# Freedom4 application for licence variation

Consultation

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# Contents

Section 1

# Executive summary

1.1 Freedom4 Limited ('Freedom4') has submitted a request to Ofcom to vary its Wireless Telegraphy Public Fixed Wireless Operator 3.6 to 4.2 GHz licence ('3.6 GHz licence') in two ways:

- to increase the central station maximum power; and
- to remove the requirement to coordinate low-power terminals and allow them to be used for providing mobile services.

1.2 This document assesses Freedom4's request and in doing so:

- provides background information on the 3.6 GHz band and Freedom4's licence;
- sets out Ofcom's statutory and policy framework;
- considers the engineering effects of increased power levels, including the potential for interference to other users;
- considers the implications for the coordination of Freedom4's service with other users in the band; and
- considers Freedom4's request in the light of Ofcom's statutory and other legal duties.

1.3 The main points of our assessment are:

- Freedom4's licence does not limit the technologies it may use but does limit the applications to fixed applications only;
- there appears to be no reason for us to refuse the variation of Freedom4's licence to remove the limitation to fixed applications;
- on power limits, our conclusion is that it is appropriate for us to increase the maximum in-band power level from +14dBW/MHz to +23dBW/MHz (+53dBm/MHz) for central stations and to remove the absolute limit of 22dBW/MHz (EIRP).
- for terminal stations, coordination should not be necessary for those with a spectral density not exceeding 25dBm/MHz and total EIRP not exceeding 30dBm unless a proposed central station is within 100MHz and 2km of a point-to-point link; and
- we note Freedom4's preference not to vary the out of block emission limits in its current licence and consider that by maintaining the current block edge mask there is no change in the interference environment for adjacent services. However with the introduction of mobile terminals there is a need to ensure sufficient separation in frequency from adjacent services. Terminal station out of block emission limits have been proposed to achieve this.

1.4 Our initial view is that the variation should be made as soon as practicable, subject to the outcome of this consultation.

1.5 Ofcom wishes to make clear that it has not reached a decision on these matters and is seeking stakeholders' views on Freedom4's request. It will carefully consider any arguments and comments made in response to this consultation before reaching a final decision.

1.6 We are asking stakeholders to consider the following question when responding to this consultation:

*Are there any reasonable grounds why Ofcom should not grant Freedom4's request to vary its licence as soon as practicable? If so, please explain your reasoning for this.*

## Section 2

# Introduction

2.1 This document consults on Ofcom's consideration of an application from Freedom4 to vary its 3.6 GHz licence. Freedom4 Limited ('Freedom4') submitted a request to Ofcom on 9 December 2008 to vary its licence in two ways:

- to increase the central station maximum power; and
- to remove the requirement to coordinate low-power terminals and allow them to be used for providing mobile services.

2.2 The documents comprising Freedom4's application are at Annex 8

## Ofcom's approach to spectrum management

2.3 Our general approach to spectrum management has been set out in a number of documents, including:

- the Spectrum Framework Review consultation document published in November 2004 ('SFR') and Statement published in June 2005 ('SFR Statement')[1];
- the Spectrum Trading consultation document published in November 2003 ('Trading Consultation Document') and Statement published in August 2004 ('Trading Statement')[2]; and
- the Spectrum Liberalisation consultation document published in September 2004 ('Liberalisation Consultation Document') and Statement published in January 2005 ('Liberalisation Statement')[3].

## Implementation of Ofcom's liberalisation policy

2.4 We are implementing a policy of liberalisation in the following ways:

- publishing a list of specific licence variations that are considered to be intrinsically unproblematic and to which we would therefore normally expect to be able to agree;
- varying individual licences following requests for change of use from licensees;
- varying some entire classes of existing licences to make them less usage and technology specific;
- publishing guidance for licensees about the levels of interference which they might tolerate and which will be a key criterion in deciding whether or not to allow the removal or reduction of restrictions.

[1] http://www.ofcom.org.uk/consult/condocs/sfr
[2] http://www.ofcom.org.uk/consult/condocs/spec_trad/
[3] http://www.ofcom.org.uk/consult/condocs/liberalisation

2.5 In the Spectrum Liberalisation Guidance Notes[4] we provided information on the procedures for reducing or removing licence restrictions on spectrum use. We said that some requests for complex or novel variations might require detailed analysis, consultation with third parties and international co-ordination. In some cases we may find that liberalisation raises concerns about efficiency and competition that need to be addressed through regulatory intervention.

2.6 It should be noted that following consultation in June 2007 we granted a variation request from the 3.5GHz operator UK Broadband[5], the technical aspects of which were similar to Freedom4's request.

## Matters covered in this document

2.7 This document is structured as follows:

- Section 3 sets out background to the 3.6-4.2 GHz band and the Freedom4 licence, including the licence fee;
- Section 4 sets out our statutory duties and explains our approach to spectrum liberalisation and the variation of licences;
- Section 5 sets out the licence variation that Freedom4 has requested, the engineering effects that would follow from making the variation, including the potential for interference to other users, and sets out our conclusions on the engineering effects of the requested changes to Freedom4's;
- Section 6 sets out our assessment against its statutory and other legal duties of the variation of Freeedom4's licence to make it application neutral and to permit a higher in-band power level;
- The annexes include a copy of Freedom4's licence, the proposed changes to it if the variation is made, an impact assessment and a copy of Freedom4's application[6].

[4] http://www.ofcom.org.uk/radiocomms/ifi/trading/libguide/
[5] http://www.ofcom.org.uk/consult/condocs/bb_application/
[6] Annex 3 'Market Analysis' which contains company and market-sensitive information is confidential and is not published.

**Section 3**

# Background information on the 3.6 GHz frequency band and Freedom4's licence

3.1 This section describes the regulatory position on the 3.6 GHz band (3.6 to 4.2 GHz), part of which Freedom4 is licensed to use and the main features of Freedom4's licence including the licence fee.

## 3.6 GHz band – international and UK regulatory position

3.2 In ITU Region 1, which includes Europe, the frequency bands 3.4 to 3.6 GHz and 3.6 to 3.8 GHz are allocated to the fixed service and to the fixed-satellite service (space-to-Earth) on a primary basis and to the mobile service on a secondary basis. The revised European Common Allocation Table (ECA), which was agreed at the May 2007 meeting of ECC Working Group Frequency Management (WG FM), shows that the frequency band 3.4 to 3.8 GHz is also allocated on a primary basis to the mobile service. The ECA, as revised, indicates that the major co-primary use of the 3.5 GHz band (3.4 to 3.6 GHz) is for broadband wireless access ("BWA") and co-ordinated programme making and special events applications for occasional use.

3.3 The background to this is that in 1998 the 3.5 GHz band was identified as a preferred frequency band for fixed wireless access (see ERC/REC13-04 and ERC/REC14-03)[7].

3.4 The 3.4 to 3.8 GHz band is one of those being considered within the European Union's 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 European Union 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. In July 2006 the European Commission issued a mandate to CEPT to develop least restrictive technical conditions for the relevant bands and to report by 29 July 2007.

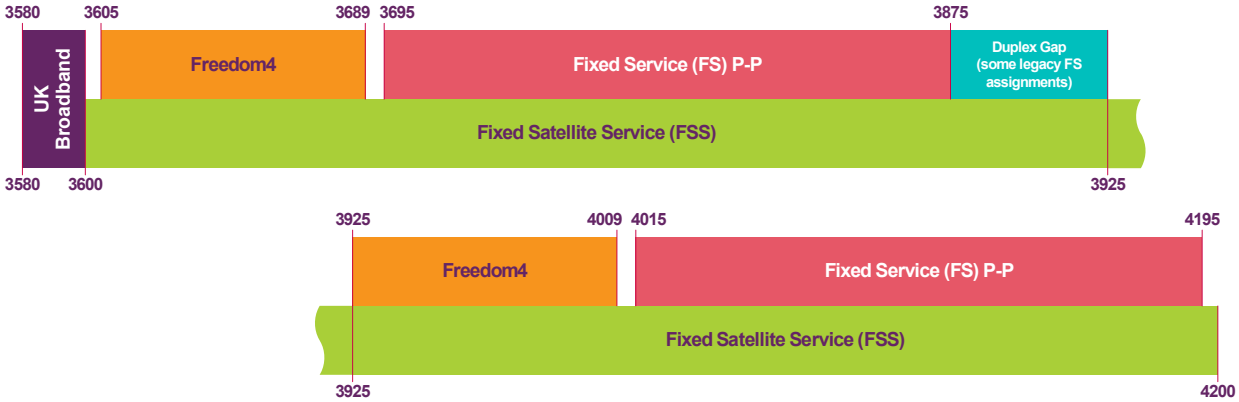
3.5 In March 2007 the Electronic Communications Committee adopted a Decision (ECC/DEC/(07)02[8]) that designated the spectrum within the band 3.4 to 3.6 GHz and/or 3.6 to 3.8 GHz for BWA deployment, subject to market demand and with due consideration of other services deployed in these bands. The Decision says that administrations shall consider allowing flexible usage modes within authorised BWA deployments in these frequency bands, taking into account the considerations in the Annex to the Decision. 'Flexible usage modes' means licence conditions that allow the deployment of various types of terminal stations – fixed, nomadic or mobile.

[7] http://www.ero.dk/documentation/docs/doc98/official/Word/REC1304E.DOC; http://www.ero.dk/documentation/docs/doc98/official/Word/REC1403E.DOC

[8] ECC Decision of 30 March 2007 on availability of frequency bands between 3400-3800 MHz for the harmonised implementation of Broadband Wireless Access systems (BWA)(ECC/DEC/(07)02) see http://www.ero.dk/documentation/docs/doc98/official/Word/ECCDEC0702.DOC?frames=0

3.6 On 21 May 2008 the European Commission published its Decision 2008/411/EC ("the Decision") on the harmonisation of the 3.4 to 3.8 GHz bands for Electronic Communication Services[9]. The Decision requires implementation of the band 3.4 to 3.6 GHz within 6 months of publication and implementation for the band 3.6 to 3.8 GHz by 1 January 2012. The UK implemented the Decision through The 3400-3800 MHz Frequency Band (Management) Regulations 2008 (S.I. 2008/2794). Our position is that the UK is already compliant with both conditions as we have licensed operators in both bands and through our policy of liberalisation to service and technology neutrality, we can facilitate the implementation of the technical requirements of the Decision, without prejudice to incumbent services.

**Figure 1. Existing band arrangement (frequencies shown in MHz)**




## Freedom4's licence

3.7 In 2003, Pipex Communications acquired the company GX Networks which at that time held a Wireless Telegraphy Act licence for 2 x 84 MHz of spectrum in the bands 3.6 to 4.2 GHz. GX Networks was the last in a succession of companies that had held the spectrum licence since it was initially granted in 1992 by the Radiocommunications Agency. Most had trialled Fixed Wireless Access technology but had not developed commercial services in the band.

3.8 The licence authorises the establishment, installation and use of Public Fixed Wireless Access transceivers, within the UK[10]. End-user terminals which are included as part of the licensed Radio Equipment are limited to customer premises equipment. The licence also stipulates a maximum eirp of +14 dBW/MHz, though the Interface Requirement (IR 2015) with which the licensed equipment must comply says that +21 dBW/MHz may be considered on a case-by-case basis (e.g. for backhaul purposes using narrow beam antennas).

[9] While the frequencies licensed to Feedom4 are in the range 3.6GHz to 4.2 GHz, only the lower block (3605MHz to 3689MHz) falls within the band below 3.8GHz considered in the EC Decision. It is this block that will, initially at least, be capable of supporting WiMAX services. Noting the upper block (3925MHz to 4009MHz) is also subject to coordination with existing users, it may be convenient to apply the same power and out of band emissions criteria for both blocks.

[10] not including any of the Channel Islands nor the Isle of Man.

3.9 In 2004 Ofcom agreed a request from Pipex to partially liberalise the licence by removing technical restrictions that limited use to FDD systems. This was consistent with our principles of liberalisation and technology neutrality, implementing the package of EC Communications Directives, and permitted Pipex to develop WiMAX technology and to roll out trial networks. In October 2007, Pipex re-branded as Freedom4 Limited.

3.10 A copy of Freedom4's current licence is at Annex 6 and a draft of revised terms if the variation is granted is at Annex 7.

## Licence Fee

3.11 The licence is for an indefinite term subject to annual payment of a spectrum fee, currently £821,088 p.a. The fee was set under the Radiocommunications Agency's programme of introducing Administered Incentive Pricing (AIP) and based on an estimate of the opportunity cost of the spectrum, with allowance for the sharing and coordination obligations of this spectrum band.

3.12 Although recognising factors which at that time impeded development of the licensed service or effective use of the spectrum, the fee has nonetheless been held at this level since 2003 and has not been re-assessed since. Freedom4 (and its predecessor companies) has therefore been obliged to continue paying the annual spectrum fee at this rate in order to retain the licensed rights to use of the spectrum.

3.13 We intend to consult during 2009 on a Strategic Review of Spectrum Pricing[11] which will examine the principles upon which spectrum is valued and how AIP levels should be calculated. We propose to use the output of this exercise to review how the fee level is calculated and if appropriate to propose a revised level of AIP for the spectrum used by Freedom4 at a subsequent consultation on Ofcom's Wireless Telegraphy charging regulations.

[11] See http://www.ofcom.org.uk/radiocomms/ifi/srsp/

## Section 4

# Ofcom's duties and functions and spectrum liberalisation

4.1 This section provides a brief overview of the main UK and European legislative provisions relevant to wireless telegraphy licensing and to the requested variation. It does not provide a comprehensive statement of all legal provisions which may be relevant to our functions and to wireless telegraphy licensing.

4.2 This section also explains our approach to spectrum liberalisation.

## Ofcom's general duties

4.3 Section 3 of the Communications Act 2003 (the '2003 Act') states the general duties of Ofcom. Under section 3(1) 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.Z

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

- the optimal use for wireless telegraphy of the electro-magnetic spectrum;
- the availability throughout the UK of a wide range of services;
- the availability throughout the UK of a wide range of TV and radio services which (taken as a whole) are both of high quality and calculated to appeal to a variety of tastes and interests;
- the maintenance of a sufficient plurality of providers of different television and radio services; and
- the application in the case of all television and radio services of standards that provide adequate protection to members of the public from the inclusion of offensive and harmful material, unfair treatment in programmes and unwarranted infringement of privacy;

and we are require to have regard to certain matters which include:

- principles of better regulation (section 3(3));
- the desirability of promoting competition (section 3(4)(b));
- the desirability of encouraging investment and innovation (section 3(4)(d));
- the desirability of encouraging availability and use of broadband services throughout the UK (section 3(4)(e));

- the different needs and interests of persons in different parts of the UK (section 3(4)(l)).

4.4 The management of the UK radio spectrum is governed by the European Communications Directives, which aims to harmonise the regulation of electronic communications networks and services throughout the European Union. Section 4 of the 2003 Act requires us when carrying out our spectrum functions to act in accordance with the 'six community requirements' set out in that section when managing the wireless spectrum in the UK:

- the requirement to promote competition (section 4(3));
- the requirement to secure that our activities contribute to the development of the European internal market (section 4(4));
- the requirement to promote the interests of all persons who are citizens of the European Union (section 4(5));
- the requirement to act in a technology neutral way (section 4(6));
- the requirement to encourage to such extent as appropriate the provision of network access and service interoperability (section 4(7)); and
- the requirement to encourage such compliance with international standards as is necessary for (a) facilitating service interoperability; and (b) securing freedom of choice for the customers of communications providers (sections 4(9) and (10)).

## Ofcom's duties when carrying out spectrum functions

4.5 In carrying out its spectrum functions it is the duty of Ofcom (under section 3 of the Wireless Telegraphy Act 2006 (the '2006 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.

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.

4.6 Where it appears to us that any of its duties in section 3 of the 2006 Act conflict with one or more of its general duties under sections 3 to 6 of the 2003 Act, priority must be given to its duties under the 2003 Act.

## Ofcom's spectrum functions

4.7 Ofcom's powers to carry out these functions are set out in the 2006 Act. In summary we have the following powers:

- section 8(1) of the 2006 Act gives us the power to grant licences to establish or use a wireless telegraphy station and to install or use wireless telegraphy apparatus. We have a general discretion under this provision to decide how to award a licence, including for example whether to use an auction mechanism (provisions in respect of which are set out in section 14 of the Act);

- section 9 of the 2006 Act gives us the power to grant wireless telegraphy licences subject to such terms as we think fit; and

- schedule 1(6) of the 2006 Act gives us a general discretion to revoke or vary any wireless telegraphy licences by serving a notice in writing on the licence holder or by way of general notice to licensees in a class.

4.8 We have a duty (set out section 9(7) of the 2006 Act which reflects article 6 of the EU Authorisation Directive 2002/20/EC) to ensure that wireless telegraphy licence conditions are objectively justified in relation to networks and services to which they relate, non-discriminatory, proportionate and transparent. We consider that this obligation is ongoing and must be assessed against market circumstances and the state of technology development at the time.

4.9 We therefore have broad discretion under Schedule 1(6) of the 2006 Act to agree to vary licences but legal rules operate to limit that discretion. These legal rules include the following, in summary:

- UK obligations under European law or international agreements where use of spectrum has been harmonised: we will not agree to remove restrictions from licences or other changes that would conflict with the UK's obligations under international law. This includes changes in use or technology that would contravene binding Community measures, such as directives or harmonisation measures adopted under the Radio Spectrum Decision (676/2002/EC) and ITU Radio Regulations;

- we must comply with any direction from the Secretary of State under section 5 of the 2003 Act and section 5 of the 2006 Act;

- we must act in accordance with its statutory duties, including the duty to ensure optimal use of the spectrum, the duty mentioned in paragraph 4.7 and obligations under the European Authorisation Directive (2002/20/EC); and

- general legal principles, which include the duties to act reasonably and rationally when making decisions and to take account of legitimate expectations.

## Spectrum liberalisation

4.10 The radio spectrum is a finite resource of considerable economic and social value. Where possible we are moving to market-based mechanisms, including trading, liberalisation and spectrum pricing, which empower spectrum users to take more decisions on spectrum. We believe that this is likely to lead to optimal use of the radio spectrum.

4.11 Liberalisation, the removal or reduction of restrictions in licences, is central to this approach to spectrum management. Together with incentive pricing, auctions and spectrum trading, it makes spectrum available on a more flexible and dynamic basis for new wireless applications. It is also consistent with our aim to deregulate or simplify regulation wherever possible.

4.12 The Liberalisation Consultation Document made clear that we have no intention of allowing an interference free-for-all to develop and would continue to investigate and resolve interference, although users would be expected to assume greater responsibility for planning their use of spectrum in accordance with the enhanced freedom that liberalisation would give them. The Liberalisation Consultation Document also explained the other constraints within which liberalisation would operate, including the legal rules described above that limit our discretion to vary licences.

4.13 In considering requests for the variation of individual licences the factors that we will take into account include:

- impact on spectrum users in adjacent bands;
- benefits for consumers and citizens;
- optimal spectrum use;
- impact on competition;
- objective justification for licence conditions; and
- legal considerations that limit our discretion to vary licence conditions.

