ofcom.org.uk/consult/condocs/sfrps08/

first, the RSA holder continues its payment of sums comparable to AIP to Ofcom under section 28 and receives commercially negotiated payments from the incoming commercial user. In this scenario, Ofcom does not charge a licence fee to the incoming sharer. This is likely to be appropriate if the spectrum release is temporary and the spectrum is intended to revert to the RSA holder after a set period. Alternatively, there might be circumstances in which it is more apt for the RSA holder's payments to be reduced and for the incoming commercial user to pay AIP to Ofcom instead, for example if the spectrum release is permanent. Generally, the approach to charges will be considered for each transfer depending on the circumstances.

Extent of the RSA grants

7.14 The RSA regulations and RSA trading regulations apply in the UK but not in the Channel Islands or Isle of Man. The provisions of the WT Act relating to spectrum trading have been extended to Guernsey but not to Jersey or the Isle of Man and it would require an Order in Council to extend them there. The current spectrum trading regulations do not extend to Guernsey.

7.15 We do not intend at this stage to apply the proposed regulations to the Channel Islands or Isle of Man but will, together with the administrations of these Crown dependencies, keep the position under review.

Other non-technical conditions

7.16 Our general non-technical licence terms and conditions, for example on revocation, variation and modification, are set out in our General Licence Conditions booklet[34]. At this point, we envisage that those for RSA and WT licences after trade will follow that pattern because we do not think there are specific aspects regarding RSA and licences in this band that would justify divergence. We expect to present more detail on this in due course.

Question 4: are there specific conditions that you consider should be included in RSA grants and WT licences arising from trading in the band?

[34] http://www.ofcom.org.uk/radiocomms/ifi/licensing/booklet.pdf

Section 8

Technical limits

8.1 The objective of the technical limitations included in an RSA grant is to avoid undue interference to the neighbouring users while being as technology and application neutral as possible, consistent with any applicable international obligation. Therefore, in order to issue RSA we will need to consider the following:

- boundary conditions at the edges of the proposed RSA blocks: 3400 MHz, 3480 MHz, 3500 MHz, 3580 MHz.
- in band power limits in the 3400 – 3480 MHz and 3500 – 3580 MHz ranges.

8.2 In this section we consider first the boundary conditions and in band power limits for the 3500 – 3580 MHz block. This is a relatively simple task since the whole block is likely to be made available for new uses by MOD and because the nature of the expected adjacencies at each boundary are clear, being UK Broadband and a newcomer broadband wireless network.

8.3 We then look at boundary conditions and in band power limits for the 3400 – 3480 MHz block. The consideration of these boundary conditions is more complicated because the EPSS air to ground videolink service is expected to stay in the 3400 – 3480 MHz block and, since it is an existing use that is protected under the Commission Decision, the technical parameters in the Decision do no apply to it. Moreover, whilst the EPSS use currently abuts the 3480 MHz boundary (which means that we need to consider a EPSS / UK Broadband adjacency at 3480 MHz) it could be moved down the band (in which case, we would need to consider the adjacency of generic broadband wireless / UK Broadband). Different considerations also apply at the 3400 MHz boundary where the MOD itself is the adjacent user below 3400 MHz.

8.4 Whilst our focus is primarily on the technical conditions that we will need to set within the initial grant of RSA(s), we recognise that the MOD is expecting to trade some RSA spectrum and that, if it does so, then new boundary conditions will need to be defined in revised RSAs or the new WT Act licences that will be issued following such trades. This will be an issue mainly for MOD and new licensees to determine (subject to the need for the UK to comply with the Commission Decision), but we think it would be helpful for us to indicate here how these new adjacencies might be handled.

8.5 Finally, all of the above considers the case where the MOD itself applies for an RSA covering all of the 3400 – 3480 MHz and 3500 – 3580 MHz ranges. As noted in section 6, it is possible that two different parts of government may request RSA leading to two separate applications: a department with oversight of emergency services – the Home Office for example – could apply for an RSA covering the EPSS use in part of the 3400 –3480 MHz block, and the MOD could apply for another for RSA covering the remainder of the 3400 – 3480 MHz block and all of the 3500 – 3580 MHz block.

8.6 Accordingly, this section is set out in following order:

1) boundary conditions, and in-band power limits, for the 3500 – 3580 MHz block

2) boundary conditions, and in-band power limits, for the 3400 – 3480 MHz block

3) possible treatment of new boundaries created following RSA trades

4) handling of additional boundary conditions between RSAs if the band is divided into two RSA grants

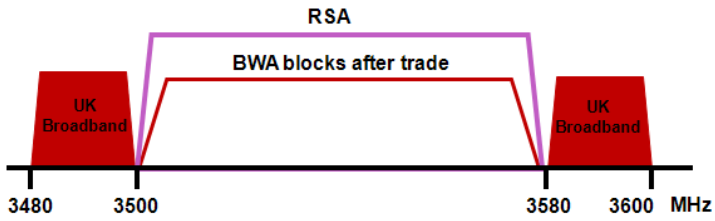
8.7 Before turning to the detail, we note that the technical conditions that we propose are specified in terms of block edge masks, rather than Spectrum Usage Rights (SUR)[35]. This is because the Commission Decision sets out obligations with which Member States must comply when they allocate spectrum within 3400 – 3800 MHz to new users. In particular, the technical parameters which are set out in the annex to the Decision are expressed as a block edge mask. As regards existing users, the relevant application to consider is the Emergency services use of air-to-ground videolinks. In this context, we note that the key advantage of SURs is that they allow trade-offs to be made between transmitter density and transmitter power. But this flexibility is not necessary in for this application since there will only be one airborne transmitter per channel per geographical area. Hence, block edge masks are appropriate for this type of use as well.

Boundary conditions, and in-band power limits, for the 3500 – 3580 MHz block

8.8 The block between 3500 MHz and 3580 MHz is currently used for PMSE video links. The adjacent user on both sides of the block is UK Broadband, whose use of the spectrum can be categorised as broadband wireless. We consider that the likely future scenario is one where the MOD releases this block totally or partially to the market, and where broadband wireless applications are deployed in it in line with the Decision aims[36]. Therefore, the uses on either side of each of the 3500 MHz and the 3580 MHz boundaries will be similar.

8.9 The block arrangement is shown in the figure below. We need to specify technical requirements for broadband wireless base stations (BS) and terminal stations (TS). We address these next.

Figure 8.1: RSA in the 3500 – 3580 MHz block



[35] SURs are a form of technology and application neutral technical boundary conditions that are based on the interference caused to neighbouring services rather than the technical characteristics of the transmitter. The alternative approach is the block edge mask (BEM), a spectrum emissions mask that is defined, as a function of frequency, relative to the edge of a block of spectrum that is licensed to an operator. While the BEM describes the power/frequency envelope that transmitting equipment is allowed to produce, the SUR approach sets limits on the level of interference that will be experienced by neighbouring users. See http://www.ofcom.org.uk/radiocomms/isu/sursguide/

[36] The Decision allows, and therefore it would be possible for the MOD to trade with, a potential user who deploys an electronic terrestrial electronic communications network which does not fall into the broadband wireless category

Base station limits

8.10 The Commission Decision contains technical parameters in its annex for out of block and in block emissions limits for central stations (base stations). Although the Decision requires Member States to make spectrum available in compliance with the technical parameters in its annex, we have evaluated alternatives. We do this to ensure that we do not overlook an aspect of the situation in the UK that might lead to prejudice to existing users. We also consider that we must be particularly careful when setting base station out of block emissions conditions since these have a big impact on the deployment plans, choice of equipment and therefore costs for potential future users.

8.11 With regards to the out of block limits we have considered the following alternatives:

1) Apply the Decision parameters to both UK Broadband licence (through a change in the licence) and RSA grant.

2) Keep existing UK Broadband conditions and re-use them on the RSA grant.

3) Introduce a new requirement based on pico-cellular scenarios while maintaining the Decision mask for high power macro BSs.

4) Apply the Decision mask to the RSA grant and leave the existing conditions specified in UK Broadband licence unchanged.

8.12 We analyse next the costs and benefits of each of the options.

1) Apply the Decision parameters to both UK Broadband licence and RSA grant

8.13 The main benefit of Option 1 is that the technical conditions for all BWA use in the band in the UK will be in compliance with the Decision parameters, which we think will become widely adopted across Europe. In addition, conditions on both sides of the 3500 MHz and 3580 MHz boundaries would be equal, hence users on both sides would be entitled to the same level of protection. However, our understanding is that the current BS mask in the UK Broadband licence fits the company's deployment plans better than the Decision mask, and that UK Broadband's preference at this point is not to align with the Commission Decision. Since the Decision does not require Member States to impose its technical parameters on existing users, we prefer to discard this option and not to change UK Broadband licence conditions at this time.

2) Keep existing UK Broadband conditions and re-use them on the RSA grant

8.14 With option 2 we bear the risk of not complying fully with the Commission's harmonisation Decision and could, thus, face infraction proceedings on the basis that we would be making a new grant or licences with parameters that are different from those mandated by the Decision. Furthermore, option 2 would formalise in the UK a set of requirements that diverged from the prevalent conditions in Europe. UK licensees would have to procure UK specific equipment, hindering the benefits of harmonisation and introducing an additional cost over those borne by their European counterparts.

3) Introduce a new requirement based on pico-cellular scenarios while maintaining the Decision mask for high power macro BSs

8.15 The rationale for this option is a deployment strategy based on very small cell sizes, which we understand has been considered by stakeholders potentially interested in the spectrum. BSs in this scenario would have low power and small size, which would constrain the capabilities of the RF filters. The constraints would mean that such BSs may not be able comply with the relatively demanding requirements of the block edge mask in the Decision. This situation would justify introducing a new set of requirements that allow relaxed out of band requirements for low power BSs.

8.16 We think that we should not follow this route, which would require us to specify the power levels and the out of band characteristics of low power BSs. We consider that such matters are better decided by manufacturers and operators and that they should pursue any formal recognition of this type of equipment through standardisation followed by liaison with the CEPT. Furthermore, we have no evidence of the type of deployment that future holders of spectrum will favour.

4) Apply the Decision mask to the RSA grant and leave the existing conditions in UK Broadband licence unchanged

8.17 This approach would make new licences in the RSA spectrum compliant with the Decision, while UK Broadband would preserve its current licence conditions until it wished to change. We think that BS manufacturers will tend to design equipment compliant with the Decision mask since this mask is likely to be widely adopted in Europe. This will enable economies of scale to be realised and will reduce the cost of equipment for UK deployments in the RSA spectrum.

8.18 Although the arrival of BWA services in the adjacent band might increase unwanted emissions into the UK Broadband block, we think the Decision mask would provide sufficient protection to ensure that UK Broadband equipment was not unduly affected. The main downside to this option is that the out of block conditions at different sides of each of the 3500 MHz and 3580 MHz boundaries would not be symmetrical. This is undesirable because it means that one licensee will suffer higher emissions from the other even though the applications would be the same on both sides. However, we do not think that this is a significant shortcoming since the differences in the out of block requirements are small. Therefore, we consider that option 4 presents the best compromise.

8.19 We summarise the benefits and costs of the four options in table below.

Table 8.1: summary of cost and benefits of the alternatives for out of block requirements for base stations

<table>
<tr><td colspan="2">1) Apply the Decision parameters to both UK Broadband licence and RSA grant</td></tr>
<tr><td>Benefits
Conditions on both sides of the boundary are symmetrical
All BWA usage in the band is subject to the conditions recommended by the Commission</td><td>Costs
UK Broadband deployment plans could be disrupted.</td></tr>
<tr><td colspan="2">2) Keep existing UK Broadband conditions and re-use them on the RSA grant</td></tr>
<tr><td>Benefits
UK Broadband usage rights are maintained as in the current licence.
Conditions on both sides of the boundary are symmetrical</td><td>Costs
Non-compliant with the technical parameters of the Decision and, thus, risk of infraction proceedings.
The regulatory conditions in the band in the UK will diverge from the prevalent conditions in Europe</td></tr>
<tr><td colspan="2">3) Introduce a new requirement based on pico-cellular scenarios. Maintain the Decision mask for high power macro BSs</td></tr>
<tr><td>Benefits
This option will best fit a potential deployment based on a pico-cellular BS layer and a macro-cellular BS layer</td><td>Costs
No evidence of technical support from the standardization committees at ETSI, from CEPT or from the Commission.
Non compliance with the Commission Decision and with the regulatory conditions prevalent in Europe.
No evidence that future bidders for MOD’s spectrum would have pico cell deployments in their plans.</td></tr>
<tr><td colspan="2">4) Apply the Decision mask to the RSA grant and leave the existing conditions in UK Broadband licence unchanged</td></tr>
<tr><td>Benefits
UK will be fully compliant with the Decision:<ol type="a">
the Decision parameters are applied to the new license, and
there is no prejudice to the existing licensee. UK Broadband license conditions do not change.
UK Broadband preference is to keep their current conditions.</td><td>Costs
The conditions at the boundaries are not symmetrical, even though the usage may well be similar, i.e. BWA, on both sides of the 3500 MHz and 3580 MHz boundaries.</td></tr>
</table>

Implementation of the Decision out of block limits in the RSA grant at 3500 MHz and 3580 MHz

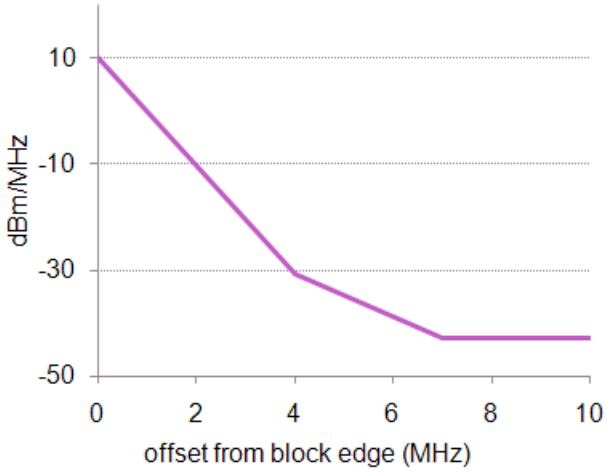
8.20 Following the analysis above our preference is to apply the out of block requirements as set out in the Commission Decision to the RSA grant and the licences arising from trade. The requirements in the Decision are expressed in terms of transmitter output power and have two breakpoints which are a factor of the size of the adjacent frequency blocks. The tabular and the graphical description are in annex 6.

8.21 However, Ofcom normally specifies the licence conditions in terms of radiated power – and not transmitter power – in order to remove any ambiguity in permitted power levels. This means that we have to take the antenna gain into account. We assume a 16 dBi antenna gain as specified in ECC Report 33[37] which is the original analysis on which the Decision mask is based.

8.22 The smallest of the adjacent blocks at the 3500 MHz and 3580 MHz boundaries are the UK Broadband blocks which are 20 MHz wide. We propose breakpoints based on this block size and therefore located at 4 MHz and 7 MHz from the RSA block edge. This gives the following block edge mask:

Figure 8.2: Out of block radiated emissions for base stations at 3500 MHz and 3580 MHz

Frequency offset from block edge (MHz)	Radiated Power Density Limits (dBm/MHz)
ΔF=0	10
0<ΔF<4	10 - 41•ΔF/4
4	-31
4<ΔF<7	-31 - 4• (ΔF-4)
ΔF≥7	- 43



8.23 In addition, the Decision contains a BS maximum in block EIRP limit of 53 dBm/MHz. We note that this limit is 6 dB lower than the current maximum in the UK Broadband licence but we see no reason to diverge from the Commission requirement on this and therefore propose to introduce an EIRP limit in the RSA grant of 53 dBm/MHz.