## Section 5

# Freedom4's licence variation request and potential engineering effects

5.1 This section explains the licence variation that Freedom4 has requested, the engineering effects that would follow from making the variation, including the potential for interference to other users, and sets out our conclusions on the engineering effects of the requested changes to Freedom4's licence.

## Freedom4's request

5.2 Freedom4's 3.6 GHz licence authorises it to establish, install and use radio transmitting and receiving stations and/or radio apparatus as described in the licence schedule (the 'Radio Equipment'). The schedule describes the Radio Equipment as Public Fixed Wireless Access transceivers including Access Point Transceivers (known as Hub Stations, Central Stations and Base Stations), Customer Premises Equipment (known also as Terminal Stations) and Radio Relay Repeaters forming part of the network. Such equipment is for transmission between fixed points, i.e. for fixed applications.

5.3 The licence does not impose any limitation on the technology that the Licensee may use. Paragraph 7 of the licence schedule stipulates that the Licensee shall ensure that the Radio Equipment conforms to a maximum EIRP limit of +14 dBW/MHz. Paragraph 8 defines a spectrum mask for the out of block emission from the Radio Equipment such that:

| Frequency offset measured from the edges of the frequency bands specified in 7(a) and 7(b) | Maximum radiated spectral power density EIRP (dBW/MHz) |
|---|---|
| -1.0 to 0.0 MHz | 14 |
| 0.0 to 0.6 MHz | $14 – (41.6 \times \Delta_{F1})$* |
| 0.6 to 1.0 MHz | -11 |
| 1.0 to 2.0 MHz | $9 – (20 \times \Delta_{F2})$** |
| 2.0 to 4.0 MHz | -31 |
| 4.0 MHz and above | -31 |

* Note: $\Delta_{F1}$ is the frequency offset from 0.0 MHz to 0.6 MHz from the band edge of the relevant Permitted Frequency Band.
** Note: $\Delta_{F2}$ is the frequency offset from 1.0 MHz to 2.0 MHz from the band edge of the relevant Permitted Frequency Band.

5.4 Freedom4 has asked for the following amendments to their licence:

- to increase the maximum radiated spectral power density (EIRP) for central stations from 14dBW/MHz to 23dBW/MHz (53dBm/MHz), and remove the absolute limit of 22dBW (EIRP);
- to remove the requirement to coordinate and maintain address information for terminal stations with a power spectral density not exceeding 25dBm/MHz and a total EIRP not exceeding 30dBm;
- to allow mobility of terminal stations; and
- for the variation to be applied to both of Freedom4's spectrum blocks.

Freedom 4 is not seeking any change to the requirement to coordinate central stations and terminal stations over 25dBm/MHz or over 30dBm total EIRP, to the coordination process, or to the out of block emissions mask.

A copy of Freedom4's variation request is at Annex 8.

## Engineering effects for Freedom4 of the requested licence amendments

5.5 The licence variation that Freedom4 has requested would allow it to operate in a number of ways that are currently prevented by the conditions in its licence:

- The variation of the description of authorised radio equipment would mean that Freedom4 would not be limited to providing connections to fixed locations, and in particular to customer premises. It could provide connections to portable or mobile terminals, as well as to fixed locations, anywhere within the UK.
- The increased in-band EIRP limit would enable Freedom4 base stations to serve portable or mobile terminals. In the absence of the higher permitted power mobile and portable terminal equipment would not perform as well as traditional FWA terminal equipment; the receivers are less sensitive and the antennas have a lower performance. A higher power is needed to deliver an acceptable level of service.
- The increased power limit would also reduce the number of base stations required to serve a given number of customers within a given coverage area.

## Engineering effects for others

5.6 We have said that we would not normally expect to grant a request to vary a licence if the change would reduce the estimated spectrum quality of neighbouring assignments below the spectrum quality benchmark based on current spectrum planning assumptions. We have considered whether the variations to Freedom4's licence described above would result in the unacceptable reduction in the quality of spectrum use enjoyed by other authorised spectrum users.

5.7 The users who may be affected by the variation are those who are spectrally adjacent to the spectrum licensed to Freedom4, i.e. UK Broadband which is assigned spectrum in the frequency range 3500 to 3580 MHz, and satellite earth stations and fixed point-point links within and above the frequencies licensed to Freedom4.

## Technology and application neutrality

5.8 As explained in paragraph 5.3, in fact the licence does not impose a limitation on what technology the licensee may use, and so it does not require amendment to deploy a WiMAX network. When we agreed to Pipex's liberalisation request in 2004, although Pipex had asked specifically to be allowed the use of WiMAX, we felt that for consistency with our liberalisation policy, the appropriate way to achieve that was to make the licence technology neutral.

5.9 Freedom4's licence would need amendment to make it application neutral. A suitable amendment would mean that the licensee would not be restricted to providing fixed applications only. In order to effect this amendment the Radio Equipment described in the schedule would need to encompass any radio transmitting and receiving stations and/or any radio apparatus.

## Maximum EIRP limits

5.10 The requested central station and terminal station EIRPs of 53dBm/MHz and 25dBm/MHz respectively are referenced from the Commission Decision (2008/411/EC) ("the Decision").

### E.i.r.p. spectral density limits for mobile deployments between 3 400 and 3 800 MHz (2008/411/EC Annex, Table 2)

| Station type | Maximum e.i.r.p. spectral density (dBm/MHz) (Minimum ATPC range: 15 dB) |
|---|---|
| Central station | + 53 ([1]) |
| Terminal station | + 25 |
| ([1]) The central station e.i.r.p. spectral density value given in the table is considered suitable for conventional 90 degrees sectorial antennas. | |

5.11 This change of EIRP limits would bring the licence into line with other similar licenses in the 3.4-3.8GHz band in Europe.

5.12 An increase in power at the central station or other high power fixed terminal stations will impact other services sharing the spectrum however the co-ordination requirement on these stations will remain unchanged and therefore the current level of protection to sharing services will be maintained.

5.13 Although Freedom4's upper spectrum block is above the frequencies that are subject of the Decision, the ongoing coordination requirement is again unchanged and we propose to apply the powerlimits consistently in both blocks.

## Removal of the co-ordination requirement for stations with a power spectral density not exceeding 25dBm/MHz

5.14 The impact of the removal of the co-ordination for mobile terminals has been assessed for satellite earth stations and fixed point-point links within and above the frequencies services sharing the band licensed to Freedom4 which are currently considered when new Freedom4 deployments are co-ordinated.

5.15 In Annex 7 - Compatibility of WiMAX with FSS - of their variation request Freedom4 provided analysis that concluded it is the central station not the low power terminal stations that is the dominant source of interference into a satellite earth station. This analysis is consistent with a UK paper submitted to ITU-R Working Party 4A in April 2008 (Document 4A/39-E).

5.16 In relation to co-ordination with satellite earth stations sharing the band we believe that as long as central stations and other high power terminal stations are co-ordinated there is no requirement for the co-ordination of terminal stations with a power spectral density not exceeding 25dBm/MHz and a total EIRP not exceeding 30dBm.

5.17 Ofcom has undertaken detailed analysis of the impact of terminal stations on existing fixed point-to-point assignments in the 4 GHz band (3.6-4.2 GHz). This analysis which is at Annex 9 concluded that there are areas where terminal stations operating to co-ordinated base stations could give rise to interference. These areas generally fall along the boresight of the point-to-point link and are dependent on the technical configuration of the link and its environment.

5.18 In order to protect fixed links receivers, an exclusion zone of 2 km around the fixed link path will be applied for central stations, meaning that for central stations deployed beyond that limit coordination of terminal stations will not be necessary providing that the base station has been coordinated using current technical parameters.

5.19 It is possible that central stations could be deployed within these zones but only after detailed co-ordination to ensure that the terminal stations will not give rise to interference.

## Limits for out-of-block emissions

5.20 In considering the conditions for limiting out-of-block emissions, we note that Freedom4 has a guardband at either end of its spectrum blocks which, although not a part of Freedom4's licensed spectrum, may be taken into account when calculating how the limits should be applied. The proposals below for Freedom4's situation are therefore a specific arrangement in this band which are without prejudice to future consideration by Ofcom of any other bands or services in the setting of emission limits generally.

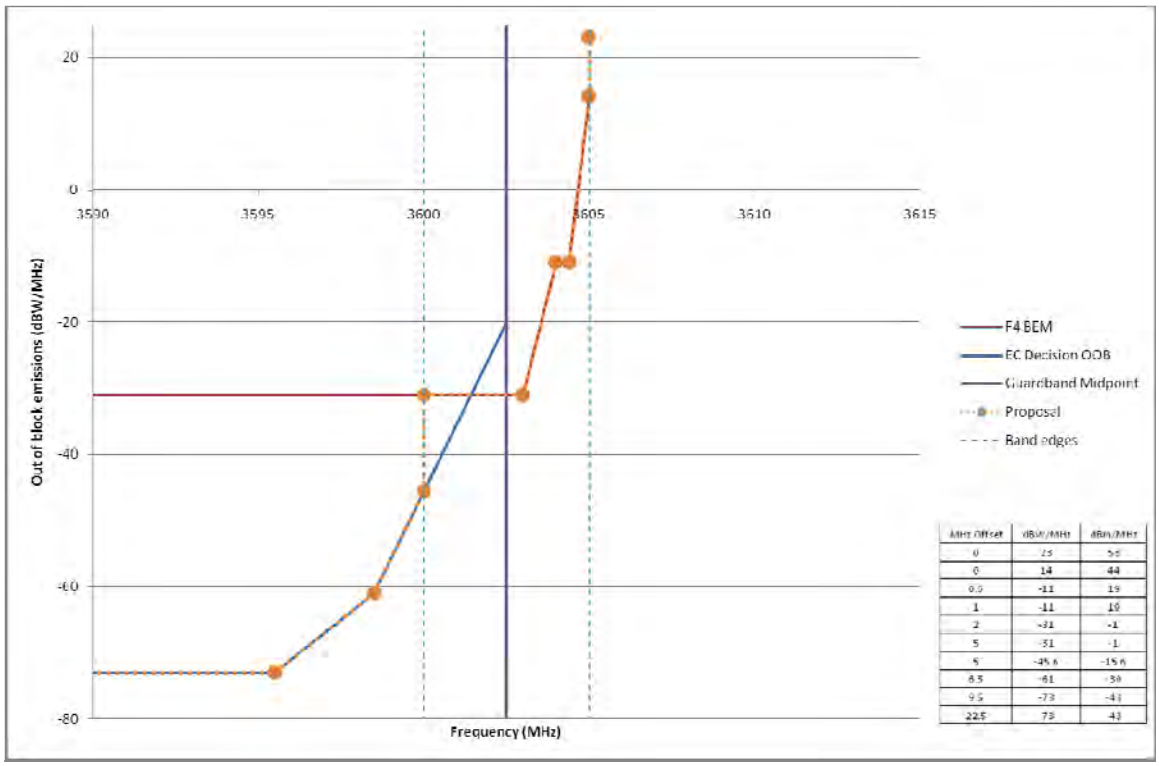
5.21 Limits for out-of-block emissions have been specified for central stations by Decision 2008/411/EC ("the Decision"). Freedom4 has requested to retain the block edge mask contained in the technical conditions of its current licence. It maintains that it has current equipment coordinated and deployed in the band that would not meet the Decision's mask and that the cost of replacing these would be prohibitive.

5.22 In assessing this aspect of Freedom4's request we note that by granting a variation to permit mobility there is a change from the current interference environment as this may lead to a higher density of deployment than at present which would increase the power being transmitted into the adjacent spectrum block. With the current out-of-block emissions this would lead to a greater impact on neighbouring spectrum users even with the current guardbands in place.

5.23 The Decision applies to adjacent frequency allocations for BWA services. It says that less stringent technical parameters can be used if agreed among the operators of neighbouring networks. Freedom4 currently have no directly adjacent BWA neighbours and there are guardbands at each end of their spectrum block.

## Equipment operating at powers above 25dBm/MHz

5.24 We propose that the current out-of-block emissions should continue to apply to equipment deployed before the implementation date of the Decision for the 3.6 to 3.8 GHz band. From 1st January 2012 the following out-of-block limits that have been derived from the Decision should apply to new installations, except where agreement is reached locally with other users.




| MHz Offset | dBW/MHz | dBm/MHz |
|---|---|---|
| 0 | -25 | -55 |
| 0 | -14 | -44 |
| 0.9 | -11 | -19 |
| 1 | -11 | -19 |
| 2 | -31 | -1 |
| 5 | -31 | -1 |
| 5 | -45.6 | -15.6 |
| 8.5 | -61 | -30 |
| 9.5 | -73 | -43 |
| 22.5 | -73 | -43 |

| MHz Offset from band edge | Maximum radiated spectral power density EIRP (dBm/MHz) |
|---|---|
| 0 | 53 |
| 0 | 44 |
| 0 < Δf < 0.6 | 44 – 41.67*Δf |
| 0.6 | 19 |
| 1 | 19 |
| 1 < Δf < 2 | 19 - 20*(Δf - 1) |
| 2 | -1 |
| 2 < Δf < 5 | -1 – 4.87*(Δf - 2) |
| 5 | -15.6 |
| 5 | -30 |
| 5 < Δf < 9.5 | -30 – 2.89*(Δf - 5) |
| ≥ 9.5 | -43 |

## Radio Equipment operating at powers up to 25dBm/MHz

5.25 If the out-of-block emission limits within the Decision are not to be applied until 5 MHz from the band edge the possibility of terminal to terminal station interference into a neighbouring operator needs to be guarded against. ECC/DEC/(07)02 states that “care should be taken not to allow a TS transmit centre frequency closer than one channel width from the block edge unless co-ordination between operators is undertaken” which is taken into account in the Decision block edge mask. Terminal separation needs to be ensured which can be done using a terminal block edge mask.

5.26 We consider that in order to protect neighbouring users the following out of block emission limits, derived from the terminal station mask in EN 302 623, should apply to terminal stations.

| MHz Offset from band edge | Maximum radiated spectral power density EIRP (dBm/MHz) |
|---|---|
| 0 | 13.7 |
| 0 < Δf < 1 | 13.7 - 15*Δf |
| 1 | -1.3 |
| 1 < Δf < 2.5 | -1.3 - 1.27*(Δf - 1) |
| 2.5 | -3.2 |
| 2.5 < Δf < 7.5 | -3.2 - 0.46*(Δf - 2.5) |
| 7.5 | -5.5 |
| 7.5 < Δf < 9.5 | -5.5 - 5*(Δf - 7.5) |
| ≥ 9.5 | -15.5 |

## Coordination of base stations

5.27 Currently, for base stations that have been installed by Freedom4, co-ordination with fixed links in adjacent spectrum and satellite earth stations within its band has been conducted by proposed new Freedom4 assignments being submitted by Freedom4 to Ofcom, which are then evaluated against the locations of existing installations using a propagation software tool. This will continue, pending a review of the co-ordination approach.

5.28 This review will consider how best to help Freedom4 plan their network effectively which should reduce the current administrative burden both on them and Ofcom in clearing new assignment proposals.

5.29 As well as coordinating Freedom4 assignments against incumbent fixed links and earth stations, it will be necessary to assess Freedom4's network of stations in the event of any new proposals for fixed links or earth stations.

5.30 In light of this, Freedom4 has requested that assignment data for other services be made available to it in order to plan more effectively the sites it submits to us for coordination. Freedom4 has said that it will make available its own rollout data for similar reciprocal coordination.

5.31 We are considering the request for data and the ongoing coordination approach separately from this licence variation request as a part of the review of co-ordination.

## Conclusions on the engineering effects of increasing the power levels in Freedom4's licence

5.32 In summary we consider that:

- the +53 dBm/MHz requested is appropriate for the in-block EIRP for all stations (except for mobile terminals),
- mobile terminals should have a maximum EIRP figure of +25 dBm/MHz.
- permitting mobile terminals will not lead to any adverse effects on other spectrum users, and

the changes to the power limits in Freedom4's licence would not reduce the estimated spectrum quality of other authorised spectrum users.

5.33 We consider that it is appropriate to maintain the current out of block emission limits (block edge mask) for central and high power fixed terminal stations in Freedom4's licence until 1st January 2012, after which the out-of-block limits that have been derived from the Decision (described in 5.23 above) should apply to new installations, except where agreement is reached locally with other users.

5.34 We consider that the out of block emission limits described in 5.25 above should apply to terminal stations.

| MHz Offset from band edge | Maximum radiated spectral power density EIRP (dBm/MHz) |
|---|---|
| 0 | 13.7 |
| 0 < ∆f < 1 | 13.7 - 15*∆f |
| 1 | -1.3 |
| 1 < ∆f < 2.5 | -1.3 - 1.27*(∆f - 1) |
| 2.5 | -3.2 |
| 2.5 < ∆f < 7.5 | -3.2 - 0.46*(∆f - 2.5) |
| 7.5 | -5.5 |
| 7.5 < ∆f < 9.5 | -5.5 - 5*(∆f - 7.5) |
| ≥ 9.5 | -15.5 |

5.35 Freedom4's existing licence is shown at Annex 6 and the proposed varied licence at Annex 7.

Section 6

# Assessment of Freedom4's request for a licence variation

6.1 This section sets out our assessment, in the light of our statutory and other legal duties, of granting Freedom4's request for a licence variation by removing the limitation to fixed applications and increasing the power limit for all stations except mobile terminals. We have examined in particular the effects on consumers' interests, the optimal use of the spectrum, competition related issues, the requirement to ensure that licence conditions are objectively justified and other legal considerations. We also examine the timing of the variation. Our conclusion is that there appears to be no reason to refuse a variation of Freedom4's licence that would remove the limitation to fixed applications and increase the maximum in-block power level. We consider that the variation should be made as soon as practicable, subject to the outcome of this consultation.

## Potential benefits for consumers and the UK economy

6.2 Broadband is becoming an integral part of the UK communications landscape, a source of everyday communication, information and entertainment in many homes and central to the strategic plans of many communications service providers. This was a key finding in Ofcom's Digital Progress Report published in April 2007, which provided a comprehensive overview of recent trends in the broadband industry and consumer use of broadband[12]. Our Communications Market report for 2008[13] found a growing interest in mobile broadband: the base of consumers adopting this means of internet connectivity was small but it was growing fast; and, in the past year mobile operators had entered the broadband market, with USB dongle based consumer services. 'Digital Britain'[14] published in January 2009 by BERR sets out the Government's commitment to promote the widespread development of mobile broadband services. Market research undertaken on Ofcom's behalf for the Digital Dividend Review[15] indicated that consumers thought that mobile broadband access would benefit themselves and businesses. Mobile broadband was perceived as potentially having additional value to society, because of the range of opportunities it offered compared to other services tested and the value it might have to businesses.

6.3 Freedom4's introduction of new broadband services could create benefits for consumers. Early development of Freedom4's new broadband services should take place in a period over which consumers will have access to similar services from a limited number of other spectrum operators. Over this period Freedom4 would be enabled to bring to the market innovative services, which could enhance consumer welfare by creating the conditions for an enriched and more innovative range of products to be made available in the market earlier than otherwise. If these new services are seen as substitutes of existing services by consumers, there would still be benefits from innovation in technology and services arising from the granting of the licence variation. However, the benefits from Freedom4's new services may arise mainly from the additional competition exerted on the comparable offer from other broadband providers.