8.24 The Decision notes that technical parameters that are less stringent than the proposed block edge mask can be used if agreed between neighbouring operators. We think that giving operators this flexibility to improve spectrum efficiency would be beneficial so propose that this relaxation is also reflected in the RSA grants and WT licences to be issued in the band.

8.25 We have noted that the Decision does not require Member States to impose its technical parameters on existing users, and that UK Broadband prefers not to change its licence conditions at this time. We therefore do not propose to apply the limits from the Decision to UK Broadband. However, we would be ready to consider aligning the licence with the Decision if UK Broadband asked us to do so. This would bring equal conditions on both sides of the 3500 MHz and 3580 MHz boundaries.

Question 5: do you agree with the proposed in block emissions limit for base stations in the 3500 – 3580 MHz block?

Question 6: do you agree with the proposed out of block emissions mask at the 3500 MHz and 3580 MHz boundaries for base stations?

[37] ECC Report 33, "The analysis of the coexistence of point-to-multipoint FWS cells in the 3.4 - 3.8 GHz band", http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP033.PDF

Question 7: do you agree that less stringent technical parameters should be permitted if agreed between neighbouring operators?

Question 8: should we align UK Broadband licence conditions for base stations at 3500 MHz and 3580 MHz with those in the RSA grants if and when UK Broadband requests us to do so?

Terminal Station limits

In block limits

8.26 The Commission Decision contains technical parameters in its annex for in block limits for terminal stations. We have to comply with these levels unless we think they could prejudice existing users. We have no evidence of this. Furthermore, we think that terminal manufacturers will design their products to comply with the Decision. A different set of levels in the UK may require manufacturers to design and commercialize equipment specific for the UK market at a cost to UK operators. On the basis of these arguments, we do not think we should diverge from the Decision on this and our proposal is as follows:

Table 8.2: In block emissions limits for fixed and mobile terminal stations

Fixed and nomadic terminal station outdoor	+ 50 dBm/MHz EIRP
Fixed and nomadic terminal station indoor	+ 42 dBm/MHz EIRP
Mobile terminal station	+ 25 dBm/MHz EIRP

Question 9: do you agree with the proposed in block emissions limits for terminal stations?

Background to the out of block requirement

8.27 The Commission Decision does not include out of block requirements for terminals and therefore there is no guidance from European legislation on this point. Ofcom has already addressed the issue of out of block terminal emissions in the 3.5 GHz band in the consultation on Freedom4 licence variation[38]. We proposed in that consultation a block edge mask for equipment operating at powers up to 25 dBm/MHz derived from:

- work carried out by CEPT SE19 on technical conditions for mobile use in the 3.5 GHz range,
- the fact that there is a 5 MHz guardband between Freedom4 and UK Broadband blocks (3600 – 3605 MHz), and
- the spectrum emission mask from ETSI standard EN 302 623[39].

[38] http://www.ofcom.org.uk/consult/condocs/freedom4/

[39] ETSI EN 302 623, "Broadband Wireless Access Systems (BWA) in the 3 400 MHz to 3 800 MHz frequency band; Mobile Terminal Stations; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive"

8.28 We do not think that the mask we proposed for Freedom4 should be applied to the RSA block at 3500 MHz and 3580 MHz. This is because that mask is underpinned by a 5 MHz guardband, which is not available at any of the boundaries of the RSA block.

8.29 Instead, we propose in this consultation four sets of out of block conditions based on a range of scenarios and assumptions. We think this provides stakeholders with the opportunity to express their views on the likely demand for this band and the level of protection from interference that is necessary. These two issues are very much linked: the terminal out of block requirement is normally devised to ensure that interference is below an acceptable level in certain deployment scenarios, and the level of interference depends on the assumptions made for the scenarios notably the density of users.

8.30 We present next our analysis of several scenarios that could appear in the band. We propose three alternative block edge masks for terminals based on the results of this analysis. In addition, we propose a fourth alternative founded on the view that the band will be very lightly used. We seek comments on these alternatives and will decide on the technical conditions to be included in the grant in the light of those comments.

Derivation of the out of block limits

8.31 In this section we summarize the technical analysis that we have conducted. The detail can be found in annex 8.

8.32 **We focus on the case of mobile terminal to mobile terminal interference.** When looking at interference caused by terminal devices in broadband wireless scenarios the most critical case is that of interference from mobile terminals to other mobile terminals. Fixed terminals would normally have a directive antenna, and interference can be detected and mitigated during the installation. Mobile terminals, on the other hand, may concentrate in high population density hot spots where separation or other mitigation measures cannot be implemented. Interference from terminals to base stations is generally less critical and covered by the technology standards so we do not consider it separately.

8.33 **Our analysis is based on the recent CEPT SE42 work** on block edge masks for terminals in the 2.6 GHz band, captured in ECC Report 131[40]. We think that the scenarios in the 3400 to 3600 MHz band will be very similar to those in the 2.6 GHz band: the propagation conditions are not very different and the most likely application in both bands is broadband wireless, WiMAX or 3GPP based. In particular, the main element of our analysis is a Monte Carlo stochastic simulation of a hot spot scenario under assumptions similar to those of the SE42 study.

8.34 **We base our simulations on 10 MHz channels and on TDD mobile terminals interfering with FDD mobile terminals**. Standardization bodies have specified or are in the process of specifying systems for this band with narrower and wider channels, but after consultation with several stakeholders we think that 10 MHz will be the most likely choice in the band. Secondly, we focus our analysis on the case of a TDD terminal interfering with a FDD victim because this is generally considered the worst case scenario.

[40] ECC Report 131, "Derivation of a block edge mask (BEM) for terminal stations in the 2.6 GHz frequency band (2500-2690 MHz)", http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP131.PDF

8.35 **User density is a key parameter in the analysis**. The higher the user density the more stringent the out of band emission limit will need to be. We think that there is high uncertainty on how busy this band will be and therefore we are not taking a firm stance on this. Instead, we simulate the hot spot case under several assumptions regarding density of users. We seek views on which of these is most likely to represent future scenarios.

8.36 The result of the simulations is a baseline out of block emission limit for each scenario, which are based on different user density assumptions. In each scenario we obtain a result in the form of the out of block EIRP value that gives a 5% probability of 3 dB desensitization at the victim. This is the protection criterion that SE42 also considered reasonable for terminals in hot spot scenarios in the 2.6 GHz band. The table below shows the out of block baseline limits calculated for each of the user densities simulated.

Table 8.3: Out of block baseline EIRP limit per 10MHz in each of the density scenarios

Density scenario modelled	Case 1 Very high density	Case 2 High density	Case 3 Medium density	Case 4 Low density
User density per m^2	0.000500	0.000300	0.000167	0.000050
Out of block baseline EIRP limit	-3.2 dBm / 10MHz	2.6 dBm / 10MHz	7.6 dBm / 10MHz	14.2 dBm / 10MHz

8.37 **We consider if and how actual terminal stations comply with these requirements**. We make the assumption that terminals are compliant with the spectral emission masks in the relevant ETSI harmonized standard (EN 302 623) and that they operate at the maximum in-block EIRP allowed by the Decision (+25 dBm/MHz, 35 dBm for a 10 MHz terminal).
We think these are realistic assumptions. First, the compliance with the ETSI EN means that the device fulfils the requirement of the R&TTE Directive so we expect all manufacturers to design the devices according to the EN requirements. Second, we think that operators would plan their networks according to the maximum available power of terminals for reasons of coverage.
Under these assumptions and under a given simulation scenario, the interference can be mitigated if the interferer and the victim frequency channels are sufficiently separated. To put it in another way, the total out of block emissions into the victim channel will depend on the frequency separation between the interferer and victim channels. Consequently, an interferer whose out of block emissions comply with the spectrum emission mask in EN 302 623 would also comply with the out of block baseline limit of Table 7.3, so long as there is an appropriate frequency separation between the channels of the interferer and the victim.

8.38 **The out of block level requirement dictates the minimum separation between channels,** assuming the interferer complies with the spectrum emission mask in ETSI EN 302 623. We compare the out of block levels at different channel separations with the requirements arising from the stochastic simulation. Table 7.4 below shows the frequency separation required in each user density scenario:

Table 8.4: Frequency separation between interferer and victim channels to meet the out of block baseline emission limits derived from the stochastic simulation when the interferer complies with ETSI EN 302 623

Density scenario modelled	Case 1 Very high density	Case 2 High density	Case 3 Medium density	Case 4 Low density
Out of block baseline EIRP limit	-3.2 dBm / 10MHz	2.6 dBm / 10MHz	7.6 dBm / 10MHz	14.2 dBm / 10MHz
Required frequency separation between victim and interferer channels	10 MHz	6 MHz	2 MHz	0 MHz
Frequency separation rounded up to 5 MHz	10 MHz	10 MHz	5 MHz	0 MHz

8.39 **The channel separation requirement is applied at the boundary between blocks.** When setting a regulatory block edge mask normally the separation requirement is shared between the two blocks. This is our preference in particular when the applications deployed at both sides of a boundary are the same. It means that each user will have to move its channel half the separation distance away from the block edge, and it ensures that the interference conditions are similar for both block users.

Alternatives for out of block limits

8.40 Our preferred approach for the out of block limits, which we elaborate below, is to build a block edge mask based on the spectrum emissions mask from the ETSI standard and the frequency separation distances shown in Table 8.4. An alternative to this would be to use the baseline EIRP limit coming out of the simulations in the block edge mask. This would make the block edge mask completely neutral in terms of technology. However, we do not think this would bring a significant advantage since all terminals operating in the band are likely to comply with ETSI EN 302 623, which is the only Harmonized Standard applicable to mobile terminals in this band.

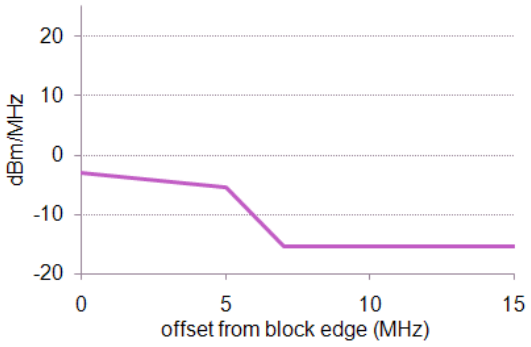
Question 10: do you agree that the block edge mask should be based on the spectrum emissions mask from ETSI EN 302 623?

8.41 We propose three alternative block edge masks based on frequency separations between the interferer and victim channels of 10 MHz, 5 MHz and 0 MHz which mean, respectively, that the channel edges would be 5 MHz, 2.5 MHz and 0 MHz away from the closest block edge. In addition, we present a fourth option based on the view that the compliance with the ETSI EN is sufficient and therefore a regulatory out of block mask is not necessary. The proposals are as follows:

8.42 **Option 1: Block edge mask based on 10 MHz separation between channels.** Figure 8.3 shows a regulatory BEM for the out of block limits derived from placing the 10 MHz spectrum emission mask from ETSI EN 302 623 with its channel edge 5 MHz away from the block boundary.

Figure 8.3: Option 1) for terminal BEM out of block EIRP limits – 10 MHz frequency separation between channels

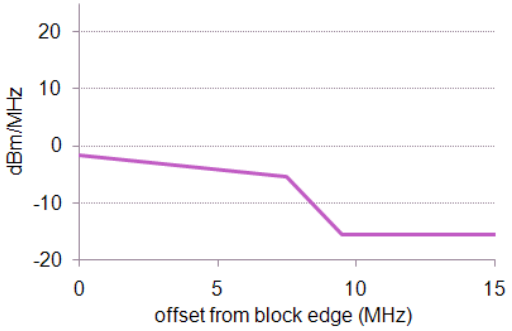
Frequency offset from Block Edge (MHz)	Radiated Power Density Limits (dBm/MHz)
ΔF = 0	-3
0<ΔF≤5	-3 - 0.5 • ΔF
5<ΔF≤7	- 5.5 - 5 • (ΔF - 5)
7<ΔF	-15.5



8.43 **Option 2: Block edge mask based on 5 MHz separation between channels.** Figure 8.4 shows a regulatory BEM for the out of block limits derived from placing the 10 MHz spectrum emission mask from ETSI EN 302 623 with its channel edge 2.5 MHz away from the block boundary.

Figure 8.4: Option 2) for terminal BEM out of block EIRP limits – 5 MHz frequency separation between channels

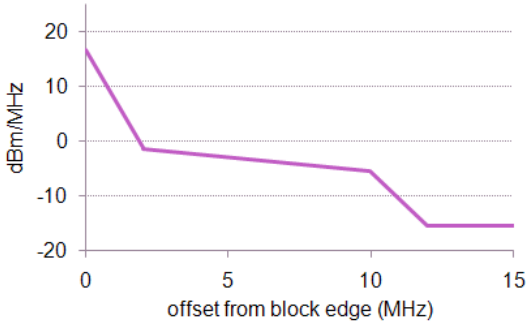
Frequency offset from Block Edge (MHz)	Radiated Power Density Limits (dBm/MHz)
ΔF = 0	-1.75
0<ΔF≤7.5	-1.75 - 0.5 • ΔF
7.5<ΔF≤9.5	- 5.5 - 5 • (ΔF - 7.5)
9.5<ΔF	-15.5



8.44 **Option 3: Block edge mask based on no separation between channels.** Figure 8.5 shows a regulatory BEM for the out of block limits derived from placing the 10 MHz spectrum emission mask from ETSI EN 302 623 at the block edge.

Figure 8.5: Option 3) for terminal BEM out of block EIRP limits – no frequency separation between channels

Frequency offset from Block Edge (MHz)	Radiated Power Density Limits (dBm/MHz)
ΔF = 0	16.7
0<ΔF≤2	16.7 – 9.1 • ΔF
2<ΔF≤10	-1.5 - 0.5 • (ΔF - 2)
10<ΔF≤12	- 5.5 - 5 • (ΔF - 10)
12<ΔF	-15.5



8.45 **Option 4: no regulatory block edge mask.** An alternative view on future deployments could be that usage will be so low that there is no need to impose a

regulatory mask. The regulatory requirement in this case would be conformity with the relevant ETSI Harmonised Standard. We consider that such conformity is normally observed by device manufacturers, as it is a way to show compliance with the R&TTE[41] directive.

8.46 This last option would let operators place their channel at the edge of their blocks. Since we have used the current ETSI standard to derive our masks, this option appears identical to option 3. However, equipment standards for channels wider than 10 MHz are likely to appear in the future, and normally the wider the channel the wider the out of block emissions. Option 4 will allow wider channels at the edge of the block provided that the devices comply with an ETSI standard, while option 3 might not.

Cost / benefit considerations

8.47 We have seen that BEM out of block emission limits are required to avoid interference into the adjacent block. But these limits imply a cost to the user of the block, who generally has three alternatives to comply with them[42]:

a) The user may fit filters to the transmitters to enable the equipment to operate adjacent to the block boundary and still meet the out of block requirements.

b) It may operate equipment without filters, or with less stringent filters, but place its channel edge away from the block boundary and well within its own block. This is because out of block emissions normally decrease as the channel edge is moved further away from the block edge.

c) It may operate equipment at lower transmitter power. This would in turn lower the out of block emissions as well.

8.48 In addition, users of two adjacent blocks may reach a bilateral agreement to use a less stringent requirement or exploit the capabilities of a technology to relax those requirements. However, this cannot be relied upon in all cases. For example, adjacent users may be competitors and unwilling to negotiate.

8.49 Hence, when setting up out of block requirements we have to carefully consider the costs that protection of adjacent services imposes on the block user. In our previous analysis we have assumed that users at 3400 to 3600 MHz will normally choose alternative b) above in order to comply with the BEM out of block limits. This is because we think that economies of scale will make it generally difficult to provision terminals with non-standard technical capabilities such as better filters. We also think that users will generally prefer to operate their equipment at the maximum available power for reasons of coverage. Therefore, we think that the block edge mask will impose a cost in terms of spectrum set aside in order to move channel edges away from the block edges.

8.50 From this perspective, the alternative block edge masks that we propose impose different costs in terms of lost spectrum. Option 1) has the highest cost since it requires that the channel edge is moved 5 MHz away from the block edge. Option 3) has the lowest cost, since it allows the user to place its channel right up the block

[41] Directive 1999/5/EC of the European Parliament and of the Council of 9 march 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity. http://ec.europa.eu/enterprise/rtte/dir99-5.htm

[42] For a detailed analysis see, for example, ECC Report 131

edge and no spectrum is "wasted" inside the block. However, the gain in spectrum efficiency with option 3) comes at the price of an increased probability of interference. Option 4) can be seen as equivalent to 3) in this context.

8.51 We do not have a preferred option at this time and would be interested to receive stakeholders' observations on which to select.

Question 11: do you agree with our derivation of regulatory out of block limits for terminals and, if so, which of the proposed four alternative regulatory conditions do you think most appropriate?

Out of block limits for fixed and nomadic terminals

8.52 We propose to apply the same out of block limits to mobile, fixed and nomadic terminals. We consider that this gives neighbouring licensees more certainty about the interference levels that they may expect from terminal devices of all kinds.

Question 12: should out of block limits for fixed, nomadic and mobile terminals be different?

Impact on UK Broadband

8.53 In line with our approach to base station limits, we propose to update UK Broadband out of block limits for terminals with limits in the RSA grant if and when UK Broadband requests us to do so.

8.54 UK Broadband current licence already contains out of block requirements for terminals, but these limits are based on fixed wireless terminals and may be too stringent for mobile devices. We consider that UK Broadband may see advantage in having its licence aligned with the terminal requirements proposed for the RSA block.

Question 13: should we align UK Broadband licence conditions for terminal stations at 3500 MHz and 3580 MHz with those in the RSA grants if and when UK Broadband requests us to do so?

Boundary conditions, and in-band power limits, for the 3400 – 3480 MHz block

8.55 Our proposal is to make RSA available in the 3400 – 3480 MHz range. In this section, we propose in block emission limits for this block and out of block emission limits for the 3480 MHz boundary but not for the 3400 MHz one. The characteristics of the military applications in the 3300 – 3400 MHz band are confidential to the MOD for national security reasons so it is not possible for us to determine technical limits that ensure interference remains below the threshold acceptable for such applications. It will be for the MOD, if it decides to release spectrum immediately above the 3400 MHz boundary, to specify the appropriate technical requirements for the protection of the military applications below the 3400 MHz boundary.

8.56 The objective of the technical limits for the RSA grant at 3480 MHz is to avoid undue interference into the UK Broadband block. To properly define technical limits we need to have an understanding of the interfering and victim applications. As we have seen above, we work on the assumption that UK Broadband has deployed a broadband wireless network. However, government departments have not yet agreed what will be the service operating immediately below 3480 MHz. The current service is the emergency services air-to-ground videolink in the 3442 – 3475 MHz block, but as we explain in paragraph 6.2 this service could be moved to a different part of the

3400 – 3480 MHz range following introduction of RSA. Therefore our approach to the RSA conditions at 3480 MHz is different to the one we had at 3500 MHz and 3580 MHz.

8.57 First, we have considered what services could potentially be located immediately below the 3480 MHz boundary. Following discussions with the MOD and emergency services organizations, we envisage three possible scenarios for the boundary at 3480 MHz:

1) The EPSS block is moved down in frequency from its current allocation at 3442 – 3475 MHz to an allocation such as, for example, 3410 – 3443 MHz. The application immediately below 3480 MHz would then be broadband wireless.

2) The upper boundary of the EPSS block is maintained at 3475 MHz.

3) The upper boundary of the EPSS block is moved to 3480 MHz.

8.58 We are not seeking views on the scenarios, since it will for the MOD and the departments sponsoring emergency services to decide on which alternative to pursue.

8.59 Second, Ofcom must ensure that whatever the scenario the departments select, the RSA grant contains requirements so that there is no rise in the undue interference to the adjacent user, UK Broadband. We do not know when the departments will decide on the scenario. They may opt to apply for RSA before the decision is made, in which case the RSA grant will have to contain clauses covering each scenario. Or the lay out of the band may be agreed before the departments apply for the grant, in which case only the conditions for the relevant scenario will be included in the grant. However, even if departments will decide at some point in the future, it is possible to look at the interference characteristics of each scenario now and to propose technical limits for protection of UK Broadband in each case. We do so in the following sections.

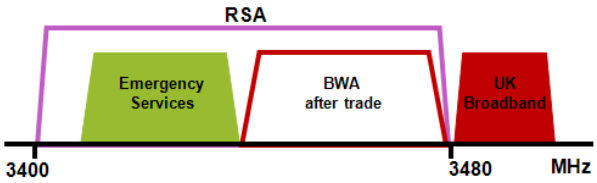
8.60 It must be noted that we are not proposing changes to UK Broadband's technical conditions at 3480 MHz. If UK Broadband asks us to do so in the future, we will consider and possibly consult on the impact that their request may have on the adjacent use at that point.

8.61 We look next at the in block and out of block requirements that arise in each of the scenarios:

The EPSS block is moved down in frequency from its current allocation at 3442 – 3475 MHz

8.62 In this scenario, we make the assumption that the MOD may release totally or partially the spectrum between the upper boundary of the EPSS block and the RSA boundary at 3480 MHz. This is shown in Figure 8.6.

Figure 8.6: Layout of the 3400 – 3480 MHz block if the EPSS block is moved down in frequency



8.63 The MOD would be bound by the Commission Decision requirement to make the spectrum available for terrestrial communications networks in compliance with the parameters set out in the annex of the Decision. Ofcom would also be bound by that requirement when issuing the licences arising after the trade. Therefore, we consider that the adjacency scenario at 3480 MHz would be similar to that appearing at the 3580 MHz boundary discussed in the previous section i.e. broadband wireless applications on both sides, and hence our technical proposal for 3480 MHz in this scenario follows the one presented for 3580 MHz:

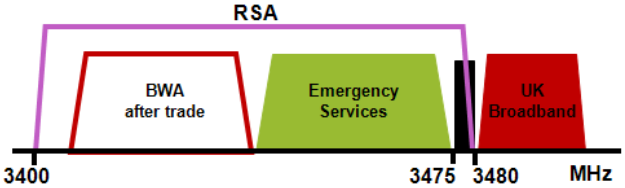
- our proposal for base station block edge mask in block and out of block EIRP limits in Figure 8.2 and paragraph 8.23,
- our proposal for terminal station in block EIRP limit in Table 8.2, and
- the four alternatives for terminal station BEM out of block EIRP limits in paragraphs 8.40 to 8.46.

Question 14: do you agree that the technical limits at 3480 MHz should copy those at 3580 MHz when the use immediately below 3480 MHz is broadband wireless?

The upper boundary of the emergency services block is maintained at 3475 MHz

8.64 This scenario maintains the current situation where UK Broadband block is separated from the emergency services block by a 5 MHz guard band. The first option with regards to the technical limits is the set of parameters in the annex to the Decision which should be applied to all new users of the band. However, as we have stated in paragraph 5.35, we consider EPSS to be an existing use and therefore we should not force the Decision parameters into the EPSS licences. Furthermore, the scenario here is not similar to the scenario on which the Decision parameters are based: in this case airborne videolinks operate below 3475 MHz and UK Broadband's BWA above 3480 MHz, while the technical parameters in the Decision are based on a BWA – BWA adjacency. Therefore, the Decision parameters are not directly applicable to the scenario from a technical standpoint.

Figure 8.7: Layout of the 3400 – 3480 MHz block if the EPSS block stays in its current allocation



8.65 The alternative that we tend to favour is to re-use the existing conditions in EPSS licences. These have governed the emissions from airborne equipment into UK

Broadband block since it was auctioned in 2003 and we have no evidence that they do not provide sufficient protection.

8.66 Our preference is for a block edge mask based on the spectrum emission masks of airborne equipment currently in use. We think that this is the best approach because

a) it preserves the technical conditions applicable to EPSS users, who would be able to continue to employ their equipment,

b) it preserves the conditions of the neighbour, who will not experience an increase in incoming interference, and

c) it gives users more flexibility in how they can meet the requirements.

8.67 In practice, we would preserve the current limits but express them in a technology neutral way. Currently, the technical characteristics of the airborne use are as in the table below:

Table 8.5: Technical limits in the current licences of EPSS airborne videolinks

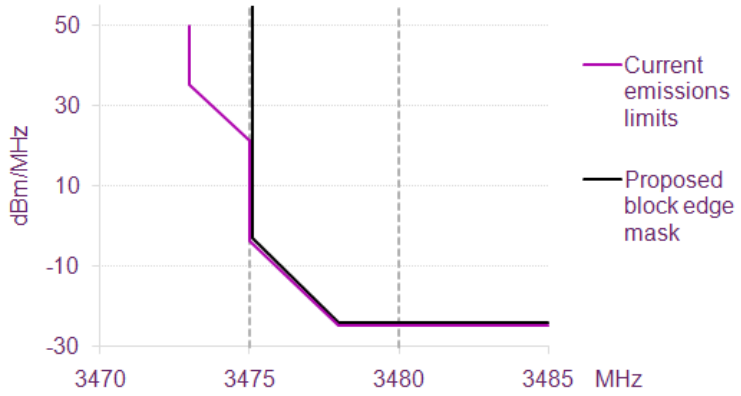
Channel bandwidth	4 MHz or 8 MHz
Channel raster	8 MHz channel BW: 3452 MHz, 3458 MHz, 3468 MHz
Maximum EIRP	20 dBW
Out of band emission limits	According to MG-42C[43] standard Part 2: 1) a radiated spectrum requirement in the form of an out of channel power density mask, plus 2) a requirement for an antenna filter, 33 MHz wide, to reduce emissions into adjacent bands

8.68 Our proposal for the new technical conditions is to replace the requirements in the above table with an in block limit and an out of block emissions mask that follows the requirements in the table above for frequencies above 3475 MHz. This is show in Figure 8.8 below[44]. In this Figure the EPSS block edge is at 3475 MHz, the current guardband at 3575 – 3580 MHz is preserved, and the UK Broadband block edge is at 3480 MHz.

[43] MG-42C, Performance & Regulatory Standards for a digital Air to Ground Microwave Video Transmission System for use by Home Office sponsored services in the 3.4 GHz emergency service band. See annex 7 of this document.

[44] We apply the MG-42C requirements to an 8 MHz carrier placed on the uppermost channel (centred at 3468 MHz) operating at the maximum authorized power (20 dBW EIRP). This results in the emissions mask shown in purple in figure 6.8

Figure 8.8: BEM out of block EIRP limits for EPSS airborne transmitters when the EPSS block stays in its current allocation



8.69 In addition, we propose an in block EIRP limit of 20 dBW in line with the current licence. This will allow the emergency services users to preserve their current coverage scenarios. The following table summarises our proposal in tabular form.

Table 8.6: BEM in block and out of block limits for airborne transmitters when the EPSS block stays in its current allocation

In block maximum EIRP	20 dBW
Frequency (MHz)	**Out of Block Radiated Power Density Limits (dBm/MHz)**
F=3475	-4
3475 < F ≤ 3478	- 4 - 7• (F - 3475)
F>3478	-25

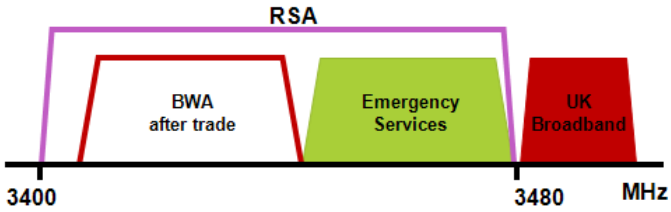
Question 15: do you agree with the proposed technical limits at 3480 MHz for the scenario where the upper edge of the emergency services block does not change from the current allocation at 3475 MHz?

The upper boundary of the emergency services block is moved to 3480 MHz

8.70 The key technical feature of this scenario is the removal of the explicit guard band[45]. This means that the out of block requirement applicable to emergency services equipment needs to be more stringent than the previous scenario in order to maintain interference into UK Broadband block close to current levels. In addition, emergency services users will see increased interference in its block from UK Broadband usage which is now closer in frequency. The layout of the band is shown in the Figure below:

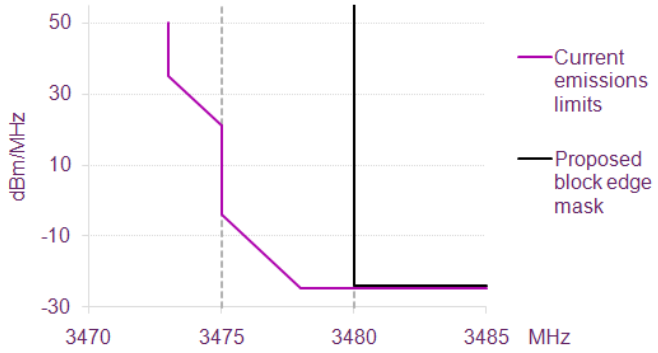
[45] Generally, Ofcom's preference is to move away from guard bands as an interference protection method, and to require strict out of block conditions instead. We think that an out of block mask is more spectrum efficient and gives users more flexibility in how to implement the required protection to their neighbours. The user may decide to comply with the block edge mask either moving its transmitter frequency away from the block edge (thereby putting a guard band in place), or reducing its transmit power, or fitting sharper filters to its transmitters, or a combination of these measures

Figure 8.9: Layout of the 3400 – 3480 MHz block if the EPSS block is moved up to 3480 MHz



8.71 In order to ensure that the levels of interference into frequencies above 3480 MHz remains unchanged compared to current levels, our proposal for the EPSS block edge mask is again based on the current requirements in EPSS licences. This results in the stringent out-of-block limit shown in Figure 8.10. In this figure, the UK Broadband block edge is at 3480 MHz, there is no guardband between the services and therefore the EPSS block edge is also at 3480 MHz.

Figure 8.10: Out of block EIRP limits for EPSS airborne transmitters when the EPSS block is moved up to 3480 MHz



8.72 The analysis here is similar to the one in paragraphs 8.64 to 8.66. The interference level into UK Broadband block is maintained equal to the level allowed by the current licences, but we express that level in a different way. The following table shows the tabular description of the proposed in block and out of block requirements.

Table 8.7: In block and out of block limits for airborne transmitters when the EPSS block is moved up to 3480 MHz

In block maximum EIRP	20 dBW
Frequency (MHz)	**Out of Block Radiated Power Density Limits (dBm/MHz)**
F>3480	-25

Question 16: do you agree with the proposed technical limits at 3480 MHz for the scenario where the upper edge of the emergency services block is moved to 3480 MHz?

Possible treatment of new boundaries created following RSA trades

8.73 We noted in section 7 that partial trades in the frequency domain are likely to occur. We also explained that the RSA trading regime envisages that the RSA holder will

communicate to Ofcom which rights and obligations are transferred as well as any additional technical limits that need to be added at the new boundaries created by any partial trade. In practice, we expect the RSA holder to negotiate these limits with the transferees, and Ofcom to implement the new limits in the new licences by way of variation of the terms and conditions of the RSA grant in the course of the trading process. We note that in this particular band the scope of negotiation would be restricted by the requirements of the Decision with regards to the technical conditions for new uses.