[12] http://www.ofcom.org.uk/research/cm/broadband_rpt/
[13] http://www.ofcom.org.uk/research/cm/cmr08/cmr08_1.pdf
[14] http://www.berr.gov.uk/whatwedo/sectors/digitalbritain/index.html
[15] http://www.ofcom.org.uk/consult/condocs/ddr/mktresearch/

6.4 We consider that granting a licence variation as soon as practicable in 2009 will maximise the potential for benefits linked to Freedom4's position in bringing innovative services to the market. The launch of Freedom4's new broadband services is likely to increase consumer awareness of mobile and nomadic broadband services and foster an improved understanding of the applications of recently developed technologies. This increased awareness and understanding is likely to contribute to a further increase in consumer take-up of these services, including services by other operators entering the market. The new Freedom4 services could therefore help stimulate further the development and innovation of wireless broadband services in the UK. This is consistent with the views we expressed in recent consultation documents regarding the use of 470-862MHz[16] and 2.6 GHz[17].

6.5 For these reasons, we have concluded that the licence variation would facilitate the creation of benefits to consumers.

## Optimal use of spectrum

6.6 Freedom4's licence is technology neutral and so it is not prevented from adopting new technologies, so long as these are operated within the technical restrictions in the licence. In order to exploit the advantages of emerging technologies, in particular the mobile functionality within the WiMAX protocol 802.16e that it has indicated it wishes to use, Freedom4 requests higher transmit powers to achieve the coverage and data transmission rates it desires.

6.7 Freedom4 is currently restricted to operating public fixed wireless access equipment, as described in its licence, which includes end user terminals located at customer premises. So far, it has launched commercial broadband access service in Manchester, Warwick and Milton Keynes. Whatever the success of this service and the future expansion of Freedom4's coverage area, the use that Freedom4 may make of the spectrum licensed to it is inherently restricted by its licence conditions. If the restrictions were varied Freedom4 could continue to provide its current service to end user premises but it would also be able to provide services to nomadic and mobile users. The provision of these new services, on top of Freedom4's current offering, would lead to a more effective use of the spectrum.

6.8 The licence variation would allow Freedom4 to respond dynamically to changing circumstances and offer other new services without being restricted to offering a fixed service to customer premises. The ability to provide broadband wireless access to mobile devices would allow Freedom4 to access new markets, and therefore generate benefits to a wider range of users. In doing so, this would involve a more efficient use of the spectrum.

## Impact on competition

6.9 We consider that by removing unnecessary constraints on the competitive process, spectrum liberalisation should be highly beneficial to competition. Freedom4's introduction of new broadband services would be likely to strengthen competition in the provision of such services. Making the licence variation could have a positive

[16] See for example Ofcom's consultation document: "Digital Dividend Review" at paragraph 8.24 "Ofcom's starting position is that any delay in making available spectrum for new uses risks a loss of consumer benefits as a result of consequent delays to the availability of new services, or to reductions in prices from increased competition;".
[17] Ofcom consultation on the "Award of available spectrum: 2500-2690 MHz, 2010-2025 MHz and 2290-2300 MHz," at paragraph 6.24.

impact on competition through new entry in markets where Freedom4 does not currently operate. It could also lead to more competition in product quality and create a wider range of services in markets where Freedom4 already operates. In either case, the launch of new services or the increased number of market players generally would intensify the competitive process, which ultimately would be to the benefit of consumers.

6.10 However, we acknowledge that there might also be circumstances in which liberalisation could weaken competition. For this reason we have carried out an analysis of the dynamics of competition in downstream markets where Freedom4 may operate if the variation were granted.

6.11 Given that we have already established a suitable framework for analysing the competitive impacts of UK Broadband's similar licence variation request[18] we propose to retain this framework in considering the current application. This analysis is set out in more detail below, and it shows that such a variation is likely to boost competition and thereby benefit consumers. It also shows that the potential for a negative impact on the competitive process is very limited.

6.12 Since Freedom4 has requested a licence variation that will allow it to provide services to nomadic and mobile users, as well as to customer premises, it is feasible that there will be a number of downstream services that will be affected by the request. We understand that Freedom4 will probably continue to operate in the provision of retail wireless broadband access services (fixed and mobile), bringing a new range of services to this market, and also seek to enter markets where it is currently not operating, for example the deployment of mobility elements of its chosen WiMAX standard.

6.13 As 3.6 GHz spectrum could be used to provide a number of downstream services, there is a broad range of potential economic markets which are relevant to this licence variation application. It is not therefore possible or relevant to define the precise boundaries of the relevant markets as that would rely on speculation about how broadband markets will develop. In particular, we consider that it is relevant to undertake analysis by reference to the same set of candidate markets analysed in relation to the earlier licence variation request by UK Broadband. In undertaking this exercise, it does not appear necessary for us to come to a firm view of the precise boundaries of all the relevant economic markets as we can assess the potential impacts on competition through the construct of a number of candidate markets. In particular, we have defined these candidate markets as follows:

- broadband access – a market which includes all broadband access, where Freedom4's new broadband services would be in competition with wired broadband access, fixed wireless access and mobile broadband access;

- mobile wireless broadband access – a market which includes Freedom4's new broadband services and its existing fully mobile broadband access services, but excludes fixed broadband access services; and

- nomadic wireless broadband access – a market which includes the portable use of terminals but excludes fully mobile broadband access.

[18] http://www.ofcom.org.uk/consult/condocs/bb_application/

6.14 We have formally defined wholesale broadband access markets in our 2006 consultation on the review of the wholesale broadband access markets.[19] In that review we also considered aspects of the retail market, the relevant conclusions are considered in the following paragraph.

## Broadband access

6.15 If broadband access were the relevant economic market, then the impact of making the licence variation could have a positive, though probably marginal, impact on competition. There is currently a wide range of retail service offerings from fixed broadband access service providers, including Freedom4, and a growing mobile broadband market, with offers from the five 3G mobile operators as well as virtual operators. We have noted in our 2006 consultation on the review of the wholesale broadband access markets that wireless technology could offer a competitive constraint to cable and xDSL technologies in the longer term, but it is not likely to provide significant competitive constraints in the short run.[20]

6.16 We consider that in the mobile segment within this market, the incumbent 3G mobile network operators (MNOs) would be in a position to compete with the new entrant in particular relying on their pricing flexibility. Whether entry by Freedom4 following the removal of licence restrictions will occur in geographically targeted entry or not, the 3G MNOs will thus be able to respond to targeted entry also by changing their tariff structures.

6.17 Incumbents may enjoy a number of advantages over new entrants. Experience from the development of 2G networks world-wide has shown that extensive network coverage has been a pre-requisite for success in mobile markets. Other incumbency advantages may stem from having created a well established commercial identity and customer basis and having enjoyed from early mover advantages in establishing a presence in the market. A new entrant would have to undertake brand development to be in a position to attract customers and might initially incur higher costs as a result.

6.18 We consider that if it is viable for firms to enter, competition is unlikely to be weakened and may be enhanced given the limited number of firms in the mobile market. Under broad conditions, new entry would be likely to reduce prices and increase output - thus increasing economic welfare.

6.19 We note that our general policy, for example as expressed in the 2.6 GHz Information Memorandum[21], is to move towards authorising the use of spectrum on a technology and application neutral basis that provides much greater flexibility for the use of spectrum to respond to demand and to be economically efficient.

[19] Review of the wholesale broadband access markets 2006/07: Identification of relevant markets, assessment of market power and proposed remedies, available at http://www.ofcom.org.uk/consult/condocs/wbamr/wbamr.pdf

[20] See "Review of the wholesale broadband access markets" published 21 November 2006, available at http://www.ofcom.org.uk/consult/condocs/wbamr/wbamr.pdf. Low take-up and availability of the technology underpinned this conclusion, see paragraph A2.6.

[21] "Auction of Spectrum 2500 – 2690, 2010 – 2025MHz Information Memorandum, published 4 April 2008, http://www.ofcom.org.uk/consult/condocs/2ghzrules/statementim/im/im.pdf . See in particular paragraph 5.38 on page 94.

## Mobile wireless broadband access

6.20 The mobile wireless broadband access market is narrower than the broadband access market as it excludes fixed broadband access services. If this were the relevant market, the impact on competition could be significant, depending on the take up of Freedom4's proposed new broadband services. Freedom4 has already entered this market by launching a combined 3G and WiFi mobile broadband service. This has been made possible by Freedom4 and its partners developing flexible technology that can access and hand-over across a range of frequency bands, with a mobility element currently being delivered over licence-exempt spectrum. If the licence variation is made, Freedom4 could extend the quality of its service offerings and could bring significant additional competition to providers of mobile wireless broadband access services, which would ultimately be to the benefit of consumers. We do not consider that entry would weaken the competitive process as the incumbent mobile network operators would be able to respond competitively to new entry.

## Nomadic wireless broadband access

6.21 The nomadic wireless broadband access candidate market is limited to the provision of broadband access to stationary users at different locations. In a market defined as narrowly as this Freedom4 would not be the sole provider of services. There are a large and increasing number of WiFi hotspots that provide facilities for nomadic use. Also, other operators have access to spectrum that might be used to compete in the provision of nomadic wireless broadband services, and other spectrum (e.g. the 2.6 GHz band) is to be made available over coming years that could support the provision of these services. Therefore, our view is that competition in this market is likely to be enhanced by Freedom4's presence and that there is unlikely to be any detrimental impact.

## Conclusions on the identification of affected markets and competition impacts

6.22 The question of the precise scope of the relevant economic market is an empirical one and can only be fully addressed once relevant services are being offered and consumers' and suppliers' behaviour observed. However, the high level analysis above shows that such a variation is likely to facilitate greater intensity in the competitive process, which ultimately would be to the benefit of consumers. Further, the potential for detrimental impacts on competition from making the licence variation are limited.

6.23 Concerns about a weakening of competition following a licence variation seem unwarranted. Considering a possible range of communication markets we do not envisage a situation where existing market players would be prevented from competing with Freedom4 and where the entry of a new service provider could lead to weaker competition and diminished consumer benefits. On the contrary, we consider that making the licence variation would be beneficial and assist the promotion of competition.

## Freedom4's licence fee

6.24 A licence fee can be charged to incentivise the licence holder to utilise the spectrum in an optimal manner. This is known as Administered Incentive Pricing (AIP) and involves levying an annual fee on the licence holder to affect the ongoing cost of having the right to use the spectrum. The principles for applying AIP suggest generally that it should be set to reflect the full opportunity cost - i.e. taking into account the marginal value of the spectrum in other uses as well in the current use.

6.25 It could be argued that in order for us to fulfil our duty to secure optimal use of spectrum an increased licence fee should be charged to reflect an increased value of the spectrum arising from the changes, otherwise risking the spectrum being utilised in a sub-optimal manner. However, Freedom4's current level of fee was based on calculations made several years ago and which have not been reviewed recently. The market for spectrum, the sharers in the relevant spectrum bands and the available technologies have all changed significantly.

6.26 As outlined in Section 3, we will consult during 2009 on a Strategic review of Spectrum Pricing[22] and we anticipate applying the principles to be defined for evaluating spectrum, to review Freedom4's licence fee and subsequently to consult on the appropriate level to be set.

## Discrimination

6.27 It might be argued that liberalising Freedom4's licence would be discriminatory, because, while being allowed mobile use Freedom4 would not be subject to the restrictions on use in 2G and 3G licences and would enjoy the benefit of having a tradable licence.

6.28 We consider that undue discrimination can only arise where different treatment is given to persons in similar circumstances, or where the same treatment is given to persons in different circumstances, and there is lack of objective justification for the treatment given. In this case, we consider that there are sufficient differences in the circumstances of Freedom4 and the 2G and 3G operators to justify the existence of different licence conditions. The main differences are:

- 2G and 3G licensees have developed extensive networks whereas, in contrast, if Freedom4 is allowed to provide mobile services it will need to build a network from what is at present a very limited geographical and customer base.

- The MNOs operate in recognised prime mobile frequency bands whereas the 3.6 GHz band was until recent years seen primarily as one suitable only for fixed services. Equipment being developed for the band has had to be designed to overcome the unfavourable propagation characteristics of the band for mobile communications relative to those of the established mobile cellular bands.

- Freedom4 currently provides different services from 2G and 3G operators and may continue to do so even if the licence variation is made.

6.29 It should in any event also be noted that we are currently considering responses to our recent consultation on liberalising and making tradable the 2G and 3G licences..

[22] See http://www.ofcom.org.uk/radiocomms/ifi/srsp/

## Timing of the licence variation

6.30 Freedom4 has asked for the variation to be applied as soon as possible. We therefore propose, subject to the responses to this consultation, to issue a statement and, if appropriate, the variation, shortly after the close of the consultation period.

## Objective justification for licence conditions

6.31 As mentioned in Section 4, we have a statutory duty (in section 9(7) of the Wireless Telegraphy Act 2006) to ensure that licence conditions are objectively justified in relation to networks and services to which they relate, non-discriminatory, proportionate and transparent. We consider that this obligation is ongoing and must be assessed against the state of technology development at the time and market circumstances. We discuss above, in section 3, the current international regulatory position and the variations Freedom4 has requested would be consistent with it. The mobile broadband market is also developing and the variations would enable to compete in that market.

## International obligations

6.32 Ofcom must comply with UK obligations under European law or international agreements where use of spectrum has been harmonised. As explained in Section 5, the European Commission Decision 2008/411/EC has set parameters for the harmonisation of BWA in this band. We consider that to grant the variation would be consistent with the Decision.

## Direction from the Secretary of State

6.33 Ofcom must comply with any direction from the Secretary of State under section 5 of the 2003 Act and section 5 of the 2006 Act. No such direction has been made relating to Freedom4's licence or the 3.6 GHz band.

## Conclusions

6.34 Our initial view (which is the subject of this consultation process) is that:

- technology has changed and developed since the initial licence allocation and there is new equipment on the market that is capable of using Freedom4's spectrum;
- Freedom4 wishes to deploy new technology to provide services that would benefit its customers;
- as discussed in section 5 there are unlikely to be any detrimental impacts on spectrum quality for others in neighbouring bands;
- there is therefore no spectrum management reason for maintaining the current level of restrictions in Freedom4's licence.
- we have considered whether there might be any other policy reasons for continuing with the current restrictions. We can see no public policy reasons. On the contrary our policy favours removal or reduction of licence restrictions where possible. Assessment of the proposed changes in the context of the matters to

which we are required to have regard in law indicate that we should not continue with the current restrictions.

6.35 There appears to be no sound objective justification for continuing with the current restrictions that limit Freedom4 to fixed applications and that limit the maximum in-band power permitted to +22 dBW. In addition we have considered the effects of the proposed variation in the context of our statutory duties and consider these to be positive.

*Are there any reasonable grounds why Ofcom should not grant Freedom4's request to vary its licence as soon as practicable? If so, please explain your reasoning for this.*

## Section 7

# Next steps

7.1 We will analyse all responses received by the closing date for this consultation of 20 July 2009 and in making our decision on Freedom4's application for licence variation consider them against our statutory duties.

## 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 July 2009**.

A1.2 We strongly prefer to receive responses using the online web form at http://www.ofcom.org.uk/consult/condocs/freedom4/howtorespond/form, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.

A1.3 For larger consultation responses - particularly those with supporting charts, tables or other data - please email cliff.mason@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.

Cliff Mason
3rd Floor
Riverside House
2A Southwark Bridge Road
London SE1 9HA
Tel: 020 7783 4353
Fax: 020 77783 4303

A1.5 Note that we do not need a hard copy in addition to an electronic version. We 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 question asked in this document, which is given in 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 Cliff Mason on 020 7783 4353.

## 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. Our 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, we intend to publish a statement later in 2009.

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 We seek 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:

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 version for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will normally allow ten weeks for responses to consultations on issues of general interest.

A2.6 There will be a person within Ofcom who will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organizations interested in the outcome of our decisions. This individual (who we call the 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. This may be because a particular issue is urgent. If we need to reduce the amount of time we have set aside for a consultation, we will let those concerned know beforehand that this is a 'red flag consultation' which needs their urgent attention.

### After the consultation

A2.8 We will look at each response carefully and with an open mind. 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 http://www.ofcom.org.uk/consult/244504/.

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 question

*Are there any reasonable grounds why Ofcom should not grant Freedom4's request to vary its licence as soon as practicable? If so, please explain your reasoning for this.*

## Annex 5

# 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 Consistent with Ofcom's guidelines[23] on the use of impact assessments, this analysis:

- defines the issue being considered and identifies the citizen/ consumer interest;
- defines the policy objective;
- identifies and assesses the options and identifies the impacts on stakeholders; and
- assesses the impact on competition.

## The citizen and/or consumer interest

A5.3 This document consults on Ofcom's consideration of an application from Freedom4 Limited ('Freedom4') to vary its Wireless Telegraphy Public Fixed Wireless Operator 3.6 – 4.2GHz licence ('Freedom4's 3.6 GHz licence') to:

- increase the allowed power levels;
- permit mobility of terminal stations.

A5.4 Freedom4's current 3.6 GHz licence allows it to provide fixed wireless access services only. If Ofcom were to grant Freedom4's request to vary its licence as requested this would allow Freedom4 to use the spectrum to provide a range of new services and adopt new technology. Freedom4 is proposing to use WiMAX technology to deliver fixed, mobile or portable broadband services. These new Freedom4 services are expected to deliver benefits for citizens and consumers as they will be services which currently have limited availability or have a different source of service delivery.

## Ofcom's policy objective

A5.5 Ofcom has a principal duty 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. Further, in securing this principal duty Ofcom is required to secure the optimal use of the spectrum for wireless telegraphy. Therefore, the objective of the policy is maximise the likelihood that the spectrum is used optimally, to generate economic benefits and to promote innovation and competition, thus ultimately creating benefits to consumers by reducing restrictions on spectrum use.

[23] http://www.ofcom.org.uk/consult/policy_making/guidelines.pdf

## Options considered

### The status quo

A5.6 Ofcom could decide not to grant the variation and maintain the current licence conditions. This would deny the possibility of using the spectrum for new mobile services and is likely to result in a sub-optimal choice of technological deployments and services (with a consequent reduction of benefits from spectrum use). Maintaining the status quo could only be justified if these forgone benefits were more than outweighed by the need to avoid undesirable outcomes such as impairing competition or creating the risk of an unacceptable level of interference. Ofcom has concluded from the analysis presented in the main text of this consultation document that it does not consider maintaining the status quo would be justifiable, since granting more flexibility in the use of spectrum will on balance be beneficial.

A5.7 In particular, we have assessed in paragraphs 6.10-6.29 the potential for the creation of conditions that will strengthen competition. The liberalisation of UK Broadband's 3.5GHz licence in 2008 facilitates mobility of terminal stations in the manner now requested by Freedom4. Furthermore, we have also identified potential additional benefits in our analysis of consumer benefits in paragraphs 6.2-6.6.

### Options for a licence variation

A5.8 Ofcom has considered three issues in relation to granting the request:

- whether to grant the request to permit mobility of terminals, consistent with the Commission Decision 2008/411/EC.
- if so, whether to grant the requested power increase, consistent with the Commission Decision 2008/411/EC.
- in either case, whether to grant the variation in respect of only the lower licensed band (3605 to 3689MHz) which is suitable for currently available WiMAX equipment or whether to maintain standardised licence conditions also in the upper licensed block 3925 to 4009MHz.