8.74 Ofcom has an interest on how these limits are set. This is because the end users after the trade will hold WT licences that we will issue, and also because it is our duty to ensure optimal use of the spectrum. In addition, the RSA holders might look to Ofcom for guidance in how to set the limits.

8.75 For these reasons we have studied what boundaries might appear inside the RSA blocks and we present illustrative technical limits for those boundaries. We emphasize that it is not Ofcom's task to set these limits, and that these proposals are for the RSA holders and the transferees to consider in their negotiations. Note however that we only look here at additional limits to be applied at the new boundaries inside the RSA blocks. The requirements in the RSA grant still apply, in particular at the RSA edges.

8.76 As we explain in paragraph 7.6, we think that the following trades might occur:

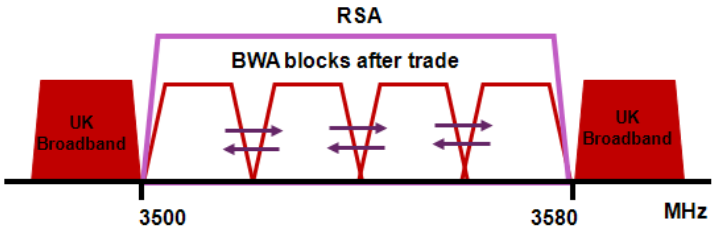
- The 3500 – 3580 MHz block is partitioned and traded into several smaller sub-blocks.
- The 3400 – 3480 MHz block is partitioned into a block for emergency services and a second block which may be released totally or partially.

8.77 We look next at the new block boundaries that these trades would generate and we suggest technical conditions that could be applied at those boundaries.

The 3500 – 3580 MHz RSA block is partitioned and traded into several smaller sub-blocks

8.78 We noted earlier that the most likely use of the 3500 – 3580 MHz block is broadband wireless. The MOD may want to trade smaller blocks leading to several new licences with new boundaries between them.

Figure 8.11: Possible lay out of the 3500 – 3580 MHz block following partial trade



8.79 The interference scenario at these new boundaries will be the same as we have seen at 3500 MHz and 3580 MHz, i.e. between two adjacent broadband wireless operators. Therefore, our suggestion is that the technical conditions at the new boundaries should be as those applicable at the RSA boundaries at 3500 MHz and 3580 MHz. In summary, we suggest

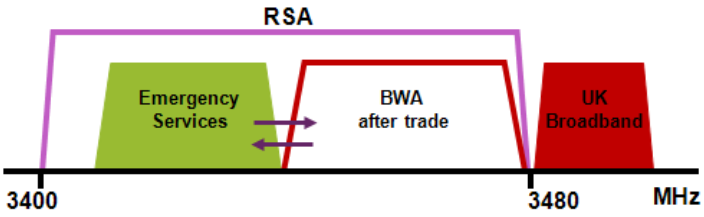
- our proposal for base station block edge mask in block and out of block EIRP limits in Figure 8.2 and paragraph 8.23,
- our proposal for terminal station in block EIRP limit in Table 8.2, and
- the four alternatives for terminal station BEM out of block EIRP limits in paragraphs 8.40 to 8.46.

Question 17: do you agree that the technical conditions of the RSA grant at the 3500 MHz and 3580 MHz boundaries are the best option for the boundaries that will appear inside the 3500 – 3580 MHz block if the block is partitioned and traded into several smaller sub-blocks?

The 3400 – 3480 MHz RSA block is partitioned into a block for emergency services and a second block that may be released totally or partially

8.80 We noted earlier that three scenarios are possible in the 3400 – 3480 MHz block after RSA has been granted. All three lead to a situation in which the emergency services allocation would be adjacent to a block that may be released to the market. We have said that this block will be under the scope of the Commission Decision, and therefore we consider that the likely use will be broadband wireless.

Figure 8.12: Possible lay out of the 3400 – 3500 MHz block following partial trade



8.81 Figure 8.12 shows the scenario in which the emergency services block is moved down in frequency, and shows the new boundary that appears inside the RSA block. Generally, when considering the technical requirements for blocks at either side of a boundary we must take account of the potential interference cases that might appear given the expected usage of the blocks. In this case, we envisage that broadband wireless applications would be deployed in one block and the emergency services airborne videolinks in the other. This means that the following interference scenarios could appear:

- broadband wireless base stations interfere with emergency services receivers,
- broadband wireless terminal stations interfere with emergency services receivers,
- emergency services airborne transmitters interfere with broadband wireless stations.

8.82 We consider next what technical limits could be required to reduce the risk of interference in these scenarios. We have not conducted an exhaustive analysis. Our suggestions are based on a limited understanding of the deployment of airborne transmitters and receivers, and on the technical limits currently applicable at 3475 MHz where UK Broadband allocation is separated from airborne use by a 5 MHz guardband. We are interested in receiving views on these proposals, although we emphasise that it will be for the RSA holders and not Ofcom to decide on the boundary conditions.

Technical limits for broadband wireless base stations to protect air-to-ground videolink receivers

8.83 The Decision sets out limits for BSs that apply to new uses. However, these limits may not be sufficient to protect emergency services applications which have the consideration of an existing use. A comprehensive analysis of this scenario would require an understanding of the deployment of emergency services receivers and their locations relative to a typical broadband wireless BS deployment. A deterministic analysis or a stochastic analysis would be necessary depending on the nature of the deployment.

8.84 Alternatively, a starting point could be the technical conditions for BSs proposed in this document in Figure 8.2, which are based on the block edge mask given in the annex to the Decision. We note that this mask was developed to ensure co-existence between BWA BSs in adjacent bands, which is a scenario different to that we consider here. However, we think that the Decision mask is relatively demanding and is most likely sufficient to protect the receivers in an adjacent band in most scenarios. We also see advantage in having consistent requirements for BSs across the band, even if the adjacent user is not a broadband wireless network.

Question 18: do you think that the out of block limits for broadband wireless base stations in Figure 8.2 are sufficient to protect air-to-ground videolink receivers in an adjacent block?

Technical limits for broadband wireless terminal stations to protect air-to-ground videolink receivers

8.85 The scenario here would also require an understanding of the deployment of the receivers. If these receivers are mobile, the scenario would be similar to the BWA TS to TS interference case that we have simulated for the terminal limits at 3500 MHz and 3580 MHz. However, there are two key differences:

1) there may only be a handful of emergency services receivers in use, and then only in the event of an emergency, in contrast with the cellular densities for broadband wireless that we have assumed in our TS to TS analysis.

2) the reliability requirements of the application is likely to be very high and receivers are likely to require a greater level of protection than commercial broadband wireless devices.

8.86 As a starting point we would suggest our range of proposals at 3500 MHz and 3580 MHz. These are based on the current ETSI standard and present a range of protection levels. We welcome the views of stakeholders on whether these are sufficient or excessive for protection of the emergency services application.

Question 19: what are your views on the requirements for protection of air-to-ground videolink receivers from interference from broadband wireless terminals?

Technical limits for airborne transmitters to protect broadband wireless receivers

8.87 Broadband wireless receivers may be fixed – at base stations or fixed terminals – or mobile. Rooftop BSs represent the worst case scenario because of the line of sight propagation and the shorter separation distance to the airborne transmitter.

8.88 Our suggestion would be to base the out of block requirements for airborne transmitters on the -25 dBm/MHz EIRP level taken from the current requirements. This is also the level we propose at 3480 MHz and above if the emergency services block is to remain in its current allocation (see paragraphs 8.64 to 8.72). We think it is sufficient to ensure low interference levels at rooftop BSs given the operational height of the air-to-ground transmitters and the characteristics of the rooftop BS antennas (directive, down-tilted).

8.89 In addition to this baseline, the RSA holder and the final users may want to negotiate a block edge mask with a transition zone on the basis of the size of the blocks, the presence of an explicit guardband (such as the current 3440-3442 MHz) and the cost and capabilities of the filter technology.

8.90 For example, if the EPSS block were to remain at 3442 to 3475 MHz and the lower end guardband maintained, a solution could be to maintain the out of block emissions rights granted in the current licences.

Question 20: do you think that an out of block requirement for airborne videolink transmitters of -25 dBm/MHz EIRP is sufficient to protect broadband wireless receivers?

Handling of additional boundary conditions between RSAs if the band is divided into two RSA grants

8.91 We have explained in section 6 that the MOD and the departments with responsibility over EPSS spectrum may decide that the RSA grant for the EPSS block is held by a department different to the MOD. There are two ways this could be put in place:

1) The MOD applies for a grant of RSA for the whole 3400 – 3480 MHz block and then trades the EPSS spectrum with other department, which would also hold the spectrum rights as an RSA.

2) Ofcom receives two requests for RSA grant: one from the MOD for the spectrum not used by emergency services, and a second from another department for the emergency services block.

8.92 We would see the first case as a plain application of the RSA trading principles as laid out before, i.e. the MOD and its trading party – in this case another government department – would agree the conditions at the boundary between the two RSAs and would communicate those conditions to Ofcom. The proposals in this section can be used as guidance.

8.93 The second option does not involve a trade and Ofcom would have to set up the boundary conditions between the two RSAs. The boundary conditions that we have discussed in the previous section could be used as the basis for this. However, the responsibility for agreeing the new boundary conditions in this case will rest with the the MOD and the department involved and they will be better positioned to negotiate the conditions that best meet their interests.

Section 9

Next steps

9.1 Depending on the responses to this consultation we expect to be in a position to publish a Statement with our decisions by January 2010. If our decision is to proceed with RSA in the band, we will then need to amend the RSA regulations and the RSA trading regulations to include the frequency blocks for which RSA can be requested. We will also need to amend the Wireless Telegraphy Register[46] (WTR) regulations (to provide for certain information about the grants of RSA and licences issued on transfer of RSA to be published in the Register) and issue an order limiting the number of grants in the bands.

9.2 Section 122(4) of the WT Act requires that, before making regulations, Ofcom publish a notice of our proposal to make these regulations and that we consider representations made to us on the matter. The notice will set out the general effect of the proposals and include a regulatory impact assessment. Typically, we would expect to publish this notice at the same time as the Statement referred to above. The notice would give interested parties a month or so to make such representations and, depending on those representations, we would expect the regulations themselves to be made and come into force some 4 to 6 weeks thereafter.

9.3 The regulations will not address the terms and conditions on which we would issue RSA and grant future WT licences following trades of RSA. However, we intend to provide further clarification on these terms and conditions before any RSA is granted. We will also provide more detail on the operational aspects of granting and trading RSA in the band. We do not think at this stage that we will need to consult on these issues, but we will do so if we consider it appropriate.

9.4 We will continue our dialogue with government departments with regards to implementation of RSA in what is now the emergency services block.

9.5 The MOD said in its statement of December 2008 that it plans to release some spectrum to the market from within the band by November 2010. However, this is subject to change in the light of various factors as explained in that statement. It will be for the MOD itself to provide further details on how it might release spectrum in this band following the grant of RSA, for example on how the spectrum will be packaged and on the commercial process by which it will be released / traded. The MOD has indicated that it intends to issue an Information Memorandum in due course on these and other matters.

[46] http://spectruminfo.ofcom.org.uk/spectrumInfo/licences

Annex 1

Responding to this consultation

How to respond

A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 20 November 2009**.

A1.2 Ofcom strongly prefers to receive responses using the online web form at http://www.ofcom.org.uk/consult/condocs/crsa, 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 consultation responses - particularly those with supporting charts, tables or other data - please email cesar.gutierrez@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 the consultation.

Cesar Gutierrez
Ofcom
Spectrum Policy Group
Riverside House
2A Southwark Bridge Road
London SE1 9HA

Fax: 020 7981 3770

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 consultation, or need advice on the appropriate form of response, please contact Cesar Gutierrez on 020 7783 4686.

Confidentiality

A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. 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 consultation period, Ofcom intends to publish a statement in January 2010.

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 consultation 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 Vicki Nash, Director Scotland, who is Ofcom's consultation champion:

A1.16 Vicki Nash
Ofcom
Sutherland House
149 St. Vincent Street
Glasgow G2 5NW

Tel: 0141 229 7401
Fax: 0141 229 7433

Email vicki.nash@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

Consultation response cover sheet

A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses 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 consultation

BASIC DETAILS

Consultation 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 ☐

Whole response ☐

Part of the response ☐

Name/contact details/job title ☐

Organisation ☐

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

Consultation questions

Extension of RSA to the 3400 to 3600 MHz band

Question 1: do you agree that we should introduce RSA in the 3400 to 3600 MHz?

Question 2: do you agree that we should extend the relevant regulations to allow Crown bodies to be granted and to trade RSA in the 3400 – 3480 MHz and 3500 – 3580 MHz blocks? If not, which frequency ranges do you think the RSA regulations should cover and why?

Terms and conditions of the RSA grant and the WT licences

Question 3: do you agree that there should be no minimum trading unit for the RSA grant and the WT licences arising from trade in the band?

Question 4: are there specific conditions that you consider should be included in RSA grants and WT licences arising from trading in the band?

Technical limits for base stations in the 3500 – 3580 MHz block

Question 5: do you agree with the proposed in block emissions limit for base stations in the 3500 – 3580 MHz block?

Question 6: do you agree with the proposed out of block emissions mask at the 3500 MHz and 3580 MHz boundaries for base stations?

Question 7: do you agree that less stringent technical parameters should be permitted if agreed between neighbouring operators?

Question 8: should we align UK Broadband licence conditions for base stations at 3500 MHz and 3580 MHz with those in the RSA grants if and when UK Broadband requests us to do so?

Technical limits for terminal stations in the 3500 – 3580 MHz block

Question 9: do you agree with the proposed in block emissions limits for terminal stations?

Question 10: do you agree that the block edge mask should be based on the spectrum emissions mask from ETSI EN 302 623?

Question 11: do you agree with our derivation of regulatory out of block limits for terminals and, if so, which of the proposed four alternative regulatory conditions do you think most appropriate?

Question 12: should out of block limits for fixed, nomadic and mobile terminals be different?

Question 13: should we align UK Broadband licence conditions for terminal stations at 3500 MHz and 3580 MHz with those in the RSA grants if and when UK Broadband requests us to do so?

Technical limits at 3580 MHz

Question 14: do you agree that the technical limits at 3480 MHz should copy those at 3580 MHz when the use immediately below 3480 MHz is broadband wireless?

Question 15: do you agree with the proposed technical limits at 3480 MHz for the scenario where the upper edge of the emergency services block does not change from the current allocation at 3475 MHz?

Question 16: do you agree with the proposed technical limits at 3480 MHz for the scenario where the upper edge of the emergency services block is moved to 3480 MHz?

Technical limits inside the RSA blocks after a partial trade

Question 17: do you agree that the technical conditions of the RSA grant at the 3500 MHz and 3580 MHz boundaries are the best option for the boundaries that will appear inside the 3500 – 3580 MHz block if the block is partitioned and traded into several smaller sub-blocks?

Question 18: do you think that the out of block limits for broadband wireless base stations in Figure 8.2 are sufficient to protect air-to-ground videolink receivers in an adjacent block?

Question 19: what are your views on the requirements for protection of air-to-ground videolink receivers from interference from broadband wireless terminals?

Question 20: do you think that an out of block requirement for airborne videolink transmitters of -25 dBm/MHz EIRP is sufficient to protect broadband wireless receivers?

Annex 5

Regulatory Impact Assessment

Introduction

A5.1 The analysis presented in this annex represents an impact assessment, as defined in section 7 of the Communications Act 2003 (the Act).

A5.2 You should send any comments on this impact assessment to us by the closing date for this consultation. We will consider all comments before deciding whether to implement our proposals.

A5.3 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making. This is reflected in section 7 of the Act, which means that generally we have to carry out impact assessments where our proposals would be likely to have a significant effect on businesses or the general public, or when there is a major change in Ofcom's activities. However, as a matter of policy Ofcom is committed to carrying out and publishing impact assessments in relation to the great majority of our policy decisions. For further information about our approach to impact assessments, see the guidelines, Better policy-making: Ofcom's approach to impact assessment, which are on our website: http://www.ofcom.org.uk/consult/policy_making/guidelines.pdf

Previous impact assessments

A5.4 We included an impact assessment of our policy regarding the introduction of market mechanisms in the management of public sector spectrum in our January 2008[47] statement. We gave notice and set out the general effect of the regulations introducing RSA for the Crown in June 2008[48]. We do not repeat the assessments therein in this consultation document.

The citizen and consumer interest

A5.5 We concluded in our January 2008 statement that allowing public bodies to trade their spectrum holdings would benefit citizens and consumers. In relation to spectrum, the citizen and consumer interests are optimised by any step that helps create an environment in which spectrum is efficiently used and generates maximum economic value.

A5.6 In addition, in making all or parts of the 3400 to 3600 MHz band available for the public sector to trade, we are supporting the designation of the band for fixed, nomadic and mobile applications in accordance with the Commission Decision[49] on Harmonization. The Decision's objective is that new services provided in this band

[47] Spectrum Framework Review for the Public Sector, http://www.ofcom.org.uk/consult/condocs/sfrps/

[48] Notice of Ofcom's proposal to make regulations on Recognised Spectrum Access for public bodies and consultation on technical conditions http://www.ofcom.org.uk/consult/condocs/sfrps08/

[49] Commission Decision of 21 May 2008 on "the harmonisation of the 3400 – 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community" (2008/411/EC). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:144:0077:0081:EN:PDF

should mainly target end-user access to broadband communications thus increasing the choice of citizens and consumers.

Ofcom policy objective

A5.7 Our overall policy objective in introducing RSA is, as set out in our January 2008 statement, to secure optimal use of the radio spectrum by providing public bodies with incentives and opportunities to use spectrum more efficiently. We will achieve this by enabling them to trade their spectrum holdings.

A5.8 However, introduction of tradable RSA in the 3400 to 3600 MHz band may cause disruption to existing users, adversely affecting their ability to operate. Our policy objective in this band is to achieve as much as possible of the gains that tradable RSA could bring in terms of spectrum efficiency and increased economic value, but to minimize the impact on existing users.

A5.9 In order to advance towards this objective, we consider here:

- whether it should be possible for the Crown to apply for RSA in the 3400 to 3600 MHz band and, if so, in what parts of the band RSA should be available,
- the minimum spectrum trading unit for RSA grants and WT licences in the RSA spectrum, and
- the technical limits for the grants of RSA and WT licences arising from trade.

A5.10 We address each of these aspects in turn.

Which parts of the 3400 to 3600 MHz band should be added to the RSA regulations

A5.11 We have addressed this policy issue in two steps:

1) Should RSA be introduced in the 3400 to 3600 MHz band?

A5.12 We have assessed the option of introducing RSA in the band against the status quo i.e. maintaining the current regulatory conditions. We address this question in paragraphs 5.3 to 5.14 from two perspectives: the requirements arising from the Commission Decision, and the optimal use of spectrum and the benefit to citizens and consumers. Our conclusion is that the option of introducing RSA offers more advantages than the status quo.

2) Which parts of the band should be introduced in the RSA regulations?

A5.13 Several users are exploiting the band in the UK at present. We have considered this question in the light of how introduction of RSA might impact each of these users and we have built up a proposal on the basis of our evaluation of the impacts. There are four types of uses licensed by Ofcom in the band:

- **Programme Making and Special Events (PMSE) in 3400 – 3440 MHz and 3500 – 3580 MHz**
  We have assessed the option to include the PMSE spectrum block in the RSA regulations and the option of not doing so. We explain in paragraphs 5.25 to 5.30 that our preference is for the first option.

- **Emergency and Public Safety Services (EPSS) in 3440 – 3480 MHz**
  We have assessed the option to include the PMSE spectrum block in the RSA regulations and the option of leaving the block out. We explain in paragraphs 5.31 to 5.36 that Ofcom and the government departments with an interest in EPSS have a preference for the first alternative.

- **Spectrum Access, licensed to UK Broadband in 3480 – 3500 MHz and 3580 – 3600 MHz**
  We have assessed the option to cover the UK Broadband blocks in the RSA regulations and the option of leaving them out. Our preference is not to introduce this spectrum in the RSA regulations at this point as explained in paragraphs 5.37 to 5.40.

- **Amateur use in 3400 – 3475 MHz**
  Amateur access to this band is on a secondary basis and overlaps with PMSE and EPSS allocations. We have assessed in paragraphs 5.41 to 5.43 whether the presence of the amateur use justifies not covering the 3400 – 3475 MHz block in the RSA regulations and our view is that we should not exclude this block from RSA.

A5.14 We have also evaluated the impact of introducing the band in the RSA regulations on the MOD's own use. We explain in paragraphs 5.18 and 5.19 that introduction of RSA does not impose constraints on military use. Finally, we have considered satellite earth stations receivers, although this service is not formally recognised in the UK. In paragraphs 5.20 to 5.22 we explain the impact of RSA on this type of spectrum use and our view that it should not preclude the introduction of RSA in the band.

A5.15 In summary, our proposal is that RSA should be available in the blocks currently used by PMSE and emergency services – which overlap with the spectrum where amateurs are secondary users – and to exclude the block currently licensed to UK Broadband. This means that we propose to add the 3400 – 3480 MHz and 3500 – 3580 MHz blocks to the RSA regulations.

What should be the minimum spectrum trading unit for RSA grants and WT licences in the RSA spectrum

A5.16 We have considered whether to impose limits on the smallest unit of geographical coverage or frequency bandwidth that will be allowed to be transferred in a partial trade (see paragraph 7.9).

A5.17 Our preference is not to have such a minimum spectrum trading unit. The reasons for this are explained in paragraph 7.10.

Technical limits for the RSA spectrum

A5.18 The objective of the technical conditions included in a RSA grant is to avoid unacceptable interference to the neighbouring users while being as technology and application neutral as possible. In addition, when considering the technical conditions in this band we have to bear in mind the requirements of the Commission Decision.

A5.19 We have studied the technical limits to be applied to the RSA grant in two steps: we have first considered the limits applicable to the upper block of the RSA i.e. 3500 – 3580 MHz. Second, we look at the limits for the boundary at 3480 MHz. We look at

these two issues in turn below. Note that we do not specify conditions at the lower edge of the lower RSA block at 3400 MHz. The reasons for this are given in paragraph 8.55.

Limits for the 3500 – 3580 MHz block

A5.20 We have looked at the technical conditions inside and at the boundaries of the 3500 – 3580 MHz block. We think that broadband wireless systems will be deployed in this block if traded, so we need to set out conditions for broadband wireless base and terminal stations.

A5.21 Our proposals for the in block limits are, in both cases, taken from the Commission Decision. We do not see any justification for different levels in the UK as explained in paragraphs 8.23 and 8.26.

A5.22 We study alternatives for out of block limits for base stations in paragraphs 8.10 to 8.23. We think that the best option is to apply the block edge mask from the Commission Decision.

A5.23 The Decision does not provide guidance for out of block limits for terminal stations. We have simulated interference scenarios and we are proposing a set of alternative block edge mask based on them, plus another option where only compliance with ETSI standard is required. We present the options and consider their costs and benefits in paragraphs 8.42 to 8.52. We do not have a preference for any of the options and we expect to build our opinion on the basis of the responses we receive.

Limits at 3480 MHz

A5.24 We present proposals for the requirements at 3480 MHz and inside the RSA block below that boundary. The arrangement for this block depends on the negotiations of government departments regarding the allocation of the emergency services. We have considered three possible outcomes of these negotiations:

- The EPSS block is moved down in frequency from its current allocation at 3442 – 3475 MHz
- The upper boundary of the emergency services block is maintained at 3475 MHz
- The upper boundary of the emergency services block is moved to 3480 MHz

A5.25 We are not consulting on these scenarios since it is not for Ofcom to decide between them. However, we consult on proposals for technical limits for each of the scenarios.

A5.26 In the first scenario we consider that the MOD might want to release the spectrum immediately below 3480 MHz for broadband wireless usage. Our proposal in this scenario is to mimic the limits applicable at 3500 MHz and 3580 MHz, on the basis that the interference is broadly equivalent. This is explained in paragraphs 8.62 and 8.63.

A5.27 Our proposals for the second and third scenarios are based on the current limits applicable to emergency services air-to-ground use. We think that this is the best approach because it maintains the conditions of the emergency services users, who would be able to keep using their equipment, and the conditions of the neighbour,

who will not see an increase in incoming interference. In practice, we are preserving the current conditions but we propose to express them in a different way as explained in paragraphs 8.64 to 8.69.

Equality Impact Assessment (EIA)

A5.28 Ofcom is required by statute to assess the impact of all our functions, policies, projects and practices on race, disability and gender equality. An EIA is an analysis of the potential impacts a proposed a policy or project is likely to have on people depending on their background or identity and is our way of fulfilling the obligations mentioned above.

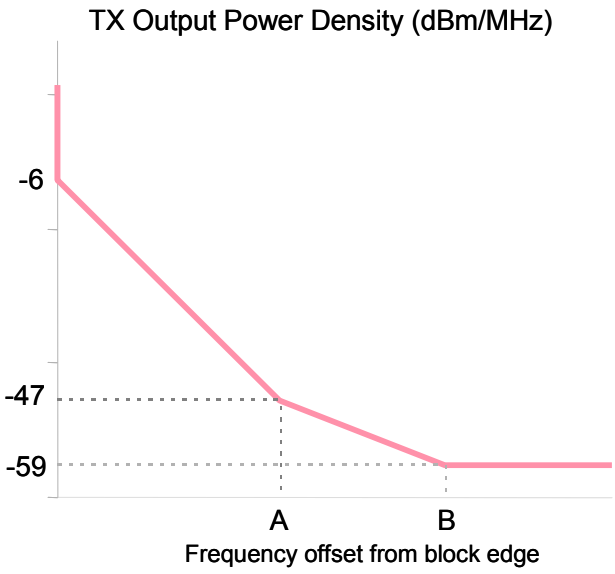
A5.29 Following an initial analysis undertaken in relation to this project we are not aware that the issues being considered here are intended to (or would, in practice,) have a significant differential impact on different racial groups, on disabled citizens or consumers or other minority groups compared with citizens and consumers in general. Similarly, the proposed policies do not make distinctions between consumers or citizens in different parts of the UK or between consumers and citizens on low incomes. We do not believe that the proposed policies will have a particular effect on one group of consumers over another.

Annex 6

Technical parameters for Base Stations in Commission Decision 2008/411/EC

Frequency offset	TX Output Power Density Limits (dBm/MHz)
ΔF=0	-6
0<ΔF<A	-6 - 41·(ΔF/A)
A	-47
A<ΔF<B	-47 - 12·((ΔF-A)/(B-A))
ΔF≥B	-59
ΔF: frequency offset from block edge; A, B are the frequency offset break points in the table below	

Frequency offset break points	% of the block size
A	20%
B	35%
The percentages given in the Definition column refer to the smaller of the adjacent blocks, if blocks are of unequal size	



Annex 7

Home Office standard MG-42C part 2, section 3.5

3.5 **Radiated spectrum**

3.5.1 Standard test modulation

a) For the purpose of this test the modulation applied to the transmitter will be provided from a digital encoder system which incorporates multiplexing and encryption if available.

b) Test signals delivered to both video and sound inputs of the encoder system will be :

Video : 100 % colour bars
Sound : 3 kHz sinusoidal audio tone applied at manufacturers full system level

3.5.2 Method of measurement

a) The transmitter output port shall be connected to either :

i) a spectrum analyser via an attenuator
or
ii) an artificial load with a means of sampling the emission with a spectrum analyser

b) The transmitter to be operated in accordance with the manufacturers instructions and at full rated output power.

c) The spectrum analyser shall have a variable long persistence display, or digital storage display and its controls adjusted as follows :

i.f. bandwidth	-	30 kHz
total sweep width	-	50 MHz
total scan time	-	20 seconds
video filter	-	300 Hz

d) The unmodulated transmitter carrier shall be observed and its amplitude on the display screen set to a convienient datum level by the adjeustment of the spectrum analyser controls.

e) The transmitter shall be modulated by the standard test modulation.

f) The measurement shall be made under normal test conditions and repeated under extreme test conditions. (see section 6)

3.5.3 Radiated spectrum limits : Limits of spectral power density are given in Figure 1

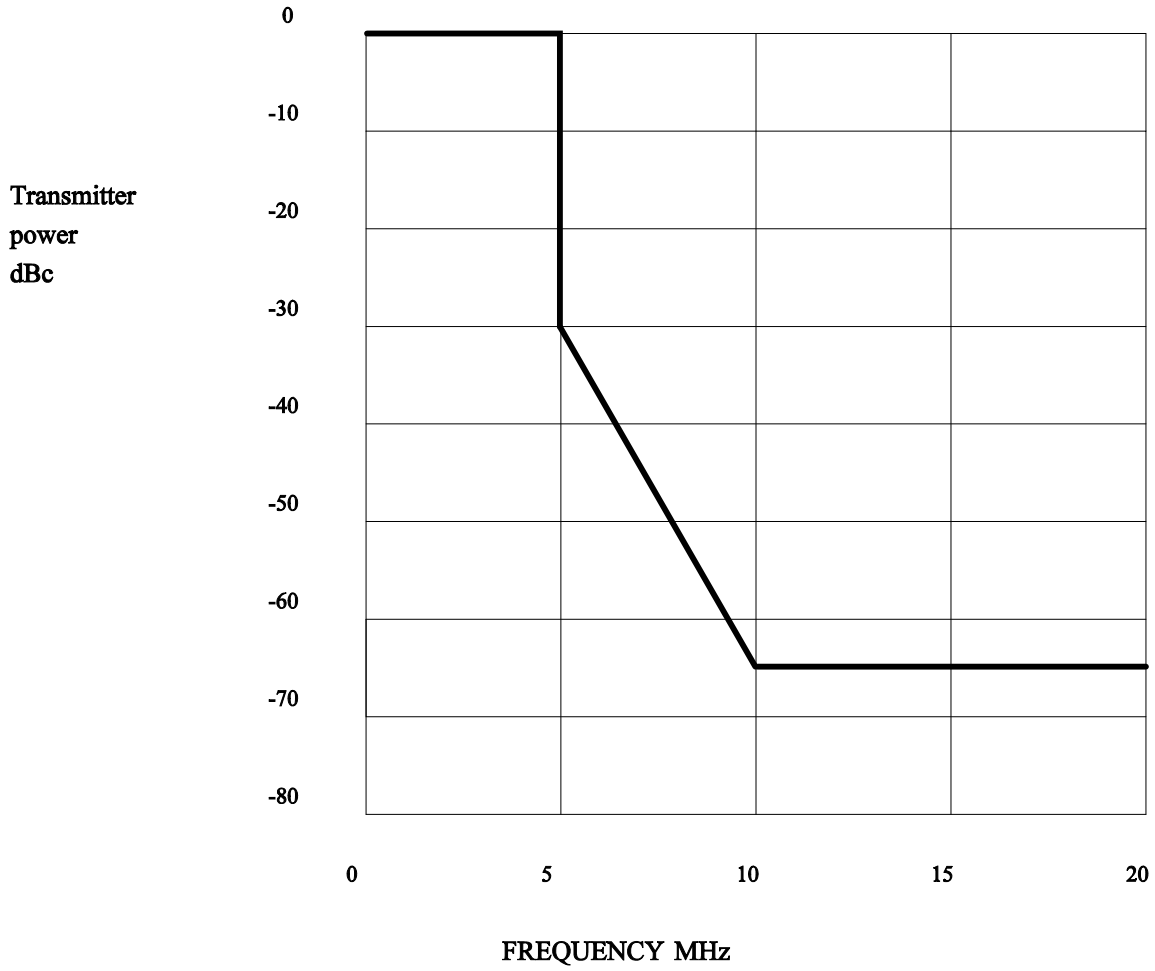
NOTE : The limits in figure (1) are considered appropriate to a proposed 3 channel radio system and may be reviewed to suit alternative arrangements. It should be

noted that all transmitters must achieve a sideband level of at least -65 dBc from :

a) 3485 MHz and above
b) 3432 MHz and below

FIG 1 MG42C part (2) issue 1

LIMITS OF SPECTRAL POWER DENSITY



3.5.4 Antenna filter

a) As a condition of the licence airborne video transmitters operating in the 3.4 GHz band shall be fitted with an antenna transmission line filter for the purposes of reducing the levels of sideband power emitted over the adjacent bands. The requirements of this filets are shown in Fig 2 below :