A5.9 Keeping the current power level could reduce the risk of a potential increase in interference to other communications. However, this option would create significant problems for the feasibility of using mobile WiMAX communications, significantly constraining effective spectrum use. For this reason Ofcom considers that the power increase should be permitted if a decision is taken to allow mobile use.

A5.10 On balance, there appears little reason not to grant the same terms in both blocks of spectrum. Freedom4 state that their intended use of the upper block is for point-point links and that a liberalised form of licence will facilitate the re-location of links (eg. for CCTV backhaul) on an occasional basis, within areas that have received clearance through the coordination process. The continued requirement for coordination of assignments will address potential interference to other users of the band.

The following tables summarise our views on the potential impact of granting the variation.

### Table A1 Variation Options

| | Benefits Cos | ts/negative impacts |
|---|---|---|
| **Issue 1 – permitting mobility** | Allows Freedom4 to pursue its development of mobile WiMAX services in the lower block<br><br>Is consistent with the Commission Decision 2008/411/EC<br><br>Allows Freedom4 parity to compete with other mobile broadband services including UK Broadband. | Possible concern over coordination of mobile terminals, which our technical analysis suggests are addressed in the proposed variation. |
| **Issue 2 – granting the requested power increase** | Allows Freedom4 the flexibility to optimise the use of its spectrum<br><br>Is consistent with the maximum power level given in Commission Decision 2008/411/EC | Concerns about possibility of increased interference to adjacent services. |
| **Issue 3 – Granting the same terms also for the upper licensed block** | Increased flexibility of use of this block for deploying new services<br><br>Allows Freedom4 to optimise use for backhaul links in this spectrum | Concerns about possibility of interference to other services. |

### Table A2 Stakeholder impacts of granting variation

| **Consumers Free** | **dom4** | **Fixed Link users** | **Satellite Earth Station users** | **Fixed / Mobile broadband operators** |
|---|---|---|---|---|
| Benefits from new services being brought to market.<br><br>Benefits from stronger competitive pressure on other mobile broadband operators if in the same market. | Allows Freedom4 more flexibility in use for both the lower and upper spectrum blocks.<br><br>Aligns with Commission harmonisation Decision for BWA services.<br><br>Allows Freedom4 to optimise its use of the spectrum with the full range of services available under 802.16e. | Face no uncertainty over the nature of Freedom4 uses.<br><br>Coordination process will protect existing use<br><br>New applications will need to coordinate with any installed Freedom4 sites | Face no uncertainty over the nature of Freedom4 uses.<br><br>Coordination process will protect existing use | Face no uncertainty over the nature Freedom4 uses.<br><br>If in the same market, face more competition on a selected range of services. |

## Competition issues

A5.11 We have considered whether the licence variation could negatively impact on competition in downstream markets. We do not believe the risk of competition concerns arising from the proposed variation is significant as discussed in detail in sections 6.9 – 6.14 of the consultation document.

## The preferred option

A5.12 Our preferred option is to grant the variation as requested, to allow the mobility of consumer terminals, the increase in base station licensed power and to apply these conditions to both blocks of spectrum. We deem that on balance this facilitates the creation of benefits for citizens and consumers, in particular those from innovation and competition in wireless data communications, and is consistent with our approach to spectrum management.

**Annex 6**

# Freedom4's Wireless Telegraphy Public Fixed Wireless Access Licence (3.6 GHz)

**Wireless Telegraphy Act 1949 and 1998**

## Fixed Wireless Access Licence

## (3.6 - 4.2 GHz)

| | |
|---|---|
| Sector/class/product | **503010** |
| Licence number | **267056** |
| Licensee | **PIPEX COMMUNICATIONS BUSINESS SOLUTIONS LIMITED - Company No. 03152569** |
| Licensee address | **1 TRIANGLE BUSINESS PARK<br>QUILTERS WAY<br>STOKE MANDEVILLE, AYLESBURY<br>BUCKINGHAMSHIRE HP22 5BL** |
| Date of first issue | **14 April 2004** |
| Licence start date | **14 April 2004** |
| Fee Payment Date | **31st December** (annually) |

1. This Licence was granted by the Office of Communications ("Ofcom") on 14 April 2004 and replaces any previous authority granted in respect of the service subject to this Licence by Ofcom.

2. This Licence authorises **PIPEX COMMUNICATIONS BUSIN ESS SOLUTIONS LIMITED**, Company No. 03152569 ("the Licensee") to establish, install and/or use radio transmitting and/or receiving stations and/or radio apparatus as described in the schedule(s) (hereinafter together called "the Radio Equipment") subject to the terms set out in the General Licence Conditions booklet OF195 and the terms set out in the schedule(s).

**Mobile & Broadband Team**
**Office of Communications**

**FIXED WIRELESS ACCESS LICENCE**
**SCHEDULE 1 TO LICENCE 267056**

Licence Category: **FIXED WIRELESS ACCESS**

Schedule Date: **29 March 2006**

## 1. Description of Radio Equipment licensed

This Licence authorises use of the following transceivers:

a) Access Point Transceivers (commonly described as hub stations, central stations and base stations);
b) Customer Premises Equipment (commonly described as terminal stations); and
c) Radio Relay Repeaters

(hereinafter the Radio Equipment).

## 2. Conformity assessment requirements

The Radio Equipment must comply with Interface Requirement ("IR") *IR 2015: Public Fixed Wireless Access Radio Systems operating within the 3 to 11 GHz Frequency Bands Administered by Ofcom*[24].

## 3. Special conditions relating to the operation of the Radio Equipment

(a) During the period that this Licence remains in force and for 6 months thereafter, the Licensee shall compile and maintain accurate records of:

(i) the following details relating to the Radio Equipment:

(a) postal address;

(b) National Grid Reference (to 10 metres resolution);

(c) antenna height, type, bearing ETN, operational EIRP and polarisation;

(d) radio frequencies in operation during the licence term;

(ii) a statement of the number of customers using the Network;

and, without prejudice to anything in this sub-paragraph, the Licensee shall furnish to Ofcom in such a manner and at such times as reasonably requested, information in the form of documents, accounts, estimates, returns and any other information which may be reasonably required for the purposes of verifying compliance with this Licence and for statistical purposes.

[24] Published by Ofcom on 16 February 2005 and available from the Ofcom website at http://www.ofcom.org.uk/radiocomms/ifi/tech/interface_req/2015.pdf

(b) The Licensee shall inform Ofcom in writing of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) shall be kept.

(c) The Licensee shall submit to Ofcom copies of the records detailed in sub-paragraph 3(a) at such intervals as Ofcom shall notify to the Licensee.

(d) The Licensee shall, upon request, supply Ofcom or any person authorised by him in that behalf with the name and address of any authorised users of the Network, or require its agents to provide such information on its behalf.

## 4. Site Clearance requirements

a) Except where specified in sub-paragraph 4(b), the Licensee must obtain from Ofcom a valid site clearance certificate prior to establishing, installing or using the Radio Equipment.

b) Sub-paragraph 4(a) does not apply to:

i) base transceiver stations incorporating transmitters radiating not more than 17dBW ERP; or

ii) aerial systems, which do not extend beyond thirty (30) metres above ground level, or which do not increase the height of an existing building by more than five (5) metres (whichever is the higher).

## TECHNICAL REQUIREMENTS

The Licensee shall ensure that the Radio Equipment performs in accordance with the following technical requirements.

## 5. Co-ordination

a) Without prejudice to the Site Clearance required in paragraph 4, the Licensee must obtain permission from Ofcom prior to establishing, installing and/or using the Radio Equipment at any geographic location covered by this Licence. Ofcom shall grant such permission where, following use of its co-ordination process, Ofcom considers that the Radio Equipment does not cause undue interference to existing authorised users of the band and adjacent band users.

b) In granting approval Ofcom may specify restrictions on the use of Radio Equipment including restrictions, beyond those set out in the other terms of this Licence, on the maximum radiated spectral power density allowed on specific frequencies, the directions of transmissions and locations of Radio Equipment.

c) The Licensee must also operate the Radio Equipment in accordance with any co-ordination procedure notified by Ofcom.

## 6. Frequency bands of operation

The Licensee is authorised to operate the Radio Equipment in the following Permitted Frequency Bands of Operation:

a) Lower frequency band: 3605 - 3689 MHz

b) Upper frequency band: 3925 – 4009 MHz

## 7. Maximum Radiated Spectral Power Density (EIRP)

Except where Ofcom specifies a lower limit in accordance with sub-paragraph 5(b) the Licensee is authorised to operate the Radio Equipment to the following EIRP limits:

a) Maximum EIRP per MHz of +14 dBW; and

b) Absolute EIRP of +22 dBW.

## 8. Permissible Out-of-Block Emissions

For out-of-block emissions, the maximum radiated spectral power density within the frequency ranges set out below as measured from the upper or lower frequencies of either of the Permitted Frequency Bands of Operation shall not exceed the following.

| Frequency offset measured from the edges of the frequency bands specified in 7(a) and 7(b) | Maximum radiated spectral power density EIRP (dBW/MHz) |
|---|---|
| -1.0 to 0.0 MHz | 14 |
| 0.0 to 0.6 MHz | $14 – (41.6 \times \Delta_{F1})$* |
| 0.6 to 1.0 MHz | -11 |
| 1.0 to 2.0 MHz | $9 – (20 \times \Delta_{F2})$** |
| 2.0 to 4.0 MHz | -31 |
| 4.0 MHz and above | -31 |

* Note: $\Delta_{F1}$ is the frequency offset from 0.0 MHz to 0.6 MHz from the band edge of the relevant Permitted Frequency Band.
** Note: $\Delta_{F2}$ is the frequency offset from 1.0 MHz to 2.0 MHz from the band edge of the relevant Permitted Frequency Band.

## 9. Geographic boundaries

This Licence authorises the Licensee to establish, install and use the Radio Equipment only in the United Kingdom.

## 10. Interpretation

In this Schedule:

(a) "Access Point Transceiver" means any station that provides connection between the FWA Network and another electronic communications network forming part of a FWA Network;

(b) "Customer Premises Equipment" means any station at a fixed location that provides connection between the FWA Network and an end-user;

(c) "EIRP" means the effective isotropic radiated power, which is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);

(d) "ETN" means East of True North;

(e) "ERP" means the effective radiated power, which is the power supplied to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole;

(f) "FWA Network" means an electronic communications network which provides a wireless telegraphy connection between end-user premises and another electronic communications network;

(g) "IR" means the United Kingdom Radio Interface Requirement published by Ofcom in accordance with Article 4.1 of Directive 1999/5/EC of the European Parliament and of the Council on Radio Equipment and Telecommunications Terminal Equipment (R&TTE) and the mutual recognition of their conformity, as implemented in the United Kingdom by the Radio Equipment and Telecommunications Terminal Equipment Regulations 2000 S.I. 2000/7/730;

(h) "Permitted Frequency Bands of Operation" means the two frequency bands set out in paragraph 6;

(i) "Radio Relay Repeater" means any station forming part of the FWA Network that forwards a communication to another station of the FWA Network; and

(j) "undue interference" has the same meaning as in Section 19 of the Wireless Telegraphy Act 1949.

## Annex 7

# Proposed Freedom4 Wireless Telegraphy Spectrum Access Licence (3.6 GHz)

**Wireless Telegraphy Act 2006**
**Office of Communications (Ofcom)**

**Licence Category: SPECTRUM ACCESS 3.6 GHz**

This Licence replaces the licence issued by Ofcom on 14 April 2004 to Pipex Communications Business Solutions Limited.

Licence no.: **267056**
Date of issue: **xx Month 2009**
Fee payment date: **31 December** (annually)

**1.** The Office of Communications (Ofcom) grants this licence to

**Freedom4 Access Limited**
**Company Reg No.: 03152569**
("the Licensee")
**5 Roundwood Avenue**
**Uxbridge**
**Middlesex**
**UB11 1FF**

to establish, install and use radio transmitting and receiving stations and/or radio apparatus as described in the Schedule (the "Radio Equipment") subject to the term, set out below.

## Licence term

**2.** This Licence shall continue in force until revoked by Ofcom in accordance with paragraph 3 below or surrendered by the Licensee.

## Licence variation and revocation

**3.** Pursuant to Schedule 1(8) of the Wireless Telegraphy Act 2006 (the "Act"), Ofcom may not revoke this Licence under Schedule 1(6) of the Act except:

(a) at the request of, or with the consent of, the Licensee;

(b) if there has been a breach of any of the terms of this Licence;

(c) in accordance with Schedule 1 paragraph 8(5) of the Act;

(d) if it appears to Ofcom to be necessary or expedient to revoke or vary the Licence for the purposes of complying with a direction by the Secretary of State given to Ofcom under Section 5 or Section 156 of the Communications Act 2003;

(e) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of regulations made by Ofcom under the powers conferred by section 30(1) and section 30(3) of the Act;

**4.** Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Schedule 1, paragraphs 6 and 7 of the Act.

## Changes

**5.** This Licence is not transferable. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30(1) and section 30(3) of the Act.

**6.** The Licensee must give prior notice to Ofcom in writing of any proposed change to the Licensee's name and address from that recorded in the Licence.

## Fees

**7.** The Licensee shall pay Ofcom the relevant fee as provided in Section 12 and 13 of the Act and the Regulations made thereunder on or before the fee payment date shown above each year, or on or before such dates as shall be notified in writing to the Licensee, failing which Ofcom may revoke this Licence.

## Radio equipment use

**8.** The Licensee shall ensure that the Radio Equipment is established, installed and used only in accordance with the provisions specified in Schedule 1 of this Licence. Any proposal to amend any detail specified in schedule 1 of this Licence must be agreed with Ofcom in advance and implemented only after this Licence has been varied or reissued accordingly.

**9.** The Licensee shall ensure that the Radio Equipment is operated in compliance with the terms of this Licence and is used only by persons who have been authorised in writing by the Licensee to do so and that such persons are made aware of, and of the requirement to comply with, the terms of this Licence.

## Access and inspection

**10.** The Licensee shall permit a person authorised by Ofcom:

(a) to have access to the Radio Equipment; and

(b) to inspect this Licence and to inspect, examine and test the Radio Equipment,

at any and all reasonable times or, when in the opinion of that person an urgent situation exists, at any time to ensure the Radio Equipment is being used in accordance with the terms of this Licence.

## Modification, restriction and closedown

**11.** A person authorised by Ofcom may require any of the radio stations or radio apparatus that comprise the Radio Equipment to be modified or restricted in use, or temporarily or permanently closed down immediately if in the opinion of the person authorised by Ofcom:

(a) a breach of a term of the Licence has occurred; and/or

(b) the use of the Radio Equipment is causing or contributing to undue interference to the use of other authorised radio equipment.

**12.** Ofcom may require any of the radio stations or radio apparatus that comprise the Radio Equipment to be modified or restricted in use, or temporarily closed down either immediately or on the expiry of such period as may be specified in the event of a national or local state of emergency being declared. Ofcom may only exercise this power after a written notice has been served on the Licensee or a general notice applicable to holders of a named class of Licence has been published.

## Geographical boundaries

**13.** This Licence authorises the Licensee to establish, install and use the Radio Equipment only in the United Kingdom.

## Interpretation

**14.** In this Licence:

(a) the establishment, installation and use of the Radio Equipment shall be interpreted as the establishment and use of stations and the installation and use of wireless telegraphy apparatus as specified in section 8(1) of the Act;

(b) the expression “interference” shall have the meaning given by section 115 of the Act;

(c) the expressions “wireless telegraphy apparatus” and “wireless telegraphy station” shall have the meanings given by section 117 of the Act;

(d) the schedule to this Licence forms part of this Licence together with any subsequent schedules which Ofcom may issue as a variation to this Licence at a later date; and

(e) the Interpretation Act 1978 shall apply to this Licence as it applies to an Act of Parliament.

## Issued By Ofcom

Signed by

## For the Office of Communications

## SCHEDULE 1 TO LICENCE NUMBER: 267056

Schedule Date: **xx Month 2009**

Licence Category: **SPECTRUM ACCESS 3.6 GHz**

### 1. Description of Radio Equipment licensed

In this Licence, the Radio Equipment means any station apparatus that transmits in accordance with the requirements of paragraphs 6 and 7 of this schedule.

### 2. Interface Requirements for the Radio Equipment use

Use of the Radio Equipment shall comply with the following Interface Requirement:

IR 2015 for Public Fixed Wireless Access radio systems operating within the 3 to 11 GHz frequency bands.

### 3. Special conditions relating to the operation of the Radio Equipment

(a) During the period that this Licence remains in force, the Licensee shall compile and maintain accurate written records of:

(i) the following details relating to the Radio Equipment where the Radio Equipment is operated from a fixed location:

a) postal address;

b) National Grid reference (to 100 metres resolution);

c) antenna height (above ground level) and type, and bearing east of true north;

d) radio frequencies used by the Radio Equipment; and

(ii) a statement of the number of subscribing customers,

and the Licensee must produce these records if requested by a person authorised by Ofcom.

(b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) of this Schedule shall be kept.

(c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph 3(a) of this Schedule at such intervals as Ofcom shall notify to the Licensee.

(d) The Licensee must also submit to Ofcom in such manner and at such times as Ofcom requests all information relating to the establishment, installation or use of the Radio Equipment as is reasonably requested for the purpose of verifying compliance with this Licence or for statistical purposes.

(e) The Licensee must ensure that the Radio Equipment is established and installed only for terrestrial use.

## 4. Co-ordination

The Licensee must operate the Radio Equipment in accordance with any co-ordination procedure notified by Ofcom.

## 5. Permitted frequency bands

The Licensee is authorised to operate the Radio Equipment in the following frequency ranges:

| | |
|---|---|
| Lower Frequency Block | 3605 – 3689 MHz |
| Upper Frequency Block | 3925 – 4009 MHz |

## 6. Maximum permissible e.i.r.p.

The Licensee shall ensure that the Radio Equipment conforms to the following e.i.r.p. limits:

| |
|---|
| Maximum e.i.r.p. +53 dBm/MHz |

Except for mobile terminals, which shall conform to the following e.i.r.p. limit:

| |
|---|
| Maximum e.i.r.p. 25 dBm/MHz |

In addition to this, the Licensee may be required to take additional measures to ensure that the establishment, installation and use of the Radio Equipment does not cause undue interference to receiving stations and/or radio apparatus operated by a neighbouring licensee.