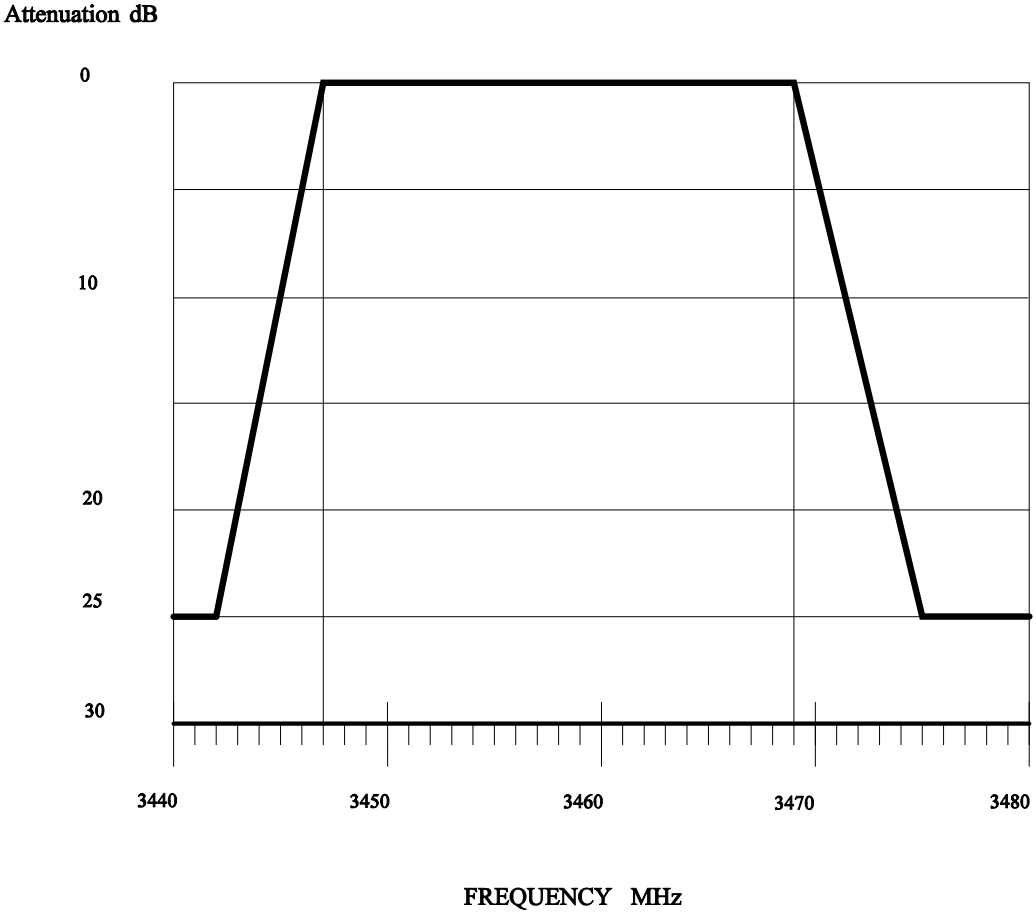
maximum attenuation over passband	3447.0 MHz to 3469.0 MHz	1dB
minimum attenuation over lower stopband	3000.0 MHz to 3442.0 MHz	25dB
minimum attenuation over upper stopband	3475.0 MHz to 4000.0 MHz	25dB
Return loss over passband	20dB minimum	
power handling	20 watts mean carrier power (continuous)	

b) Filter performance must be maintained over the operational temperature range.

c) Filters shall be designed and manufactured with due regard to their subsequent installation in aircraft.

FIG 2

FILTER SCHEMATIC RESPONSE



Annex 8

Out of block limits for mobile terminal stations

Introduction

A8.1 This annex describes our analysis of the mobile terminal to mobile terminal interference in the 3.4 GHz band. The objective is to set the out of block (OOB) limits for terminal stations that will be incorporated to the RSA grant and the licences arising from the trade. These limits will be applicable at the 3500 MHz and 3580 MHz boundaries of the RSA block, and potentially at the 3480 MHz boundary if the RSA spectrum immediately below is traded to a user different to the emergency services. The purpose of the technical limits in a licence or grant is to protect the adjacent user which, at the boundaries of the RSA, is UK Broadband.

A8.2 The Commission Decision on harmonization requires that the 3400 to 3600 MHz band is made available in accordance with the Decision technical parameters. In practice this means that the most likely usage of the RSA spectrum after trade will be broadband wireless.

A8.3 We think that broadband wireless networks deployed at 3.4 GHz will have very similar characteristics to the deployments in 2.6 GHz. This is because the propagation conditions are close and the potential technologies deployed – WiMAX or 3GPP based – are likely to be the similar on both bands.

A8.4 For this reason our technical analysis relies significantly on recent work carried out for 2.6 GHz, in particular the study by CEPT SE42 captured in ECC Report 131[50]. Following CEPT SE42 steps, we first consider a deterministic analysis that provides the likely separation distances to avoid unacceptable interference for different levels of out of band emission; and then consider a probabilistic analysis that captures the statistical nature of interference likely to arise in real deployment scenarios.

A8.5 For the deterministic analysis we calculate minimum coupling loss to avoid unacceptable interference to a receiver. This methodology is considered to be a worst case analysis because it does not take into account the statistical probability of the locations of the interfering terminals and their potential to cause interference to a wanted receiver.

A8.6 For the probabilistic analysis, we construct a scenario where we simulate the potential for interference between terminal stations based on assumptions regarding deployment and user density. We use a computer simulation (based on a Monte Carlo approach) to estimate the probability of interference. The analysis takes into account the statistical nature of the locations of the victim and interfering terminals within their respective cellular coverage areas, as well as the statistics of collisions between interfering packet transmissions and wanted packet reception at the victim receiver.

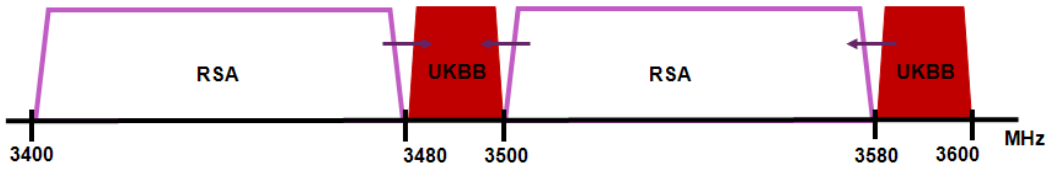
[50] ECC Report 131, "Derivation of a block edge mask (BEM) for terminal stations in the 2.6 GHz frequency band (2500-2690 MHz)", http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP131.PDF

A8.7 We use the results of the probabilistic analysis as an input our proposals for the technical conditions of the RSA grants. The proposals take the form of block edge masks that are based on the protection requirements arising from our analysis, and on consideration of the spectrum emission masks from the relevant ETSI standard.

Context of the scenario modelling

A8.8 UK Broadband, the adjacent licensee that we look to protect, has got a frequency allocation (3480 – 3500 MHz and 3500 – 3580 MHz) that allows them to deploy either paired (FDD) or unpaired (TDD) technologies. We focus our analysis on the case of a TDD terminal interfering with a FDD victim, which is generally considered the worst case scenario.

Figure A8.1: Band layout assumption for the terminal to terminal interference scenario



A8.9 We base our simulations on 10 MHz wide channels. Our grants or licences will not mandate a channel size and neither does the Commission Decision. ETSI harmonized standard[51] EN 302 623 for this band covers different channel widths of 5 MHz, 7 MHz and 10 MHz. It is recognised that even wider channels, perhaps up to 20 MHz, could be used in the future in this band. After consultation with several stakeholders we think that 10 MHz will be the most likely choice of channel sizes by broadband wireless licensees in this band in the short to medium term.

A8.10 We proceed in two steps: a deterministic analysis that estimates the separation distances for different levels of out of band emission; and a probabilistic analysis that captures the statistical nature of interference in real deployment scenarios.

Interference protection level

A8.11 In both our deterministic and probabilistic analysis we consider the case of protecting a FDD 10 MHz carrier. We consider that interference appears when the unwanted signal level causes a 3 dB desensitization to the victim receiver, i.e. the total interfering power at the receiver, which includes the unwanted signal and the thermal noise, raises 3 dB.

A8.12 The noise floor of the receiver P_N is -95dBm / 10MHz, as calculated below:

Thermal noise level @ 290K = kTB = -104.0 dBm / 10 MHz

Noise figure of the receiver = 9dB

Noise floor of the receiver, P_N= -104.0 dBm + 9dB = - 95 dBm / 10 MHz

A8.13 The suggested allowable desensitisation, D, is 3dB. The interference $P_{I,Target}$ to cause 3dB desensitisation is given by

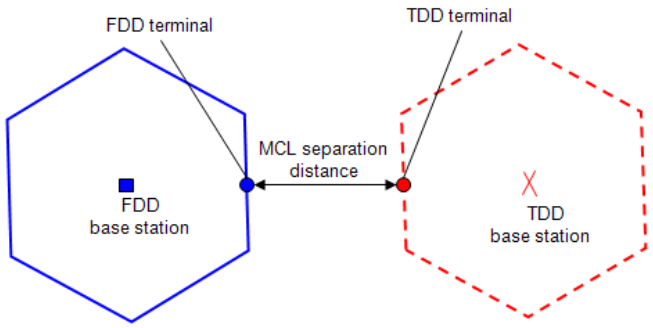
[51] ETSI EN 302 623 “Broadband Wireless Access Systems (BWA) in the 3 400 MHz to 3 800 MHz frequency band; Mobile Terminal Stations; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive

$$P_{\mathrm{I,Target}} = P_{\mathrm{N}} + 10\log_{10}\left(10^{D/10} - 1\right),\ P_{I,Target} = \text{-95.0dBm / 10 MHz}$$

Deterministic approach: Minimum Coupling Loss analysis

A8.14 This analysis adopts a minimum coupling loss methodology to estimate the physical separation between interfering and victim terminals that produces a desensitization of 3 dB at the victim receiver. Conversely, it also allows the interference level to be derived for a given separation distance between terminals. Minimum coupling loss is often considered to be a worst case analysis, because it does not take into account the statistical probability of the locations of the terminals.

Figure A8.2: Layout of "interference" scenario modelled in the minimum coupling loss analysis



A8.15 The allowable out of band transmission plus the path loss have to be less than $P_{I,Target}$, which is the level that causes 3dB desensitisation to the victim receiver. This is given by $P_{\mathrm{OOB}} + G_{\mathrm{PL,\ TS-TS}} \leq P_{\mathrm{I,\ Target}}$ where $G_{\mathrm{PL,\ TS-TS}}$ is the TS-TS propagation path gain in dB and P_{OOB} is the out of band power.

A8.16 To calculate the path loss between the interferer and victim terminals we have used the IEEE 802.11C[52] propagation model (as in ECC report 131) that is representative for large open spaces and Non Line Of Sight conditions.

A8.17 The allowable out of block transmit power, P_{OOB}, has been calculated for the interfering terminal for a range of separation distances between the terminals. The results can be found in Table A9.1 below.

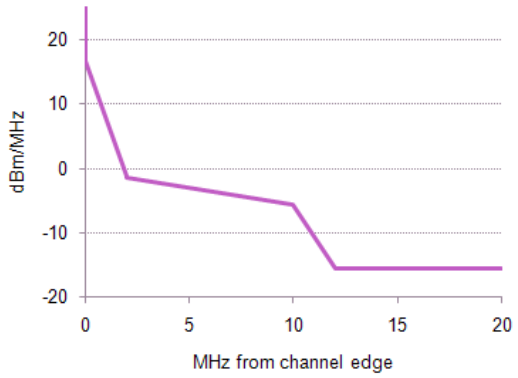
[52] "TGn Channel Models (IEEE 802.11-03/940r2)," High Throughput Task Group, IEEE P802.11, 15 March 2004

Table A8.1: Out-of-band emission level required for 3 dB receiver desensitization at different TS-TS separation distances

TS-TS separation, d (m)	Path gain, $G_{PL,TS-TS}$ (dB)	Out-of-band emission level, P_{OOB}, for 3dB desensitization (dBm/10MHz)
1	-43.3	-51.7
2	-49.3	-45.7
3.5	-54.2	-40.8
4	-55.4	-39.6
5	-57.3	-37.7
10	-67.8	-27.2
50	-92.3	-2.7
100	-102.8	7.8
150	-109.0	14.0
200	-113.4	18.4

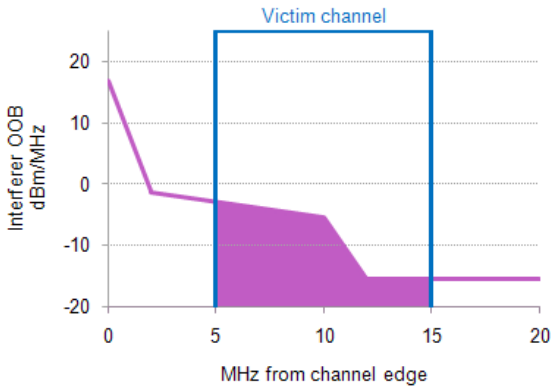
A8.18 We look next at the separation distance required for an interfering terminal whose out of block emissions follow the spectrum emissions mask presented in ETSI harmonized standard EN 302 623. The mask has been drawn by the device vendors and hence we consider that it approximates well the emissions of actual devices. We assume the EIRP is the maximum allowed by the Commission Decision i.e. 25 dBm/MHz (35 dBm for a 10 MHz terminal). The shape of the out of block emissions is shown in the figure below.

Figure A8.3: Out of block emissions of a 10 MHz bandwidth terminal compliant with ETSI EN 302 623 and 35 dBm EIRP



A8.19 The total out of block emissions into the victim channel will depend on the separation between the channels. For example, if the interferer and victim channels are separated by 5 MHz, the total power in the victim channel is approximately 3.4dBm / 10MHz and given by the integration of the interferer emissions between 5 MHz and 15 MHz away from its channel edge as shown in the figure below:

Figure A8.4: Interference power in the victim's channel when victim and interferer channels are separated by 5 MHz



A8.20 We consider three alternatives for separation between channels – 0 MHz, 5 MHz and 10 MHz – and we calculate the physical separation distance necessary for 3 dB desensitization. This is shown in the table below.