## 7. Permissible Out of Block Emissions

For Radio Equipment operating at powers above 25dBm/MHz deployed before 1st January 2010 the Licensee shall ensure that Out of Block shall conform to the following:

| Frequency offset measured from the edges of the frequency bands specified in section 5 | Maximum radiated spectral power density EIRP (dBm/MHz) |
|---|---|
| 0 | 53 |
| 0 | 44 |
| $0 < \Delta f < 0.6$ | $44 - 41.67*\Delta f$ |
| 0.6 | 19 |
| 1 | 19 |
| $1 < \Delta f < 2$ | $19 - 20*(\Delta f - 1)$ |
| ≥ 2 | -1 |

For Radio Equipment operating at powers above 25dBm/MHz deployed after 1st January 2012 the Licensee shall ensure that Out of Block shall conform to the following:

| Frequency offset measured from the edges of the frequency bands specified in section 5 | Maximum radiated spectral power density EIRP (dBm/MHz) |
|---|---|
| 0 | 53 |
| 0 | 44 |
| $0 < \Delta f < 0.6$ | $44 - 41.67*\Delta f$ |
| 0.6 | 19 |
| 1 | 19 |
| $1 < \Delta f < 2$ | $19 - 20*(\Delta f - 1)$ |
| 2 | -1 |
| $2 < \Delta f < 5$ | $-1 - 4.87*(\Delta f - 2)$ |
| 5 | -15.6 |
| 5 | -30 |
| $5 < \Delta f < 9.5$ | $-30 - 2.89*(\Delta f - 5)$ |
| ≥ 9.5 | -43 |

The Licensee shall ensure that Out of Block Emission from the Radio Equipment operating at powers up to 25dBm/MHz shall conform to the following:

| Frequency offset measured from the edges of the frequency bands specified in section 5 | Maximum radiated spectral power density EIRP (dBm/MHz) |
|---|---|
| 0 | 13.7 |

| | |
|---|---|
| 0 < Δf < 1 | 13.7 - 15*Δf |
| 1 | -1.3 |
| 1 < Δf < 2.5 | -1.3 - 1.27*(Δf - 1) |
| 2.5 | -3.2 |
| 2.5 < Δf < 7.5 | -3.2 - 0.46*(Δf - 2.5) |
| 7.5 | -5.5 |
| 7.5 < Δf < 9.5 | -5.5 - 5*(Δf - 7.5) |
| ≥ 9.5 | -15.5 |

## 8. Interpretation

In this Schedule:

(a) "dBm" means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 0.001 W);

(b) "e.i.r.p." means the equivalent isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);

(c) "IR" means the United Kingdom Radio Interface Requirement published by the Radiocommunications Agency of the Department of Trade and Industry (RA) in accordance with Article 4.1 of Directive 1999/5/EC of the European Parliament and of the Council on Radio Equipment and Telecommunications Terminal Equipment (R&TTE) and mutual recognition of their conformity as implemented in the UK by the Radio Equipment and Telecommunications Equipment Regulations 2000 S.I. 2000/7/730;

(d) "Out of Block Emission" means radio frequency emissions generated by the Radio Equipment and radiated into the frequency bands adjacent (in terms of frequency) to the Licensee's Permitted Frequency Bands;

(e) "Maximum radiated spectral power density" (of Out of Block Emissions) is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna that is outside the Licensee's Frequency Block;

**Annex 8**

# Freedom4's request and supporting documentation

**Freedom4 Request**

**Freedom4 Annex 1 – Current Licence**

**Freedom4 Annex 2 – Commission Decision 2008/411/EC**

**Freedom4 Annex 3 – Market Analysis (Confidential, not published)**

**Freedom4 Annex 4 – ECC Decision (07)02 of 30 March 2007**

**Freedom4 Annex 5 – ETSI Technical Report (published separately)**

**Freedom4 Annex 6 – ITU-R Document 4A/39-E**

**Freedom4 Annex 7 – Aegis Report on compatibility of WiMAX terminals with satellite earth stations**

**Freedom4 Annex 8 – Suggested technical requirements for licence**

# FREEDOM4 LTD

# Request for a variation to Fixed Wireless Access Licence 267056

## Final analysis submitted to Ofcom

## 9 December 2008

# Contents

# Executive Summary

## FREEDOM4 overview

FREEDOM4 is a broadband wireless access (BWA) provider with WiMAX services deployed in three UK cities and one of the largest WiFi aggregation business in Europe. FREEDOM4 is also a major spectrum owner holding national licences at 28GHz and in the 3.6-4.2GHz band. The 84MHz of spectrum held between 3.6GHz and 3.7GHz falls within the band harmonised in Europe with a primary use of BWA and in one of the bands targeted by the WiMAX Forum for the delivery of 802.16 based networks.

## Emerging market

FREEDOM4 has worked with Ofcom and other shared users of the 3.6-4.2GHz band over the past four years to improve coordination processes and optimise use of the spectrum. FREEDOM4 is now in a position where it has established contact with the majority of users in the band and has identified significant clear space in which to deploy and operate its wireless access network. Current technology allows the deployment of fixed WiMAX services but 802.16e-2005 mobile wireless equipment will become available in 2009 and market demand for mobile broadband services is now expanding rapidly. The number of devices available is also increasing with a trend from initial USB and PC cards to embedded laptops, internet tablets, ultra mobile notebooks and handsets now evident.

## Licence variation

FREEDOM4 is requesting a variation to its 3.6-4.2GHz licence to allow it to address the emerging market for mobile broadband services as follows:

- An increase in central station maximum power.
- Removal of the requirement to coordinate low power mobile terminals.

FREEDOM4 is not requesting any change to the coordination of central stations and its use of the increased power level is subject to mandatory clearance processes. FREEDOM4 (and Ofcom) have produced studies showing the dominance of central station emissions over low power terminals in terms of potential interference to other users of the band. Under these circumstances, the removal of the requirement to coordinate low power mobile devices does not increase the risk of co-channel interference in the band.

## Ofcom liaison

FREEDOM4 has set out its licence variation request and supporting analysis in the following document for consideration by Ofcom. FREEDOM4 would like to engage with Ofcom as it considers the request and is happy to provide further clarification and explanation of its conclusions as required. FREEDOM4 would particularly like to work with Ofcom on the form of licence implied by these changes and to align the licence with similar licences now issued.

# Licence Variation Request

## Introduction

FREEDOM4 holds a nationwide spectrum licence re-issued in 2004 covering 3605-3689MHz and 3925-4009MHz. FREEDOM4 shares this spectrum with a small number of satellite earth stations and, in part, with a few fixed links. FREEDOM4 is currently deploying WiMAX networks in urban areas using the lower block of spectrum. The licence is technology and service neutral and specifies a maximum power spectral density, maximum power and block edge mask. A copy of the licence is included as **Appendix 1**. FREEDOM4 is seeking a variation to the existing licence to:

- Increase the maximum radiated spectral power density (EIRP) for central stations from 14dBW/MHz to 23dBW/MHz, and remove the absolute limit of 22dBW/MHz (EIRP) for a central station;
- On the basis that the dominant source of potential interference is the central station, remove the requirement to coordinate and maintain address information for terminal stations with a power spectral density not exceeding 25dBm/MHz and a total EIRP not exceeding 30dBm.

For the avoidance of doubt, FREEDOM4 is not seeking any change to the requirement to coordinate central stations and user stations over 25dBm/MHz or over 30dBm total EIRP, to the coordination process, or to the out of block emissions mask.

## Current licence

The terms of the licence include an obligation to maintain records of the address of every terminal station, effectively restricting equipment to be operated under the licence to fixed locations, and an obligation for formal clearance and coordination of all central stations before they are brought into use. The Ofcom coordination process includes clearance of representative terminal stations within the intended coverage area around the central station. The aim of the process is to provide confidence that there is an acceptably low probability of interference from the radio systems, including central stations and terminal stations to other licensed users of the band.

## Coordination with other users of the spectrum

FREEDOM4 has adopted a policy of avoiding interference where possible through selection of market geography, careful location of central stations and fine tuning of frequency, power, antenna height, antenna type, azimuth and downtilt, and only relying on mitigation where necessary. The locations of other users installations are known to Ofcom and as a consequence of the ongoing coordination process are, we believe, now known to FREEDOM4. FREEDOM4 has held discussions with all of the relevant earth station operators in the areas of the country where it seeks to deploy network. These discussions have been very informative and have shown that there are surprisingly few sites where the lower block of spectrum is actually in use. Most sites are in rural areas where distance and local shielding provide adequate protection. Two sites are, however, on the edge of urban areas. Discussions with the station operators for these two sites indicate that it is likely that a coordination agreement that is workable for both parties and which does not unreasonably constrain either party can be concluded. There remain some C Band fixed links but FREEDOM4 is able to simply avoid using part of its spectrum to avoid interference with these systems.

## Developments in terminal station technology

Development of terminal stations for Broadband Wireless Access devices has recently progressed to include small, USB based, plug in units for laptop PCs, and is moving towards small, low power devices designed to be built into laptops and other handheld terminals in the same manner as WiFi enabled devices. A fundamental design aim of these mobile devices it to maximise battery life, imposing limits on the maximum power of any radio transmitters. Space and practical use considerations restrict the choice of antenna to small, Omni-directional units, further limiting EIRP. Advanced modulation schemes, coupled with techniques such as diversity are used to reduce the effect of these power limits on bandwidth but, nevertheless, practical operation of the equipment is limited to typically no more than 1Km from the central stations, and generally less in the target urban environments. For efficient operation of wireless broadband access networks it is important to maximise the usable capacity and to discourage connection of devices where signal quality is low, leading to inefficient use of spectrum and a reduction in network capacity.

The WiMAX certification process assures compliance of devices with the relevant WiMAX forum standards. In the case of terminal stations, WiMAX compliant devices must detect a network before transmitting, ensuring that mobile devices will only transmit when they are within viable range of a central station, typically less than 1Km. Parameters are set in the network that will reject attempts to connect terminals unless the signal is of sufficient quality.

## Market drivers

The recent decision 2008/411/EC taken by the EU to harmonise the 3.4-3.8GHz band was instigated by the established need to provide additional capacity, and hence spectrum, for terrestrial broadband wireless access. The decision is intended to provide fixed, mobile and nomadic access for end users to broadband services across Europe, subject to certain technical considerations and constraints. A copy of this decision is attached as **Appendix 2**. Providing Broadband Wireless Access to mobile devices using 3.6-3.8GHz spectrum opens new markets for services bringing benefits to a wide range of users. **Appendix 3** sets out the FREEDOM4 analysis of the its potential market, and includes a recent FREEDOM4 press release on demonstrating seamless handover between networks operating at 2.6 and 3.6GHz. This shows how different bands can be combined to extend network capacity, allowing the most appropriate spectrum to be used for fixed and mobile services at a particular location. This also opens opportunities to mix networks built for coverage in rural areas with networks built for capacity in more populated areas. However, the current licence obligation to maintain information on the location of terminal stations effectively prevents FREEDOM4 addressing these markets as it would clearly not be practical to meet the requirement to maintain a record of the address of all terminal stations with mobile devices. The possibility of users roaming onto a UK based network from other networks across Europe or beyond exacerbates this problem.

## Technical considerations

The European Union decision refers to technical considerations detailed in European Communications Committee decision ECC/DEC/(07)02, attached as **Appendix 4**. This decision concludes that devices transmitting a maximum power density of 25dBm per MHz together with at least 15dB of automatic transmit power control should be allowed as mobile devices, subject to due consideration being given to other users of the band.

The WiMAX standard requires considerably more power control than has been identified as minimising power is an effective way of controlling interference within the network. The decision also sets the maximum power spectral density for a central station as 53dBm/MHz, which is the level FREEDOM4 is seeking in this variation request. Work carried out by ETSI as TR 102 742 V1.1.1 (2008-03) gives further technical details of the requirements for terminal stations. A copy is attached as **Appendix 5**. This sets the power spectral density for a mobile terminal station at 25dBm/MHz, the same as is given in the EU decision, and the same level that FREEDOM4 is seeking in this variation.

FREEDOM4 takes the view that while mobile devices are likely to be able to achieve a power density of 25dBm per MHz, they are unlikely to achieve a total power of more than 30dBm in the immediate future. Consequently, FREEDOM4 is proposing a cap of 30dBm on terminal stations, below which coordination would not be required. With this cap, a station supporting a channel with a 5MHz bandwidth would operate at 23dBm/MHz, and with a 10MHz channel would be operating at 20dBm/MHz, well below the EU levels, and providing a substantial safety margin for other users of the band. Any terminal station radiating over 25dBm/MHz or over 30dBm total EIRP would continue to need coordination unchanged from the current requirement, and FREEDOM4 would be obliged to maintain records of the locations of any such stations.

## Technical evaluation of the need for coordination

Work has been undertaken by Ofcom to examine the compatibility of Broadband Wireless Access networks with fixed satellite services as the basis for a submission to the ITU. A copy of this submission is included as **Appendix 6**. The report concludes that where "coordination is completed, it is also possible to deploy nomadic or mobile BWA devices within the coverage zones of BWA central stations without causing additional interference to the coordinated earth station." A second piece of work, attached as **Appendix 7**, has been undertaken for FREEDOM4 by Aegis Systems Ltd to give additional confidence in the potential impact of mobile devices on earth stations. This work analysed the impact of a random population of mobile terminal stations around a number of randomly located central stations and reaches the conclusion that with the relative maximum power of the user and central station terminals, interference at an earth station will always be dominated by the central station. A change in the maximum central station power, as is being sought by FREEDOM4, will increase the dominance of the central station. As the central station will, in all cases, have been coordinated, the existence and use of mobile devices will, therefore, not cause additional interference to an earth station.

## Variation sought

Based on the market opportunity, the EU and ECC decisions, the analysis undertaken by Ofcom for the ITU and the analysis carried out by Aegis, FREEDOM4 seeks a variation in its licence to:

- Increase the maximum power spectral density of a central station to 23dBW/MHz and to remove the absolute power limit;
- Remove the requirement to coordinate and maintain records of the location for terminal stations with a maximum power spectral density of 25dBm per MHz subject to a maximum EIRP of 30dBm and other technical requirements set out in the ETSI document ETSI TR 102 742 V1.1.1 (2008-03).

- These devices would then be allowed to be mobile or nomadic. Note that the power ceiling limits the total power for a 10MHz bandwidth device to less than a **third** of the limit implied by the EU decision.

For the avoidance of doubt, FREEDOM4 is not seeking any variation in the requirement to comply with the existing block edge mask or to coordinate through the Ofcom process all central stations together with any terminal stations over the threshold power spectral density and total EIRP set out in the previous paragraph.

As part of this variation, FREEDOM4 further requests that other parts of the text of the licence are brought into alignment with similar, more standard, licences.

A copy of FREEDOM4's proposal for the modified technical licence text is attached as **Appendix 8**. Suggested text for inclusion in the coordination section of the licence being drafted by Ofcom is as follows:

*Terminal Station coordination is required when:*

- *Maximum EIRP per MHz exceeds +25 dBm; or*
- *Absolute EIRP exceeds +30 dBm.*

The current licence does not differentiate between the top and bottom blocks with conditions and requirements applying equally to all spectrum. For ease of drafting and usage, FREEDOM4 can see no reason why the requested variation should not apply to both blocks under Ofcom's spectrum liberalization policy. There is more potential for coordination in the top block because of the density of band sharers but if cleared, optimum efficiency is achieved by application of the variation across the full licence.

**Wireless Telegraphy Act 1949 and 1998**

# Fixed Wireless Access Licence (3.6 - 4.2 GHz)

| | |
|---|---|
| Sector/class/product | **503010** |
| Licence number | **267056** |
| Licensee | **PIPEX COMMUNICATIONS BUSINESS SOLUTIONS LIMITED - Company No. 03152569** |
| Licensee address | **1 TRIANGLE BUSINESS PARK<br>QUILTERS WAY<br>STOKE MANDEVILLE, AYLESBURY<br>BUCKINGHAMSHIRE HP22 5BL** |
| Date of first issue | **14 April 2004** |
| Licence start date | **14 April 2004** |
| Fee Payment Date | **31st December** (annually) |

1. This Licence was granted by the Office of Communications ("Ofcom") on 14 April 2004 and replaces any previous authority granted in respect of the service subject to this Licence by Ofcom.

2. This Licence authorises **PIPEX COMMUNICATIONS BUSINESS SOLUTIONS LIMITED**, Company No. 03152569 ("the Licensee") to establish, install and/or use radio transmitting and/or receiving stations and/or radio apparatus as described in the schedule(s) (hereinafter together called "the Radio Equipment") subject to the terms set out in the General Licence Conditions booklet OF195 and the terms set out in the schedule(s).

**Mobile & Broadband Team**
**Office of Communications**

# FIXED WIRELESS ACCESS LICENCE
# SCHEDULE 1 TO LICENCE 267056

Licence Category: **FIXED WIRELESS ACCESS**

Schedule Date: **29 March 2006**

## 1. Description of Radio Equipment licensed

This Licence authorises use of the following transceivers:

a) Access Point Transceivers (commonly described as hub stations, central stations and base stations);
b) Customer Premises Equipment (commonly described as terminal stations); and
c) Radio Relay Repeaters

(hereinafter the Radio Equipment).

## 2. Conformity assessment requirements

The Radio Equipment must comply with Interface Requirement ("IR") ***IR 2015: Public Fixed Wireless Access Radio Systems operating within the 3 to 11 GHz Frequency Bands Administered by Ofcom***[1].

## 3. Special conditions relating to the operation of the Radio Equipment

(a) During the period that this Licence remains in force and for 6 months thereafter, the Licensee shall compile and maintain accurate records of:

(i) the following details relating to the Radio Equipment:

(a) postal address;

(b) National Grid Reference (to 10 metres resolution);

(c) antenna height, type, bearing ETN, operational EIRP and polarisation;

(d) radio frequencies in operation during the licence term;

(ii) a statement of the number of customers using the Network;

and, without prejudice to anything in this sub-paragraph, the Licensee shall furnish to Ofcom in such a manner and at such times as reasonably requested, information in the form of documents, accounts, estimates, returns and any other information which may be reasonably required for the purposes of verifying compliance with this Licence and for statistical purposes.

(b) The Licensee shall inform Ofcom in writing of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) shall be kept.

[1] Published by Ofcom on 16 February 2005 and available from the Ofcom website at http://www.ofcom.org.uk/radiocomms/ifi/tech/interface_req/2015.pdf

(c) The Licensee shall submit to Ofcom copies of the records detailed in sub-paragraph 3(a) at such intervals as Ofcom shall notify to the Licensee.

(d) The Licensee shall, upon request, supply Ofcom or any person authorised by him in that behalf with the name and address of any authorised users of the Network, or require its agents to provide such information on its behalf.

## 4. Site Clearance requirements

a) Except where specified in sub-paragraph 4(b), the Licensee must obtain from Ofcom a valid site clearance certificate prior to establishing, installing or using the Radio Equipment.

b) Sub-paragraph 4(a) does not apply to:

i) base transceiver stations incorporating transmitters radiating not more than 17dBW ERP; or

ii) aerial systems, which do not extend beyond thirty (30) metres above ground level, or which do not increase the height of an existing building by more than five (5) metres (whichever is the higher).

## TECHNICAL REQUIREMENTS

The Licensee shall ensure that the Radio Equipment performs in accordance with the following technical requirements.

## 5. Co-ordination

a) Without prejudice to the Site Clearance required in paragraph 4, the Licensee must obtain permission from Ofcom prior to establishing, installing and/or using the Radio Equipment at any geographic location covered by this Licence. Ofcom shall grant such permission where, following use of its co-ordination process, Ofcom considers that the Radio Equipment does not cause undue interference to existing authorised users of the band and adjacent band users.

b) In granting approval Ofcom may specify restrictions on the use of Radio Equipment including restrictions, beyond those set out in the other terms of this Licence, on the maximum radiated spectral power density allowed on specific frequencies, the directions of transmissions and locations of Radio Equipment.

c) The Licensee must also operate the Radio Equipment in accordance with any co-ordination procedure notified by Ofcom.