Table A8.2: The minimum spatial separations between terminals with different frequency separations for a 3dB desensitization

Frequency separation between interferer and victim terminals	Total out of block emissions from interferer terminal (dBm/10MHz)	Maximum path gain (dB)	Minimum separation distance needed between terminals (m)
0 MHz	14.2	109.2	152
5MHz	3.4	98.4	75
10MHz	-3.5	91.5	47

A8.21 These results show that, for the environment modelled of open areas and shadowed conditions, if there is no frequency separation between channels (i.e. no guard band) then a 3dB desensitization of the receiver will appear if the devices are closer than 152 metres. For a 10 MHz guard band the distance is 50 metres. It should be noted these estimates are based on the use of out of block emissions compliant to the EN 302 623 standard. If a more stringent OOB mask for the terminal station is practical then the estimated minimum coupling loss separations will decrease.

A8.22 The minimum coupling loss analysis captures the relationship between victim receiver desensitisation and the interferer-victim separation, but it does not account for the likelihood of such desensitization occurring in a cellular environment. The relative positions of interferer and victim are time variant, and the likelihood of a given separation distance will be a factor of parameters such as network deployment and user density. Consequently, it can be expected that the requirements arising from the deterministic analysis over estimate the potential for interference. A stochastic approach that accounts for the probabilistic nature of interference in a cellular environment will estimate results more representative of real scenarios.

Probabilistic approach

A8.23 We use a Monte Carlo analysis to take into account the statistical nature of the locations of the victim TS and interferer TS within their respective cells, as well as the statistics of collisions between interfering and wanted packets at the victim receiver.

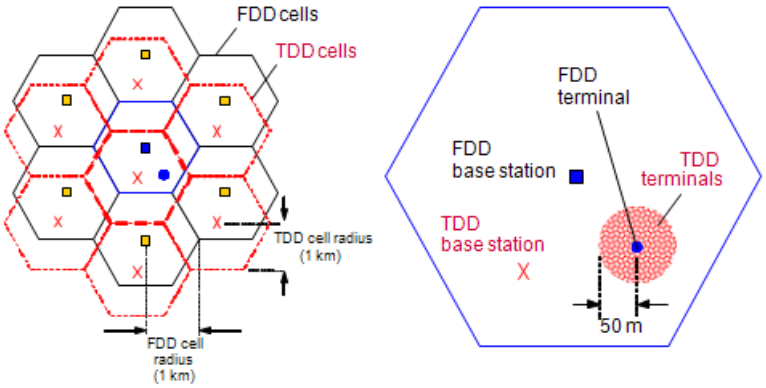
Scenario layout

A8.24 Interference is most likely to occur when the victim handset is at the edge of its reception area and when the interferer is at maximum power (i.e. the received signal from the base station is at its lowest strength and the interfering signal is at its strongest). The probability is highest when victim and interferer are in close proximity such as in a hot-spot environment.

A8.25 A macro-cellular deployment is considered in order to capture geometries where both the interferer and "victim" terminals are far from their serving base stations. We assume that the potential interferers are within a hot-spot environment around the potential victim.

A8.26 This scenario layout is shown in Figure A8.5 below. The FDD and TDD macro-cellular base station deployment are shown. The interfering TDD terminals are clustered around a "victim" FDD terminal. This layout is similar to the one used by CEPT SE42 in their work for 2.6 GHz terminals.

Figure A8.5: Layout of "interference" scenario modelled in the Monte Carlo analysis



Density of the "interfering" terminals in hot-spot environment

A8.27 To assess a suitable OOB TS level we consider the impact of low, medium and high levels of usage, i.e. user density, as shown in the following table.

Table A8.3: Characteristics of macro cellular hot-spot environments

	People density (m^{-2})	Hot-spot radius (m)	No. of people in hot-spot
Very high-density hot-spot	1/3	25	655
High-density hot-spot	1/5	50	1571
Hot-spot	1/10	75	1768

A8.28 We consider four cases of terminal usage densities on the basis of these hot-spot scenarios:

- **Case 1:** An average spatial density of 1 person per 3m² is assumed representative of a very high-density macro cellular hot-spot, 10% of whom are considered to be using their wireless terminal devices. It is then assumed that 15% of the active terminals operate in the 3.5GHz band (the rest operating in other frequency bands). The terminals are then assumed to be uniformly distributed across a total of ten 10MHz blocks.

- **Case 2:** An average spatial density of 1 person per 5m² is assumed representative of a high-density macro-cellular hot-spot, 10% of whom are considered to be using their wireless terminal device. It is then assumed that 15% of the active terminals operate in the 3.5GHz band (the rest operating in other frequency bands). The terminals are then assumed to be uniformly distributed across a total of ten 10MHz blocks.

- **Case 3:** An average spatial density of 1 person per 5m² is assumed representative of a medium-density macro-cellular hot-spot, 10% of whom are considered to be using their wireless terminal device. It is then assumed that 5% of the active terminals operate in the 3.5GHz band (the rest operating in other frequency bands). The terminals are then assumed to be uniformly distributed across a total of ten 10MHz blocks.

- **Case 4:** An average spatial density of 1 person per 10m² is assumed representative of a macro-cellular hot-spot, 10% of whom are considered to be using their wireless terminal device. It is then assumed that 5% of the active terminals operate in the 3.5GHz band (the rest operating in other frequency bands). The terminals are then assumed to be uniformly distributed across a total of ten 10MHz blocks.

A8.29 This results in the following scenarios of interfering terminals around the “victim” terminal.

Table A8.4: Number of interfering terminals clustered around the “victim” terminal

Case	Terminal density per m^2 in adjacent 10MHz channel	Terminal density per m^2	Hot-spot radius, metres	No. of terminals modelled (M)
1) Very high density	(1/3) x 0.1 x 0.15 x 0.1	0.0005	25	1
2) High density	(1/5) x 0.1 x 0.15 x 0.1	0.0003	50	2
3) Medium density	(1/5) x 0.1 x 0.05 x 0.1	0.0001	50	1
4) Low density	(1/10) x 0.1 x 0.05 x 0.1	0.00005	75	1

Methodology of calculating the maximum out-of-block transmit power

A8.30 The Monte Carlo approach adopted accounts for the statistics of victim TS and interferer TS locations within their respective cells, as well as the statistics of collisions between interfering and wanted packets at the victim receiver.

A8.31 Our analysis considers snapshots of a “victim” FDD terminal placed randomly within its macro cell. The TDD terminals are then clustered randomly in a uniform distribution within the hot-spot radius around a FDD terminal.

A8.32 For each snapshot the received wanted signal of the “victim” FDD terminal is calculated. Then the OOB EIRP of the interfering TDD terminal that would cause a desensitisation of 3dB in the FDD terminal is calculated. This level takes into account the rise in the noise floor resulting from intra system interference effects, as well as the available wanted signal power (see the simulation steps below). The transmit power of the TDD terminal is calculated according to its location in the TDD macro-cell. If this transmit power leads to a OOB level greater than the one calculated for the 3 dB desensitization, we consider that the TDD terminal interferes with the FDD victim.

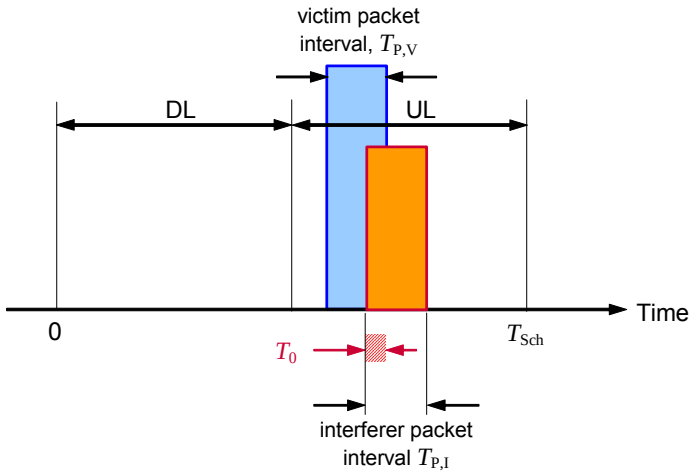
A8.33 This Monte Carlo analysis follows the methodology used in the 2.6GHz band documented in ECC Report 131. However, it is worth noting that we have used a different propagation model to derive the pathloss between the base station and terminal link because the modified Hata used within ECC Report 131 is not considered valid for 3.5GHz. Instead we have replaced this with the IEEE802.16 Erceg model[53] for terrain type B.

The impact of packet collisions

A8.34 One important aspect that is taken into account within the analysis is the likelihood of partial overlap between the interfering and victim signal transmissions. This factor is relevant in cases where the radio technologies used by the victim and the interferer make use of time-division multiple-access (TDMA), as is the case, for example, in packet-based transmission schemes

A8.35 Consequently, the terminal stations in such systems transmit and receive data in bursts of finite time duration. As a result, the probability of collision at a victim TS receiver between a wanted downlink (DL) packet and an interfering uplink (UL) packet (originating from an adjacent TS) is less than unity. Furthermore, the extent of interference experienced by the victim is also a function of the degree of overlap (in time) between the wanted and interfering packets, as illustrated the following Figure.

Figure A8.6: Illustration of a partial overlap between the interferer and victim packets.



[53] IEEE 802.16.3c-01, “Channel Models for Fixed Wireless Applications,” July 2001

A8.36 In this analysis the packet overlap effects are captured by the probability of collision parameter $G_{Coll} = 10log_{10}\left(\frac{T_0}{T_{P,V}}\right)$, where T_0 is the overlap interval between a wanted DL packet (of duration $T_{P,V}$) and an interfering UL packet (of duration $T_{P,I}$) at the victim receiver.

A8.37 In the case of a complete overlap, $T_0 = T_{P,V}$ (i.e., $G_{Coll} = 0dB$), and the victim experiences the full effect of interference. Conversely, in the case of no overlap, $T_0 = 0$ (i.e., $G_{Coll} = -\infty$), and the victim experiences no interference.

Parameter values

A8.38 The following tables contain the parameters used in the simulations.

Table A8.5: List of FDD receiver parameter values

Cell radius	1000 metres
BS antenna height	30 metres
Minimum BS-TS separation	50 metres
BS-TS path loss model	802.16 Erceg model for terrain type B
TS antenna gain	0 dBi
Noise-equivalent bandwidth, *B*	10 MHz
TS noise figure, NF_{TS}	9 dB
Desensitization	3 dB resulting in an increase in the interference level of 0 dB relative to the noise floor i.e. $G_{D,FDD}$ = 0 dB
Intra-system noise rise, $G_{I,FDD}$	6 dB
Downlink packet duration, $T_{P,V}$	2.5 ms

Table A8.6: List of TDD transmitter parameter values

Cell radius	1000 metres
Hot-spot radius	25m / 50 metres / 75m
BS antenna height	30 metres
Minimum BS-TS separation	50 metres
BS-TS path loss model	802.16 Erceg model for terrain type B
TS spatial density	1/3 m^{-2} x 0.1 x 0.15 x 0.1 (per 10 MHz) 1/5 m^{-2} x 0.1 x 0.15 x 0.1 (per 10 MHz) 1/5 m^{-2} x 0.1 x 0.05 x 0.1 (per 10 MHz) 1/10 m^{-2} x 0.1 x 0.05 x 0.1 (per 10 MHz)
Number of interferers in hot-spot, M	2 or 1
Uplink packet duration, $T_{P,I}$	2.5 ms
Uplink/downlink ratio, $u_{UL/DL}$	1:1

Table A8.7: List of generic parameter values

Operating frequency	3.5 GHz
Number of Monte Carlo trials	15000
TS-TS separation	25, 50 or 75 metres (max), 1 metre (min)
TS-TS path loss model	IEEE 802.11 Model C
Separation between	Random process

FDD and TDD base stations	
Scheduling interval, T_{Sch}	20 ms
TS antenna height	1.5 m

Simulation steps

A8.39 The following steps are performed for each Monte Carlo snapshot:

1) Drop the victim FDD TS at a random (uniformly distributed) location within the FDD macro-cell.

2) Drop M TDD TS interferers at random (uniformly distributed) locations within a hot-spot surrounding the FDD TS.

3) Drop the TDD hot-spot at an appropriate location within the TDD macro-cell[54].

4) Calculate the TDD power control factor, $-40\mathrm{dB} \leq \mathrm{G_{PC}} \leq 0\mathrm{dB}$, based on the location of the TDD TS within the TDD macro-cell.

5) Calculate the interference allowance, $\mathrm{G_{A,FDD}}$. This accounts for the fact that, as a victim TS moves in from the cell-edge and approaches its serving base station, the wanted DL signal increases, and so for a fixed signal-to-interference plus-noise ratio (and hence DL quality), the victim receiver can tolerate a proportionally greater amount of interference.
Specifically, $\mathrm{G_{A,FDD}} = \mathrm{G_{1,FDD}} - \mathrm{G_{0,FDD}}$ where $\mathrm{G_{1,FDD}}$and $\mathrm{G_{0,FDD}}$ are the base-to-terminal mean path-gains in dB at the victim terminal's location and the cell edge respectively.

6) Calculate the tolerable interference, $\mathrm{P_{I,FDD,Target}}$, at the victim FDD TS, based on Equation below

$$P_{I,FDD,Target} = P_N + G_{I,FDD} + G_{D,FDD} + G_{A,FDD},$$

where

Thermal noise floor at the receiver, P_N = -95 dBm / 10MHz

Intra-system noise rise, $G_{\mathrm{I,FDD}}$ = 6dB

Tolerable increase in interference, $G_{\mathrm{D,FDD}}$ = 0 dB (for a desensitization D of 3dB).

7) Calculate the path gain between the victim TS and each of the M TS interferers.

8) Calculate the collision factor, $\mathrm{G_{Coll}}$, for each victim-interferer pair.

9) Select the dominant TS interferer (i.e., which would cause greatest interference).