## 6. Frequency bands of operation

The Licensee is authorised to operate the Radio Equipment in the following Permitted Frequency Bands of Operation:

a) Lower frequency band: 3605 - 3689 MHz

b) Upper frequency band: 3925 – 4009 MHz

## 7. Maximum Radiated Spectral Power Density (EIRP)

Except where Ofcom specifies a lower limit in accordance with sub-paragraph 5(b) the Licensee is authorised to operate the Radio Equipment to the following EIRP limits:

a) Maximum EIRP per MHz of +14 dBW; and

b) Absolute EIRP of +22 dBW.

## 8. Permissible Out-of-Block Emissions

For out-of-block emissions, the maximum radiated spectral power density within the frequency ranges set out below as measured from the upper or lower frequencies of either of the Permitted Frequency Bands of Operation shall not exceed the following.

| Frequency offset measured from the edges of the frequency bands specified in 7(a) and 7(b) | Maximum radiated spectral power density EIRP (dBW/MHz) |
|---|---|
| -1.0 to 0.0 MHz | 14 |
| 0.0 to 0.6 MHz | $14 – (41.6 \times \Delta_{F1})$* |
| 0.6 to 1.0 MHz | -11 |
| 1.0 to 2.0 MHz | $9 – (20 \times \Delta_{F2})$** |
| 2.0 to 4.0 MHz | -31 |
| 4.0 MHz and above | -31 |

* Note: $\Delta_{F1}$ is the frequency offset from 0.0 MHz to 0.6 MHz from the band edge of the relevant Permitted Frequency Band.
** Note: $\Delta_{F2}$ is the frequency offset from 1.0 MHz to 2.0 MHz from the band edge of the relevant Permitted Frequency Band.

## 9. Geographic boundaries

This Licence authorises the Licensee to establish, install and use the Radio Equipment only in the United Kingdom.

## 10. Interpretation

In this Schedule:

(a) "Access Point Transceiver" means any station that provides connection between the FWA Network and another electronic communications network forming part of a FWA Network;

(b) "Customer Premises Equipment" means any station at a fixed location that provides connection between the FWA Network and an end-user;

(c) "EIRP" means the effective isotropic radiated power, which is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);

(d) "ETN" means East of True North;

(e) "ERP" means the effective radiated power, which is the power supplied to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole;

(f) "FWA Network" means an electronic communications network which provides a wireless telegraphy connection between end-user premises and another electronic communications network;

(g) "IR" means the United Kingdom Radio Interface Requirement published by Ofcom in accordance with Article 4.1 of Directive 1999/5/EC of the European Parliament and of the Council on Radio Equipment and Telecommunications Terminal Equipment (R&TTE) and the mutual recognition of their conformity, as implemented in the United Kingdom by the Radio Equipment and Telecommunications Terminal Equipment Regulations 2000 S.I. 2000/7/730;

(h) "Permitted Frequency Bands of Operation" means the two frequency bands set out in paragraph 6;

(i) "Radio Relay Repeater" means any station forming part of the FWA Network that forwards a communication to another station of the FWA Network; and

(j) "undue interference" has the same meaning as in Section 19 of the Wireless Telegraphy Act 1949.

# COMMISSION DECISION

## of 21 May 2008

## on the harmonisation of the 3 400-3 800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community

*(notified under document number C(2008) 1873)*

**(Text with EEA relevance)**

(2008/411/EC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision) [1], and in particular Article 4(3) thereof,

Whereas:

(1) The Commission has supported a more flexible use of spectrum in its Communication on 'Rapid access to spectrum for wireless electronic communications services through more flexibility' [2], which, *inter alia*, addresses the 3 400-3 800 MHz band. Technological neutrality and service neutrality have been underlined by Member States in the Radio Spectrum Policy Group (RSPG) opinion on Wireless Access Policy for Electronic Communications Services (WAPECS) of 23 November 2005 as important policy goals to achieve a more flexible use of spectrum. Moreover, according to this opinion, these policy goals should not be introduced abruptly, but in a gradual manner to avoid disruption of the market.

(2) The designation of the 3 400-3 800 MHz band for fixed, nomadic and mobile applications is an important element addressing the convergence of the mobile, fixed and broadcasting sectors and reflecting technical innovation. The services provided in this frequency band should mainly target end-user access to broadband communications.

(3) It is expected that the wireless broadband electronic communications services for which the 3 400–3 800 MHz band is to be designated will to a large extent be pan-European in the sense that users of such electronic communications service in one Member State could also gain access to equivalent services in any other Member State.

(4) Pursuant to Article 4(2) of Decision No 676/2002/EC, the Commission gave a mandate dated 4 January 2006 to the European Conference of Postal and Telecommunications Administrations (hereinafter the CEPT) to identify the conditions relating to the provision of harmonised radio frequency bands in the EU for Broadband Wireless Access (BWA) applications.

(5) In response to that Mandate, the CEPT issued a report (CEPT Report 15) on BWA, which concludes that the deployment of fixed, nomadic and mobile networks is technically feasible within the 3 400-3 800 MHz frequency band under the technical conditions described in the Electronic Communications Committee's Decision ECC/DEC/(07)02 and Recommendation ECC/REC/(04)05.

(6) The results of the Mandate to the CEPT should be made applicable in the Community and implemented by the Member States without delay given the market demand for the introduction of terrestrial electronic communication services providing broadband access in these bands. Taking into account the differences in current use and in market demand for the 3 400-3 600 MHz and 3 600-3 800 MHz sub-bands at national level a different deadline should be established for the designation and availability of the two sub-bands.

(7) The designation and making available of the 3 400-3 800 MHz band in accordance with the results of the Mandate on BWA recognises the fact that there are other existing applications within these bands and does not preclude the future use of these bands by other systems and services to which these bands are allocated in accordance with the ITU Radio Regulations (designation on a non-exclusive basis). Appropriate sharing criteria for coexistence with other systems and services in the same and adjacent bands have been developed in ECC Report 100. This report confirms, *inter alia*, that sharing with satellite services is often feasible considering the extent of their deployment in Europe, geographical separation requirements and case-by-case evaluation of actual terrain topography.

[1] OJ L 108, 24.4.2002, p. 1.
[2] COM(2007) 50.

(8) Block Edge Masks (BEM) are technical parameters that apply to the entire block of spectrum of a specific user, irrespective of the number of channels occupied by the user's chosen technology. These masks are intended to form part of the authorisation regime for spectrum usage. They cover both emissions within the block of spectrum (i.e. in-block power) as well as emissions outside the block (i.e. out-of-block emission). They are regulatory requirements aimed at managing the risk of harmful interference between neighbouring networks and are without prejudice to limits set in equipment standards under 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 [1] (the R&TTE Directive).

(9) Harmonisation of technical conditions for the availability and efficient use of spectrum does not cover assignment, licensing procedures and timing, nor the decision whether to use competitive selection procedures for the assignment of radio frequencies, which will be organised by Member States in line with Community law.

(10) Differences in the national legacy situations could result in competitive distortions. The existing regulatory framework gives Member States the tools to deal with these problems in a proportionate, non-discriminatory and objective manner, subject to Community law including Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services (Authorisation Directive) [2] and Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services (Framework Directive) [3].

(11) The use of the 3 400-3 800 MHz band by other existing applications in third countries can limit the introduction and use of this band by electronic communications networks in several Member States. Information on such limitations should be notified to the Commission pursuant to Articles 7 and 6(2) of Decision No 676/2002/EC and published in accordance with Article 5 of Decision No 676/2002/EC.

(12) In order to ensure effective use of the 3 400-3 800 MHz band also in the longer term, administrations should continue with studies that may increase efficiency and innovative use, such as meshed network architectures. Such studies should be taken into account when considering a review of this Decision.

(13) The measures provided for in this Decision are in accordance with the opinion of the Radio Spectrum Committee,

HAS ADOPTED THIS DECISION:

*Article 1*

This 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 3 400-3 800 MHz band for terrestrial systems capable of providing electronic communications services.

*Article 2*

1. No later than six months after entry into force of this Decision Member States shall designate and make available, on a non-exclusive basis, the 3 400-3 600 MHz band for terrestrial electronic communications networks, in compliance with the parameters set out in the Annex to this Decision.

2. By 1 January 2012 Member States shall designate and subsequently make available, on a non-exclusive basis, the 3 600-3 800 MHz band for terrestrial electronic communications networks, in compliance with the parameters set out in the Annex to this Decision.

3. Member States shall ensure that networks referred to in paragraphs 1 and 2 give appropriate protection to systems in adjacent bands.

4. Member States shall not be bound to implement the obligations under this Decision in geographical areas where coordination with third countries requires a deviation from the parameters in the Annex to this Decision.

Member States shall make all practicable efforts to solve such deviations, which they shall notify to the Commission, including the affected geographical areas, and publish the relevant information pursuant to Decision No 676/2002/EC.

*Article 3*

Member States shall allow the use of the 3 400-3 800 MHz band in accordance with Article 2 for fixed, nomadic and mobile electronic communications networks.

[1] OJ L 91, 7.4.1999, p. 10. Directive as amended by Regulation (EC) No 1882/2003 (OJ L 284, 31.10.2003, p. 1).
[2] OJ L 108, 24.4.2002, p. 21.
[3] OJ L 108, 24.4.2002, p. 33. Directive as amended by Regulation (EC) No 717/2007 (OJ L 171, 29.6.2007, p. 32).

*Article 4*

Member States shall keep the use of the 3 400-3 800 MHz band under scrutiny and report their findings to the Commission to allow regular and timely review of the Decision.

*Article 5*

This Decision is addressed to the Member States.

Done at Brussels, 21 May 2008.

*For the Commission*
Viviane REDING
*Member of the Commission*

*ANNEX*

## PARAMETERS REFERRED TO IN ARTICLE 2

The following technical parameters called block edge mask (BEM) are an essential component of conditions necessary to ensure coexistence in the absence of bilateral or multilateral agreements between neighbouring networks. Less stringent technical parameters, if agreed among the operators of such networks, can also be used. Equipment operating in this band may also make use of e.i.r.p. ([1]) limits other than those set out below provided that appropriate mitigation techniques are applied which comply with Directive 1999/5/EC and which offer at least an equivalent level of protection to that provided by these technical parameters ([2]).

A) LIMITS FOR IN-BLOCK EMISSIONS

*Table 1*

**E.i.r.p. spectral density limits for fixed and nomadic deployments between 3 400 and 3 800 MHz**

| Station type | Maximum e.i.r.p. spectral density (dBm/MHz) (including tolerances and automatic transmitter power control (ATPC) range) |
|---|---|
| Central station (and repeater station downlinks) | + 53 ([1]) |
| Terminal station outdoor (and repeater station uplinks) | + 50 |
| Terminal station (indoor) | + 42 |

([1]) The central station e.i.r.p. spectral density value given in the table is considered suitable for conventional 90 degrees sectorial antennas.

*Table 2*

**E.i.r.p. spectral density limits for mobile deployments between 3 400 and 3 800 MHz**

| Station type | Maximum e.i.r.p. spectral density (dBm/MHz) (Minimum ATPC range: 15 dB) |
|---|---|
| Central station | + 53 ([1]) |
| Terminal station | + 25 |

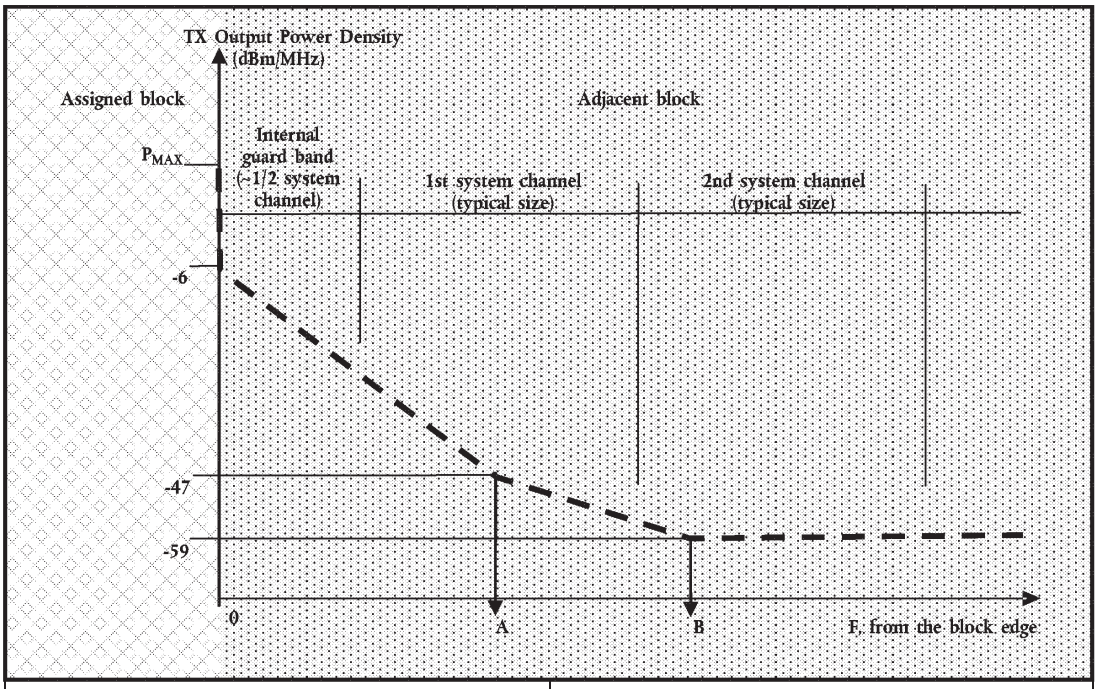
([1]) The central station e.i.r.p. spectral density value given in the table is considered suitable for conventional 90 degrees sectorial antennas.

([1]) Equivalent isotropically radiated power.
([2]) The generic technical conditions applicable to fixed and nomadic networks are described in Harmonised Standards EN 302 326-2 and EN 302 326-3, which also include definitions for a central station and a terminal station. The term central station may be considered equivalent to the term base station in the context of mobile cellular networks.

B) LIMITS FOR OUT-OF-BLOCK EMISSIONS (BLOCK EDGE MASK FOR CENTRAL STATIONS)

*Figure*

**Central station out-of-block emissions**




| Frequency offset | Definition (% of the size of the assigned block) |
|---|---|
| A | 20 % |
| B | 35 % |
| NB: The percentages given in the 'Definition' column refer to the smaller of adjacent blocks, if blocks are of unequal size. | |

*Table*

**Tabular description of central station block edge mask**

| Frequency offset | Central station transmitter output power density limits (dBm/MHz) |
|---|---|
| In-band (within assigned block) | See Tables 1 and 2 |
| $\Delta F = 0$ | – 6 |
| $0<\Delta F<A$ | $-6-41\cdot(\Delta F/A)$ |
| A | – 47 |
| $A<\Delta F<B$ | $-47-12\cdot((\Delta F-A)/(B-A))$ |
| $\Delta F \geq B$ | – 59 |

# ELECTRONIC COMMUNICATIONS COMMITTEE

ECC Decision
of 30 March 2007
on availability of frequency bands between 3400-3800 MHz
for the harmonised implementation of
Broadband Wireless Access systems (BWA)

(ECC/DEC/(07)02)

## EXPLANATORY MEMORANDUM

## 1 INTRODUCTION

This CEPT/ECC Decision addresses the availability of frequency bands between 3400-3800 MHz for the harmonised implementation of Broadband Wireless Access (BWA) systems.

BWA is a descriptive term for radiocommunications systems providing wireless delivery (mainly to an end user but not exclusively) of broadband traffic that can encompass fixed, nomadic and mobile applications. It is also considered that BWA systems might include backhauling services for the same or a second operator.

Results of CEPT/ECC studies clearly identify the band 3400-3600 MHz as the widest available choice for current and future BWA deployment in CEPT. The band 3600-3800 MHz has been identified as a possible additional or alternative frequency band. On the basis of a survey undertaken by ERO in 2005, updated in 2006, a clear majority of European countries indicated that they already use the 3400-3600 MHz band for Fixed Wireless Access (FWA). In addition, it was also indicated in the survey that the use of the 3600-3800 MHz band for wireless access systems was at that time limited to a few European countries.

To prepare the harmonisation of the frequency bands 3400-3600 MHz and 3600-3800 MHz for BWA, the following sharing considerations have been carried out:

- The intra-service sharing (i.e. co-existence rules for two BWA systems/cells of different operators) was originally addressed in ECC Report 33 (February 2006) for FWA/NWA deployment. The subsequent studies of mobile usage mode, i.e. Mobile Wireless Access (MWA) systems, were based on certain assumptions that included un-coordinated deployment as well as possible concentration of users (with active user density representative of BWA scenarios) in indoor environment. These studies indicated that a guard band of around one channel might be needed for MWA Terminal Station (TS) to TS compatibility scenario, which is understood to be implicitly provided by Central Station (CS) Block Edge Mask requirements.

- The inter-service sharing of BWA vs. other systems and/or services across entire 3400–3800 MHz range. The other systems and/or services considered in this study were Electronic News Gathering and Outside Broadcasting (ENG/OB), Fixed Point-to-Point links, Fixed-Satellite Service (Space-to-Earth) and Radiolocation Service (primary allocation below 3400 MHz and secondary allocation above 3400 MHz). The results of these studies are contained in ECC Report 100. This Report provides guidance for Administrations on co-ordination between BWA and other systems/services in the band, the details of the coordination depending upon the characteristics of other systems/services and the BWA as well as BWA usage mode. This includes guidance for co-channel sharing scenarios as well as for some adjacent compatibility cases, such as the impact from BWA operation in the 3400-3600 MHz band into FSS earth station receivers operating above 3600 MHz.

## 2 BACKGROUND

In 1998 the band 3400-3600 MHz was identified as a preferred frequency band for FWA (ERC/REC13-04, ERC/REC14-03, ERC Report 25 refer). The band 3600-3800 MHz is also used in some CEPT countries for multipoint FWA systems in accordance with provisions of ERC/REC 12-08. Consequently, many CEPT administrations have already delivered FWA licences to operators in order to provide FWA services. These authorisations are more often technologically neutral and provide flexibility and freedom for operators to choose the best use of the spectrum for fixed applications. Any modification of the use of the spectrum, especially on the usage mode, shall be analysed in terms of compatibility and general policy for the licensed band.

During recent years the broadband connectivity has been increasing in Europe dramatically, boosted by the demand for high speed access to the Internet, large volume e-mailing, video and audio streaming and file sharing and further innovative multimedia services. The prospects of BWA take-up have been changing recently after the consolidated industry efforts resulted in development of open inter-operability standards and new modulation technologies, allowing to overcome the former line-of-sight requirements for links in subject bands, hence allowing deployment of easy-to-install indoor user terminals. Recognising this ever increasing demand for broadband connectivity and the improved prospects of radiocommunications systems in satisfying these demands in a most universal way, the ECC has studied

the advantages and disadvantages of the development of a regulatory framework for BWA in the frequency band 3400-3800 MHz.

BWA systems are expected to be mainly deployed in all usage modes i.e. FWA, Nomadic Wireless Access (NWA) and MWA, where the CS will be at a fixed location, while TS will be deployed in a ubiquitous way. This Decision did not consider wireless access systems using Multipoint-to-Multipoint (MP-MP, also known as Mesh) architectures. Therefore further studies might be necessary in order to verify the applicability of this Decision for MP-MP (Mesh) systems subject to market availability of such systems.

It should be noted that BWA TSs may use either directional or omni-directional antennas. It is assumed that, for FWA/NWA use, the vast majority of TSs using omni-directional antennas will be operated indoors, but this may not necessarily be the case for MWA use.

The more traditional authorisation approach required the regulator to make decisions between the service definitions identified for each particular frequency band within an allocation table (e.g. European Common Allocations table in ERC Report 25). This then required the regulator to define specific operating conditions. These conditions were required to manage the interference potential for the specific usage mode (e.g. fixed and mobile). Therefore, this may have meant that not all of the usage modes would be permitted. In some CEPT countries there has already been a move towards spectrum authorisations that allow operators flexibility in the manner in which networks are deployed and configured. These are spectrum block geographical area authorisations. This is where the operator is given authorisation to use a particular frequency block for a defined geographic area, rather than defining the operating conditions (e.g. specific location of transmitters, specific bandwidth etc.). In this regime it could be possible, depending on the national situation, to give to the operators the flexibility to determine the usage mode. However it has to be acknowledged, that the need for managing the different interference potential related to the specific usage mode might result in limiting this additional flexibility, or in different constraints for the use of some modes.

## 3 REQUIREMENT FOR AN ECC DECISION

The allocation or designation of frequency bands for use by a service or system under specified conditions in CEPT administrations is laid down by law, regulation or administrative action. ECC Decisions are required to deal with the radio spectrum related matters and for the carriage and use of equipment throughout Europe. The harmonisation on an European basis supports the *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*. A commitment by CEPT administrations to implement an ECC Decision will provide a clear indication that the required frequency bands will be made available on time and on a European-wide basis.

**ECC Decision**
**of 30 March 2007**

**on availability of frequency bands between 3400-3800 MHz**
**for the harmonised implementation of**
**Broadband Wireless Access systems (BWA)**

**(ECC/DEC/(07)02)**

"The European Conference of Postal and Telecommunications Administrations,

*considering*

a) that the frequency bands 3400-3600 MHz and 3600-3800 MHz are allocated to the Fixed Service and to the Fixed-Satellite Service (space-to-Earth) on a primary basis in ITU Region 1;

b) that the bands in considering "a" are allocated to the Mobile Service on a secondary basis and the band 3400-3600 MHz is also allocated to the Radiolocation Service on a secondary basis in ITU Region 1;

c) that definitions of Broadband Wireless Access (BWA) applications encompassing Fixed Wireless Access (FWA), Nomadic Wireless Access (NWA), and Mobile Wireless Access (MWA) can be found in Recommendation ITU-R F.1399;

d) that the European Common Allocation Table (ECA) specified in ERC Report 25 foresees an allocation in the frequency band 3400-3800 MHz on a primary basis to the Mobile Service, recognising that in some countries the status of the Mobile Service may be secondary;

e) that the ECA indicates the major co-primary utilisation of the band 3400-3600 MHz for BWA applications and coordinated SAP/SAB applications for occasional use;

f) that the ECA indicates the major co-primary utilisation of the band 3600-3800 MHz for BWA, medium/high capacity Fixed Service links and FSS applications;

g) that the band 3400-3600 MHz has been identified as a preferred frequency band for FWA (ERC/REC 13-04, ERC/REC 14-03 refer);

h) that the band 3600-3800 MHz has been also used in some CEPT countries for multipoint FWA systems in accordance with provisions of ERC/REC 12-08;

i) that in some countries the band 3400 MHz to 3410 MHz is used by land, airborne and naval military radars;

j) that FSS earth stations are operated in the bands 3400-3600 MHz and 3600-3800 MHz, especially above 3700 MHz;

k) that Radio Amateur Services are authorised in the frequency band 3400-3410 MHz on a secondary basis;

l) that spectrum authorisations for BWA in the bands in considering "a", based on assignment/allotment of spectrum blocks over a defined geographical area, may allow one or more of the applications of BWA referred to in considering "c";

m) that for spectrum authorisations for BWA in the bands in considering "a" that are given by Administrations to individual equipment, i.e. Central Stations (CS), the conditions of use may need to be qualified to manage the technical arrangements between a number of different operators;

n) that for an efficient introduction of BWA in the frequency bands identified in considering "a", administrations will have to consider an appropriate co-ordination regime, e.g. licensing on a regional, local area or on an individual equipment basis, that takes in to account the extent of the use of these bands by other systems or services (e.g. FSS, Point-to-Point FS, etc);

o) that in general, if suitable separation distance is set up between BWA CS and other systems the impact of BWA Terminal Stations (TS) is not significant. Therefore registration of CSs alone may be sufficient for managing sharing issues;

p) that within the two frequency bands defined in considering “a”, if both bands completely available for BWA, pairing of sub-bands 3400-3500/3500-3600 MHz and 3600-3700/3700-3800 provide suitable frame conditions for Frequency Division Duplex (FDD) and Time Division Duplex (TDD) systems or their combination;

q) that ECC Report 33 on "The analysis of the coexistence of point-to-multipoint Fixed Wireless Systems cells in the 3.4-3.8 GHz band" (February 2006) provides guidelines for efficient, technology independent deployment of 3.5 GHz and 3.7 GHz point-to-multipoint FWA systems;

r) that ECC Report 76 on "Cross-border coordination of multipoint fixed wireless systems in frequency bands from 3.4-33.4 GHz" (February 2006) addresses the issue of finding a most suitable method and criteria for cross-border coordination between point-to-point systems and multipoint FWA systems located on different sides of a national border;

s) that ECC Recommendation (04)05 (adopted in February 2006) provides “Guidelines for accommodation and assignment of multipoint fixed wireless systems in frequency bands 3400-3600 MHz and 3600-3800 MHz”;

t) that ECC Report 100 on ”Compatibility studies in the band 3400-3800 MHz between Broadband Wireless Access Systems (BWA) and other services” addresses the inter-service sharing and adjacent band compatibility of BWA vs. other existing services/systems (point-to-point, ENG/OB, fixed-satellite service (space-to-Earth) and radiolocation service);

u) that taking into account the availability of spectrum on a national basis, some CEPT administrations have already released spectrum within the 3400-3600 MHz band and may also consider providing spectrum to BWA within the 3600-3800 MHz band as far as compatible operation with earth stations in the fixed-satellite service (s-E) as well as with existing Point-to-point links in the fixed service is possible;

v) that it is important to make spectrum available for BWA in order to meet an overall demand for broadband connectivity;

w) that the identification of the bands defined in considering “a” for BWA does not preclude the future use of these bands by other systems and services to which these bands are allocated or designated;

x) that the frequency assignment/allotment for BWA should also take into account the existing bi- or multi-lateral international agreements and general cross-border co-ordination procedures as given in ITU Radio Regulations to ensure suitable protection of similar or different systems and services in neighbouring countries;

y) that in EU/EFTA countries the radio equipment that is under the scope of this Decision shall comply with the R&TTE Directive. Conformity with the essential requirements of the R&TTE Directive may be demonstrated by compliance with the applicable harmonised European standard(s) or by using the other conformity assessment procedures set out in the R&TTE Directive;

DECIDES

1. that spectrum shall be designated for BWA deployment within the band 3400-3600 MHz and/or 3600-3800 MHz, subject to market demand and with due consideration of other services deployed in these bands;

2. that administrations shall consider allowing flexible usage modes within authorised BWA deployments in the frequency bands identified in Decides 1, taking into account the considerations as described in the Annex;

3. that for the deployment of BWA networks in the frequency bands identified in Decides 1, administrations shall take into account the in-band and adjacent band compatibility with other services/systems (e.g. FS, FSS, ENG/OB, etc) and as a result, coordination of the BWA CS with existing services/systems may be required in the concerned area;

4. that this Decision enters into force on 30 March 2007;

5. that the preferred date for implementation of this Decision shall be 01 July 2007;

6. that CEPT administrations shall communicate the national measures implementing this Decision to the ECC chairman and the Office when the Decision is nationally implemented."

*Note:*

*1 The following Members have a derogation to implement this Decision:*
*Spain until 31 December 2012*

*2 Please check the Office web site (http://www.ero.dk) for the up to date position on the implementation of this and other ECC Decisions.*

## Annex

## Considerations for Implementation of Flexible Usage Mode for BWA in 3400-3600 MHz and/or in 3600-3800 MHz

### 1. Definitions

The reference to "flexible usage mode" means regulatory provisions (e.g. licence conditions), which would allow BWA licence holder to deploy various types of TSs: fixed (Fixed Wireless Access - FWA), nomadic (Nomadic Wireless Access - NWA) or mobile (Mobile Wireless Access - MWA).

The detailed definitions of FWA, NWA and MWA are given in Recommendation ITU-R F.1399.

A typical example of FWA TS could be a stationary roof-top user equipment. An example of NWA TS could be a desk-top portable user equipment or laptop PC equipped with the internal BWA access card. An example of MWA TS could be a handheld user terminal.

### 2. General considerations

When deciding on granting flexible usage mode rights to BWA licence(s), administrations shall consider following issues:

- Compliance with relevant provisions of legal instruments governing the field of radiocommunications, such as the ITU Radio Regulations, EU legislation and corresponding national telecommunications laws (i.e. national acts transposing ITU and EU acts, as well as any further sovereign regulations in the field);
- Legacy situation, e.g. consider the regulatory limitations and conditions of existing (previously issued) authorisations in the frequency bands subject to this Decision;
- Technical provisions established by existing international frequency co-ordination agreements.

### 3. Technical considerations

As a starting point, the guidance given in ECC Recommendation (04)05 on technical conditions for implementation of flexible usage mode, to be set in the technology neutral BWA licence process, shall be considered.

Furthermore, the introduction of MWA usage mode will be subject to following additional requirements for deployment of mobileTS:

a. Maximum radiated power density of 25 dBm/MHz;
b. Minimum ATPC range of 15 dB;
c. When blocks are assigned contiguously (without external guard bands) care should be taken not to allow a TS transmit centre frequency closer than one channel width from the block edge unless co-ordination between operators is undertaken. Co-ordination may include the application of other specific interference mitigation measures. However it is understood that such a "virtual guard channel" is implicit, under normal circumstances, through application of the CS Block Edge Mask as recommended in ECC/REC(04)05.

**Radiocommunication Study Groups**

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**1 April 2008**
**English only**

# United Kingdom

## ADDITIONAL INFORMATION FOR PRELIMINARY DRAFT NEW REPORT

## Compatibility of broadband wireless access networks and fixed-satellite service networks in the 3 400-4 200 MHz band

### 1 Introduction

The Executive summary of the preliminary draft new Report (Annex 1 to Doc. 4A/429, Chairman's Report, ITU-R WP 4A, 4-8 June 2007) on the compatibility of BWA states "As BWA is being introduced, harmful interference and loss of service for FSS receivers has been reported. Thus introduction of broadband wireless access (BWA) networks in portions of the 3 400-3 800 MHz band will have a detrimental impact on FSS reception in the entire 3 400-4 200 MHz band due to interference received both in-band and out-of-band." Section 8.1 of the PDN Report considers the possibility that individually licensed or registered FSS earth stations may be protected from harmful interference via detailed coordination by BWA system operators to ensure that harmful interference is not caused to FSS receivers.

This paper examines the situation in the United Kingdom regarding the practical coordination zones around licensed earth stations and considers the possible impact of the introduction of mobile terminals within BWA systems. It also describes Ofcom's experience to date regarding licensed FWA systems in the band 3 400-3 600 MHz and more particularly the band 3 600-4 200 MHz.

Conclusion e) of the PDN Report regarding the possibility of successful coexistence of FSS and particular BWA systems in a spectrum environment such as exists in the UK is supported. Ofcom's experience indicating that, with careful management, the introduction of BWA systems can lead to more efficient use of the spectrum and eventually provide consumer benefits through competitive delivery of broadband.

### 2 Background and Regulatory situation

Historically, the bands 3 600-4 200 MHz and 5 925-6 750 MHz were used in the third quarter of the 20th century to provide part of the main backbone telecommunications infrastructure in the UK, with a network of terrestrial microwave links between the major commercial centres constructed in a traditional figure of 8 network with redundancy. The band 3 400-3 600 MHz is not allocated to the FSS in the UK. As such, initial use of C-band by satellite earth stations was constrained by the requirement to coordinate with the existing terrestrial users and this has led to many of the major teleports in the band being located either many kilometres from major conurbations, or having to

provide high levels of local shielding in order to mitigate interference when located closer to major conurbations. Because of the pre-existing fixed links, there has been little use of C-band receive only terminals, though a small number are known to exist, and this is discussed below. Since the early 1990s, a licence has been held by successive operators to provide FWA services in paired bands between 3 605-3 689 MHz and 3 925-4 009 MHz. A variety of modulation schemes and technology have been used, mainly consisting of DS-CDMA and FH-CDMA followed by a COFDM modulation scheme. The major drawback of all of these schemes was the need to successfully coordinate both FWA bands with existing terrestrial and satellite users before service could be offered. With the introduction of WiMAX technology, it has been possible for the current licensee to successfully coordinate the lower band with existing C-band earth stations in the majority of cases where clearance has been sought at the maximum allowed e.i.r.p. density (currently 14 dBW/MHz), with several successful trials being held just beyond line of sight distances of major Teleports. The major contributory factor to this recent success is that as explained below, the majority of UK earth stations are still operating in the conventional C-band of 3 700-4 200 MHz, facilitating coordination of the WiMAX TDD service in the band 3 625-3 689 MHz. Coordination of the upper band has proved more problematical, though it is possible to use the band for point to point links where advantage can be taken of better antenna discrimination.

Whilst Ofcom doesn't licence terminals for receive frequency use, those terminals that are either licensed to transmit in the 6 000 MHz band, or are co-sited with a licensed earth station transmitter, can register their receive emissions and have them taken into consideration when new assignments are made to terrestrial services in the band. As such, there is a requirement on the FWA licensee in the band 3 600-4 200 MHz to coordinate any Base station and terminal station that might cause interference to an existing C-band satellite earth station.

Currently there are 112 receive C-band satellite earth stations associated with licensed terminals that are registered with Ofcom in the UK spread across some thirty sites.

Of these 112 terminals, twenty are pre registered ESV terminals for berths at three quays in the same harbour in Scotland, all with receive frequencies above 4 000 MHz.

Fourteen terminals at other sites are licensed to operate down to 3 600 MHz, though of these, only four are registered to operate to a satellite with a 3 600 MHz capability. Another seven are operating to satellites with a lower frequency of 3 625 MHz and another three operate to satellites with a lowest frequency of 3 700 MHz.

Eighteen of the remaining terminals are registered to operate down to 3 625 MHz and apart from one operating to a satellite with 3 700 MHz as its lowest frequency, all are operating to satellites with a 3 625 MHz capability.

Three other terminals are registered to operate with a lowest frequency between 3 625 MHz and 3 700 MHz, and one of these is operating to a satellite with a 3 700 MHz lowest frequency.

Of the remaining terminals, 40 are registered with lowest receive frequencies between 3 700 MHz and 4 000 MHz and eleven are registered with a lowest receive frequency higher than 4 000 MHz.

In addition to these receive emissions associated with licensed terminals, Ofcom is also aware of four sites with receive only facilities that span the whole band and operational arc, along with another six sites with a restricted receive only requirement above 4100 MHz. The whole band sites are mainly in rural areas and are taken into consideration.

Currently in the European Community there are plans to introduce BWA in a harmonised manner, including mobile use and this has led to a number of earth station operators expressing concern regarding the impact of mobile terminals in the coordinated band. The area analysis provided

below for a number of the major teleport sites in the UK illustrates that provided the BWA base stations and terminal stations are coordinated, then the impact of mobile terminals should be accounted for by the current mandatory coordination.

## 3 Detailed coordination parameters in the band 3 600-4 200 MHz

In the UK, each FWA Base station site and a selection of terminal station sites within each service area are tested against the full database of registered earth stations in the band, using a 200m terrain data base and a 20% long term and 0.05% short term criteria, the maximum licensed FWA power (currently 14 dBW/MHz) and a check for frequency overlap. If either of the criteria is exceeded, then the FWA operator is required to enter into detailed coordination with the potentially affected earth station operator.

As indicated in the PDN Report, the distances involved can vary and are very dependent on local terrain. Figures 1 – 6 below illustrate the potential long term coordination areas around a selection of the larger teleport sites in the UK for base and terminal stations at the maximum e.i.r.p. densities currently being considered in the draft EC decision, namely 23 and 20 dBW/MHz and for a nomadic/mobile terminal at a power slightly higher than that possible with current technology, namely 0 dBW/MHz. The base stations are assumed to be mounted at a height of 20 metres, terminals stations 10 metres and the nomadic stations at 1.5 metres and no discrimination is assumed at the BWA antenna (worst case, always max power towards the earth station). The satellite earth station parameters were taken from the registered parameters for a C-band earth station at each site and the I/N zones mapped for the relevant dish operating to both 62°E or 58°W, which are among the most popular orbital positions registered. The mapping was calculated using the shuttle 90 m terrain database and Recommendation ITU-R P.452-12, with no clutter losses or local shielding taken into account, and the I/N ranges set from -10 dB to >20 dB. Whilst it is recognised that the areas within which detailed coordination is required would be larger for short term interference, the purpose of the analysis was to illustrate that if the BWA base and fixed terminal stations are coordinated, then the probability is that the mobile terminals can also be considered coordinated.

## 4 Assessment of the impact of nomadic devices

As documented in previous studies and the PDN Report, it can be seen from the comparison of Figures 1(a) through to 6(a), that the size of the mitigation (detailed coordination) area for individual sites is dependent on the local horizon profiles. In particular the total mitigation area for both sites north of London (Figures 2 and 3) is larger than those for the other sites because of the elevated position of the sites compared to the Thames Valley to the south and east, the site in Figure 2 is 141 m above sea level (a.s.l.) and that in Figure 3 is 111m a.s.l., whereas the Thames Valley is only some 10-50 m a.s.l.

What is clearly seen from comparison of each set of plots, (Figure 1a, 1b, 1c, Figure 2a etc.) is that the mitigation area for BWA Base stations is similar to or slightly larger than that for Terminal stations and that both of these areas are in every case much larger than, and encompass the mitigation area for the BWA nomadic / mobile terminals.

In the UK, nomadic or mobile BWA terminals will have a listen before talk facility and as such will be unable to operate unless they are within the sector coverage of the BWA base station (typically no more than 2 km in an urban environment). Thus, provided the BWA base stations and terminal stations have been coordinated with registered earth stations, the probability of interference from nomadic BWA devices to the earth station, is negligible.

## 5 Experience of co-ordination to date

The most difficult coordination scenario to date involves the initial deployment of WiMAX by the licensee at Milton Keynes, just over 30 kms south west of the earth station site North of Bedford. The initial analysis indicated that, at the maximum licensed FWA powers, exceedences were predicted over the required co-frequency criteria of 5 dB for a long term time percentage of 20% and 17.5 dB for 0.05% short term interference. Further examination indicated an exceedence of 19 dB for 0.005% short term interference. As part of the detailed coordination between the earth station and FWA operators it was agreed to examine the additional shielding afforded to the earth station site by mixed deciduous / evergreen woods bordering the site to the south and west. Measurements made during February (minimum foliage) indicated that the woods afforded an additional 30 dB of local shielding in the direction of the potential interferers. On this basis, the FWA operator was given provisional permission to trial the WiMax systems on a non-interference basis until a coordination agreement is reached with the earth station operator.