10) Compute the out-of-block EIRP, $\mathrm{P_{OOB,TDD}}$, for the dominant interferer, as indicated in the equation below

[54] When considering a fixed base station separation across the Monte Carlo trials, a correction is made to ensure that the largest separation between a TDD TS and the TDD BS is not greater than the TDD cell radius. When considering stochastic realisations of base station locations across the trials, the TDD hot-spot is randomly placed at a uniformly distributed location fully within the TDD macro-cell, again to ensure that the largest separation between a TDD TS and the TDD BS is not greater than the TDD cell radius.

$$P_{OOB,TDD} + G_{PL,TS-TS} + G_{PC,TDD} + G_{Coll} \leq P_{I,FDD,Target} \ ,$$

where

$G_{PL,TS-TS}$ is the TS-TS propagation path gain in dB

$G_{PC,TDD}$ is a power control factor in dB

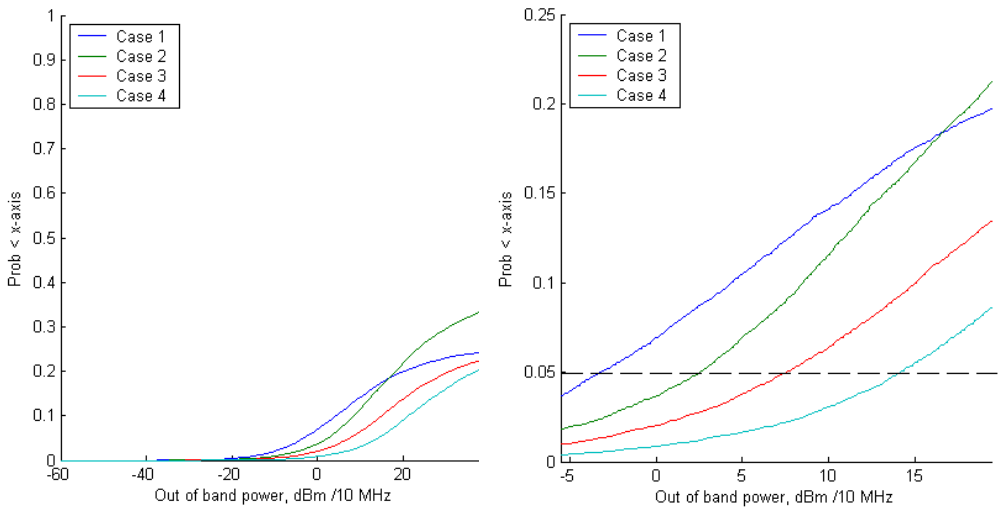
and G_{Coll} is the packet collision factor

Results from the Monte Carlo analysis

A8.40 $P_{OOB,TDD}$ is calculated for 15000 snapshots. The distribution of $P_{OOB,TDD}$ can be depicted in the form of a cumulative distribution function (CDF), as shown in Figure A9.7. The CDF shows the probability that $P_{OOB,TDD}$ does not exceed a given value. The probability of undue interference is then defined by a 5% threshold i.e. we consider acceptable that interference occurs with a probability of 5% or less. The CDF curve lets us find the value of $P_{OOB,TDD}$ that would result in the 5% probability of interference.

A8.41 Figure A9.7 show the cumulative distribution of $P_{OOB,TDD}$ for the four usage density cases. The drawing on the right zooms in the parts of the curves that cross the 5% probability line.

Figure A8.7: Cumulative distribution of the allowable out-of-block emissions



A8.42 The table below summarises the maximum OOB EIRP per 10MHz so that the probability of a TDD terminal interfering with a FDD terminal is 5%, in each of the user density scenarios simulated.

Table A8.8: Out of block baseline EIRP limit per 10MHz in each of the scenarios

Density scenario modelled	Case 1 Very high density	Case 2 High density	Case 3 Medium density	Case 4 Low density
User density per m^2	0.000500	0.000300	0.000167	0.000050
Out of block EIRP limit	-3.2 dBm / 10MHz	2.6 dBm / 10MHz	7.6 dBm / 10MHz	14.2 dBm / 10MHz

A8.43 We consider next how actual terminals would comply with these OOB requirements. We take the same approach used in the deterministic case. We apply the spectrum

emissions mask from ETSI EN 302 623 and the maximum in-block EIRP allowed by the Decision (+25 dBm/MHz, 35 dBm for a 10 MHz terminal).

A8.44 The OOB emissions decrease as we move the victim channel away from the interferer. We have calculated the emissions level for channel separations from 0 MHz to 12 MHz so that we can identify the frequency separation required for each of the density cases above. Figure A9.8 below shows OOB emissions in the victim channel as a function of the channel separation, and table A9.9 identifies the channel separation required to comply with the maximum OOB EIRP arising from the Monte Carlo simulation.

Figure A8.8: EIRP out of block emissions in the victim channel as function of the frequency separation between victim and interferer for 10 MHz bandwidth terminals compliant with ETSI EN 302 623

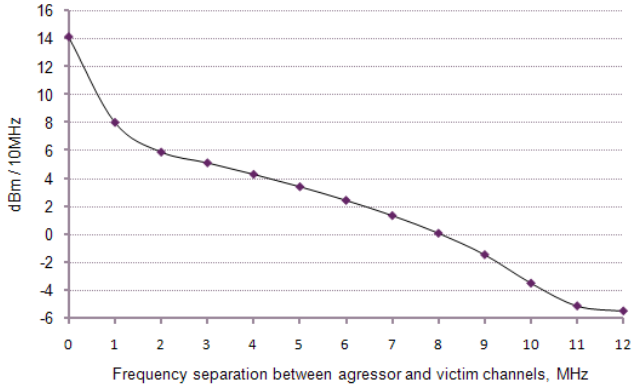
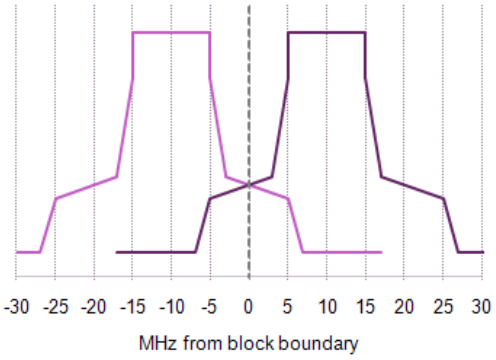


Table A8.9: Frequency separation between interferer and victim channels to meet the out of block emissions requirement from the Monte Carlo analysis

	Case 1 Very high density	Case 2 High density	Case 3 Medium density	Case 4 Low density
Maximum OOB power	-3.2 / 10MHz	2.6 / 10MHz	7.6 / 10MHz	14.2 / 10MHz
Frequency separation between victim and interferer channels	10 MHz	6 MHz	2 MHz	0 MHz
Separation rounded to the next multiple of 5 MHz	10 MHz	10 MHz	5 MHz	0 MHz

A8.45 Normally, our preference is that this frequency separation requirement is shared by both adjacent block users, most notably when the applications on both blocks are similar. This means that each block user will have to move its channel half the separation distance away from the block edge. It also ensures that the interference conditions are the same to both block users. For example, for terminals compliant with ETSI EN 302 623 and a required channel separation of 10 MHz, the channel edges will be 5 MHz away from the block edge. This is shown below:

Figure A8.9: 10 MHz frequency separation for ETSI EN 302 623 compliant terminals



Block Edge Mask proposals

A8.46 We build our proposals for regulatory block edge masks from the requirement for separation of channels coming from the stochastic analysis and from the spectrum emissions mask from the ETSI standard. We do this for channel separation distances of 10 MHz, 5 MHz and 0 MHz which mean, respectively, that the channels are 5 MHz, 2.5 MHz and 0 MHz away from their block edge. This gives us the following three options for the block edge mask:

Option 1: 10 MHz separation between channels

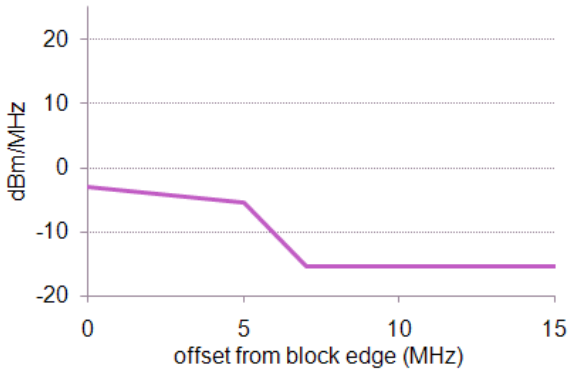
Table A8.10: Background data for Option 1) for block edge mask

Density scenario	Max OOB per 10MHz	Required Separation between channels	Rounded separation between channels	Location of the 10 MHz channel ETSI mask
Case1 Very high density	-3.2 / 10MHz	10 MHz	10 MHz	Channel centre 10 MHz away from the block edge, channel boundary 5 MHz away from the block edge
Case 2 High density	2.6 / 10MHz	6 MHz		

A8.47 A 10 MHz ETSI EN 302 623 channel is located 5 MHz away from the block boundary. The block edge mask follows the line of the spectrum emission mask from the ETSI EN. The figure below shows the proposed block edge mask and its tabular description.

Figure A8.10: Option 1) for terminal BEM out of block EIRP limits – 10 MHz frequency separation between channels

Frequency offset from Block Edge (MHz)	Radiated Power Density Limits (dBm/MHz)
ΔF = 0	-3
0<ΔF≤5	-3 - 0.5 • ΔF
5<ΔF≤7	- 5.5 - 5 • (ΔF - 5)
7<ΔF	-15.5



Option 2: 5 MHz separation between channels

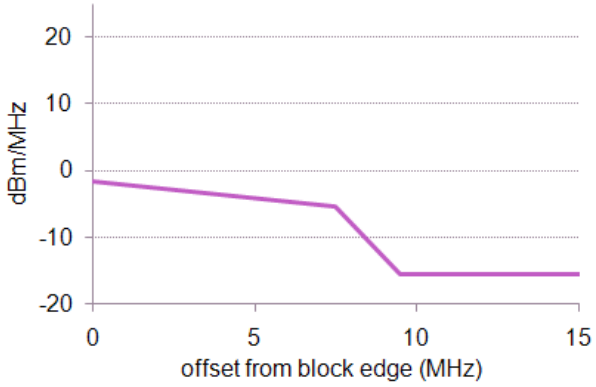
Table A8.11: Background data for Option 2) for block edge mask

Density scenario	Max OOB per 10MHz	Separation between channels	Rounded separation between channels	Location of the 10 MHz channel ETSI mask
Case 3 Medium density	7.6 / 10MHz	2 MHz	5 MHz	Channel centre 7.5 MHz away from the block edge, channel boundary 2.5 MHz away from the block edge

A8.48 A 10 MHz ETSI EN 302 623 channel is located 2.5 MHz away from the block boundary**.** The block edge mask follows the line of the spectrum emission mask from the ETSI EN. The figure below shows the proposed block edge mask and its tabular description

Figure A8.11: Option 2) for terminal BEM out of block EIRP limits – 5 MHz frequency separation between channels

Frequency offset from Block Edge (MHz)	Radiated Power Density Limits (dBm/MHz)
ΔF = 0	-1.75
0<ΔF≤7.5	-1.75 - 0.5 • ΔF
7.5<ΔF≤9.5	- 5.5 - 5 • (ΔF - 7.5)
9.5<ΔF	-15.5



Option 3: No separation between channels

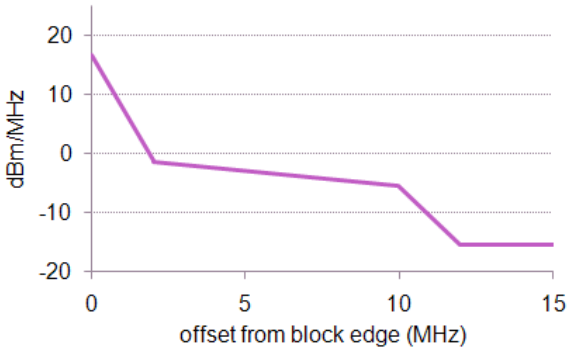
Table A8.12: Background data for Option 3) for block edge mask

Density scenario	Max OOB per 10MHz	Separation between channels	Rounded separation between channels	Location of the 10 MHz channel ETSI mask
Case 4 Low density	14.2 /10MHz	0 MHz	0 MHz	Channel centre 5 MHz away from the block edge, channel boundary by the block edge

A8.49 A 10 MHz ETSI EN 302 623 channel is located adjacent to the block boundary. The block edge mask follows the line of the spectrum emission mask from the ETSI EN. The figure below shows the proposed block edge mask and its tabular description

Figure A8.12: Option 3) for terminal BEM out of block EIRP limits – no frequency separation between channels

Frequency offset from Block Edge (MHz)	Radiated Power Density Limits (dBm/MHz)
ΔF = 0	16.7
0<ΔF≤2	16.7 – 9.1 • ΔF
2<ΔF≤10	-1.5 - 0.5 • (ΔF - 2)
10<ΔF≤12	- 5.5 - 5 • (ΔF - 10)
12<ΔF	-15.5



Annex 9

Glossary

AIP	Administered incentive pricing – setting charges for spectrum holdings to reflect the value of the spectrum in order to promote efficient use of the spectrum
BWA	Broadband Wireless Access – Radiocommunications systems providing wireless delivery (mainly to an end user but not exclusively) of broadband traffic that can encompass fixed (FWA), nomadic (NWA) and mobile (MWA) applications. It is also considered that BWA systems might include backhauling services for the same or a second operator.
CEPT	European Conference of Postal and Telecommunications Administrations
Communications Act	The Communications Act 2003, which sets out Ofcom's powers, functions and duties
Concurrent	(Of *spectrum trading*) a transaction in which rights and obligations are transferred while continuing to be rights and obligations of the transferor, cf *outright*
ECC	Electronic Communications Committee. The CEPT committee dealing with radiocommunications and telecommunications
ENG/OB	Electronic News Gathering / Outside Broadcast
EIRP	Effective isotropic radiated power
ERO	European Radiocommunications Office
FWA	Fixed Wireless Access – Wireless access application in which the location of the end-user termination and the network access point to be connected to the end-user are fixed. For example, a stationary roof-top user equipment
Harmful interference	*Interference* that creates danger or a risk of danger or degrades, obstructs or repeatedly interrupts a transmission or broadcast
Interference	Unwanted disturbance caused in a radio receiver or other electrical circuit by electromagnetic radiation emitted from an external source
ITU	International Telecommunication Union - the United Nations agency for information and communication technology responsible for developing and publishing the *International Radio Regulations*
JFMG	A private sector organisation that has been given delegated powers to grant WT licences for programme-making and special events
Market mechanisms	Approach to managing spectrum where key decisions, eg on acquiring or disposing of spectrum and what service to provide are made by

	spectrum users rather than by the regulator.
MOD	Ministry of Defence
MWA	Mobile Wireless Access – Wireless access application in which the location of the end-user termination is mobile. For example, handheld user terminal
NPIA	National Policing Improvement Agency
NWA	Nomadic Wireless Access – Wireless access application in which the location of the end-user termination may be in different places but it must be stationary while in use. For example, a desk-top portable user equipment or laptop PC equipped with the internal access card
OOB	Out of block (emissions)
Outright	(Of *spectrum trading*) a transaction in which the transferred rights and obligations pass to the transferee and are no longer rights and obligations of the transferor, cf *concurrent*
Partial	(Of *spectrum trading*) a transaction in which some rights and obligations are transferred while others are kept by the transferor, cf *total*
PMSE	Programme Making and Special Events – a class of radio application that supports a wide range of activities in entertainment, broadcasting, news gathering and community events
Radio Regulations	International Radio Regulations made by the *ITU*, which have the status and force of a treaty, allocate frequencies globally to various applications and deal with cross-border *interference*
RF	Radio Frequency
Radio-determination	The determination of the position, velocity and/or other characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of radio waves
RSA	Recognised Spectrum Access - a spectrum management instrument created by the *Communications Act* to complement *WT licences*
Spectrum trading	Ability of spectrum users to transfer rights and obligations under *WT licences* to another person in accordance with regulations made by Ofcom. Trades may be *total*, *partial*, *outright* or *concurrent*
STU	Spectrum trading unit – the smallest quantum of spectrum that may be transferred in a *partial* trade
SUR	Spectrum usage rights – a way of formulating the terms and conditions in a *WT licence* or *RSA* in a way that is independent of technology or service
Total	(Of *spectrum trading*) a transaction in which all of the rights and obligations are transferred from transferor to transferee, cf *partial*

UK FAT	The UK Frequency Allocation Table identifies responsibilities for the management of frequency bands or services and is published by Ofcom
WT Act	The Wireless Telegraphy Act 2006, which sets out the statutory framework for management of the radio spectrum consolidating a number of older Acts dating back to 1949.
WT licence	Licence granted by Ofcom to authorise installation or use of radio equipment as required by section 8(1) of the *WT Act*
WT Register	Register maintained by Ofcom containing information about grant, renewal, transfer, revocation or variation of *WT licences* and *RSA*