Several FWA sites in the London area have been cleared against the earth station site to the north of London, detailed analysis showing that none of the earth stations at this site are registered to receive co-frequency with the lower BWA band.

The second site to the north west of London has a number of earth stations registered to receive at frequencies down to 3 600 MHz, however for the realistic sites so far requested in the London Basin, the 0.05% criteria has not been exceeded and previous measurements at the site required in order to coordinate with terrestrial fixed links indicate that additional shielding in the order of 34 dB at 4 GHz is available at the earth station site in the direction of central London.

Regarding LNB blocking, the experience to date has been that even in an urban environment, where some individual C- band terminals are licensed, the distance between FWA deployment sectors and C- band earth stations has been sufficient to ensure that the total received interference is below the tolerable threshold. If ubiquitous use of C-band satellite terminals in urban areas had developed in the UK, then this situation would only be resolved by a either a reduction in BWA power, or further restrictions on deployment.

## 6 Conclusions

The UK experience indicates that where FWA is coordinated with registered C-band satellite earth stations it is normally possible to coordinate the two services at distances approaching line of sight, either through frequency separation or shielding via local mitigation. Satisfactory detailed coordination and use of BWA in urban areas is likely to be possible in those countries where in the past it has been necessary for C-band earth stations to coordinate with co-primary terrestrial fixed links and there is little deployment of C-band satellite terminals in urban areas. Where such coordination is completed, it should also be possible to deploy nomadic or mobile BWA devices within the coverage zones of BWA base stations without causing additional interference to the coordinated earth station, though there would still remain an exclusion zone around the earth station where it would not be possible to provide BWA services.

## 7 Recommendation

The UK suggest that:

i) section 8.1 of the PDN Report be modified to reflect a more positive outcome for detailed coordination in those administrations where the majority of C-band earth stations are licensed or registered. The suggested modifications are:

When the FSS earth stations are individually licensed or registered such that the locations of the stations are known, there is a reasonable probability that coordination of the BWA and FSS earth stations could be achieved. This outcome is most probable in those administrations where the bands have previously been shared with terrestrial point to point links and there is little or no deployment of FSS earth stations in urban areas. This coordination can normally be facilitated by a combination of natural terrain features and local shielding at either or both ends of potential interference paths, along with frequency coordination and power reduction if necessary. According to the studies described, BWA systems within an area of several to over 100 kilometres around existing licensed earth stations operating in the same frequencies may cause interference to the latter. In order to minimise any impact, BWA operators should carry out careful coordination on a case-by-case basis such that harmful in-band interference would not be caused to these earth stations. It is important to note, however, that even in cases where attenuation due to local clutter reduces the separation distances, the outcome of coordination is likely to leave areas around earth stations where BWA services cannot be provided in the band.

To overcome interference due to the saturation and out-of-band emission problems which may potentially affect all FSS systems with LNA/ LNBs operating in the 3 400-4 200 MHz range the following mitigation techniques may be considered:

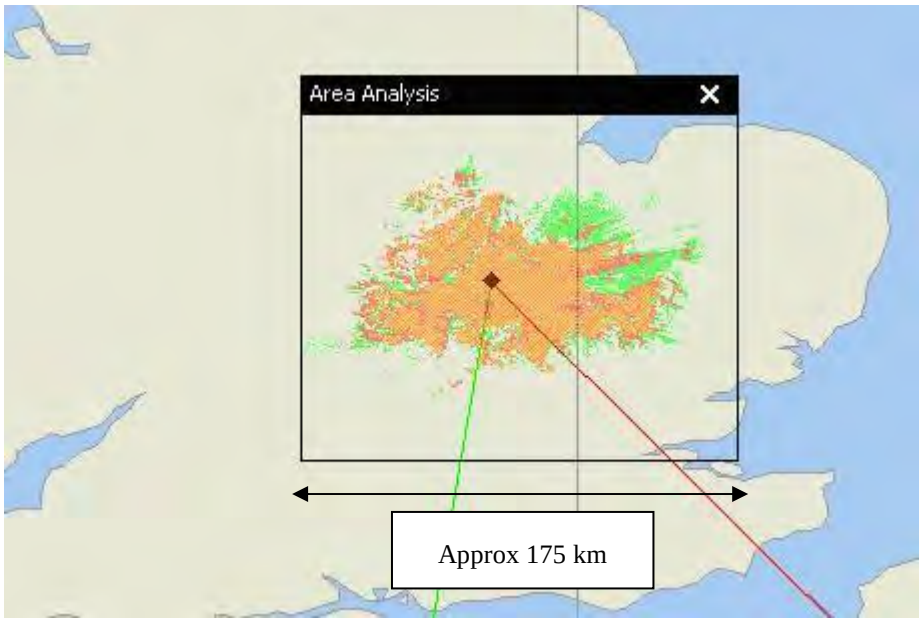
– retrofit the interfered-with FSS earth station with an LNB band pass filter;

– ensure that outdoor use of BWA terminal stations is coordinated via a combination of e.i.r.p. limits and detailed coordination of BWA coverage areas.

ii) the preliminary draft new Report “Compatibility of broadband wireless access networks and fixed-satellite service networks in the 3 400-4 200 MHz band” be liaised to ITU-R WPs 5A and 5C for comment and joint approval in a similar manner to the recommended treatment for SF series recommendations.

FIGURE 1(a)

**BWA Base Station e.i.r.p. density 23 dBW/MHz, height 20 m**

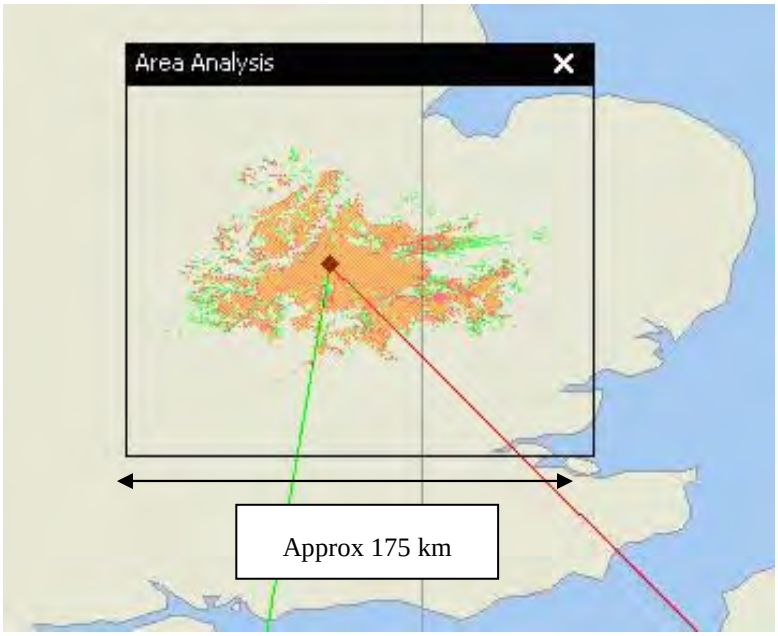



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Central Station deployment to an Earth Station site North of Bedford

FIGURE 1(b)

**BWA Terminal Station e.i.r.p. density 20 dBW/MHz, height 10 m**

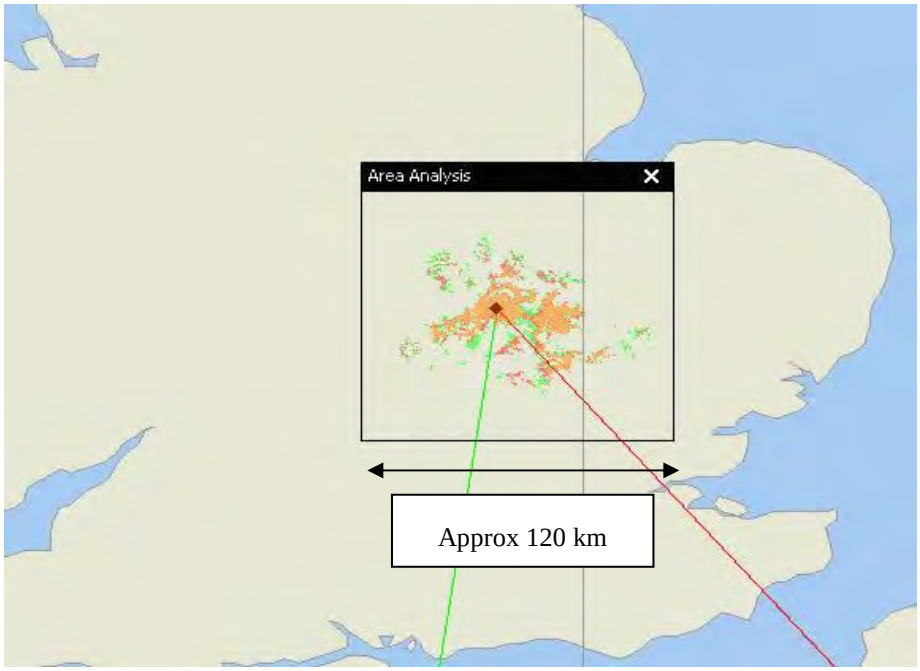



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Terminal Station deployment to an Earth Station site North of Bedford

FIGURE 1(c)

**BWA Mobile Station e.i.r.p. density 0dBW/MHz, height 1.5 m**

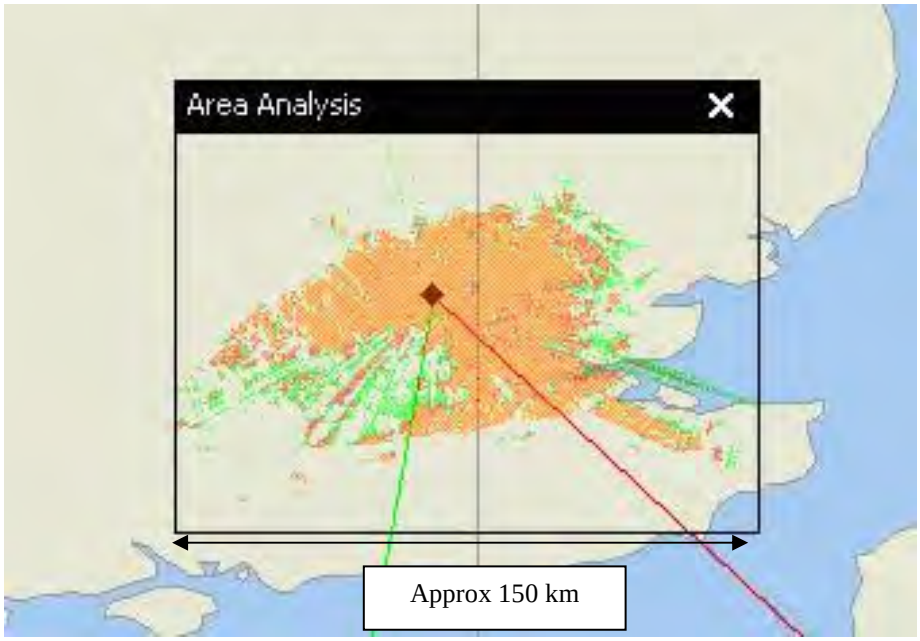



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Nomadic Station deployment to an Earth Station site North of Bedford

FIGURE 2(a)

**BWA Base Station e.i.r.p. density 23 dBW/MHz, height 20 m**

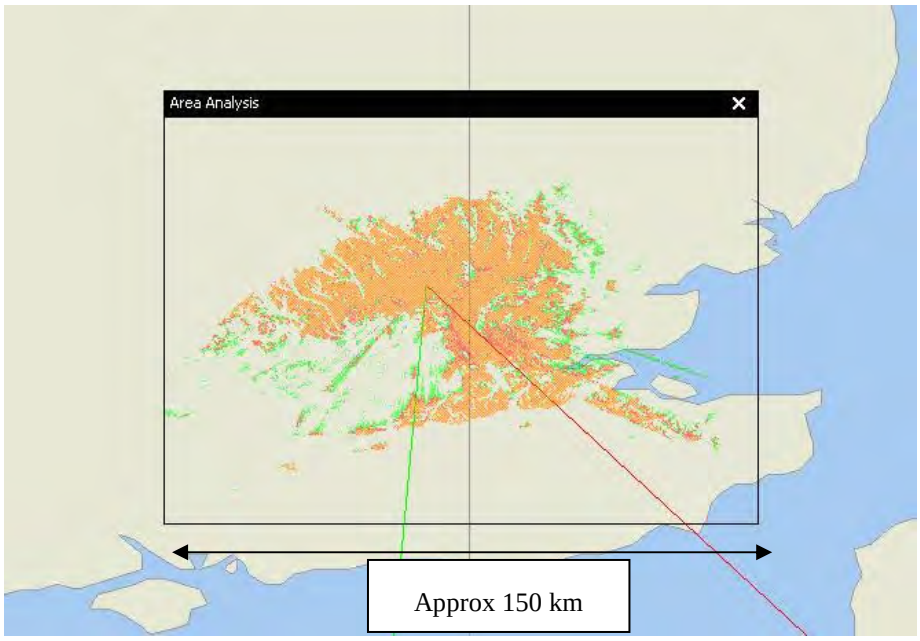



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Central Station deployment to anEarth Station site North of London

FIGURE 2(b)

**BWA Terminal Station e.i.r.p. density 20 dBW/MHz, height 10 m**

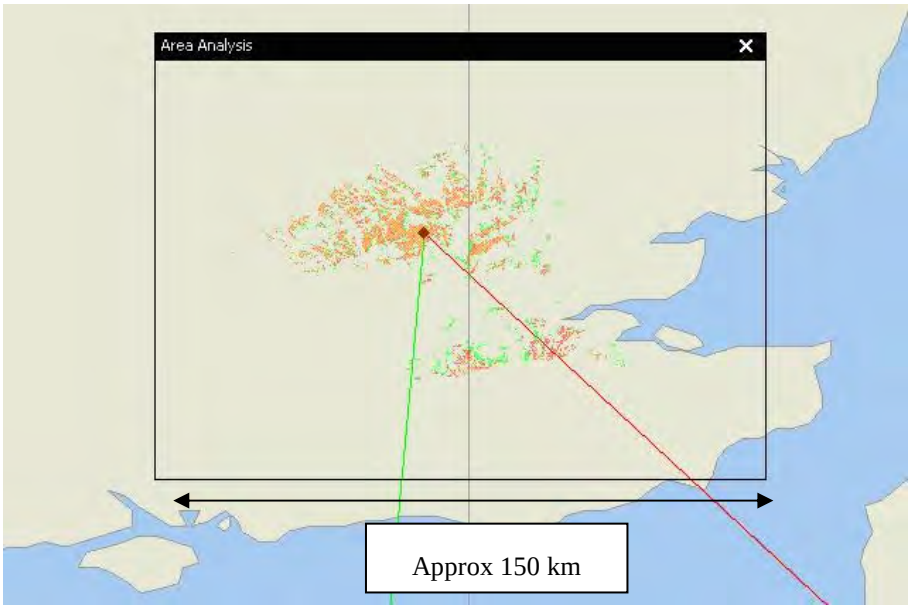



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Terminal Station deployment to an Earth Station site North of London

FIGURE 2(c)

**BWA Mobile Station e.i.r.p. density 0 dBW/MHz, height 1.5 m**

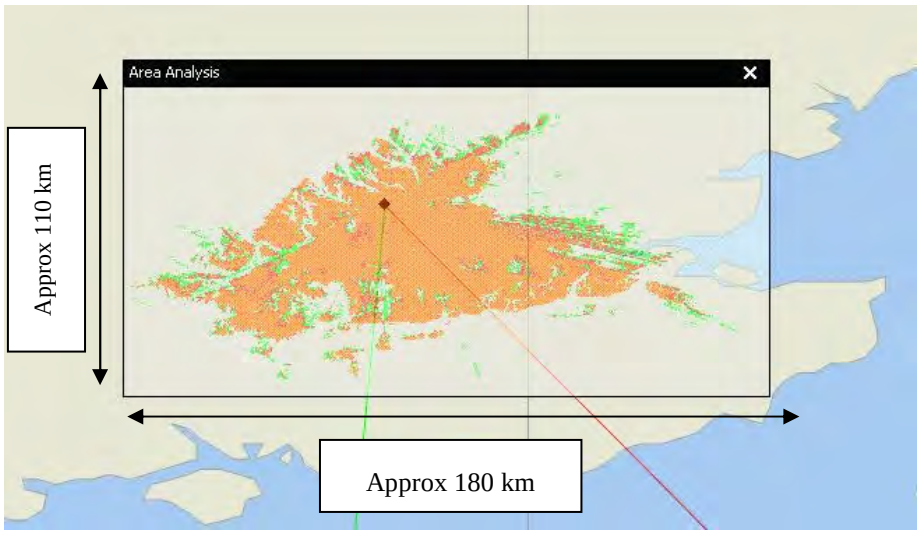



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Nomadic Station deployment to an Earth Station site North of London

FIGURE 3(a)

**BWA Base Station e.i.r.p. density 23dBW/MHz, height 20 m**

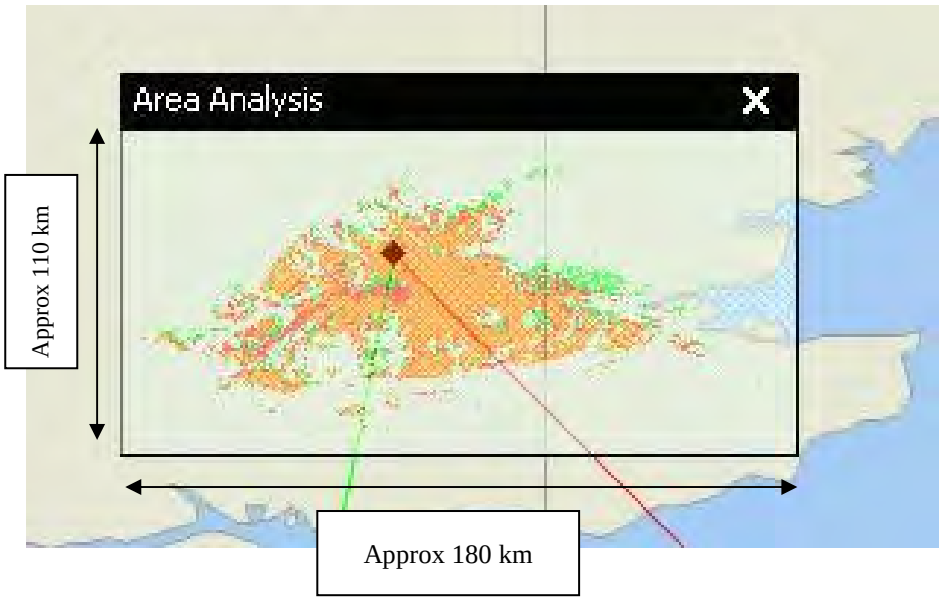



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Central Station deployment to an Earth Station site NW of London

FIGURE 3(b)

**BWA Terminal Station e.i.r.p. density 20 dBW/MHz, height 10 m**

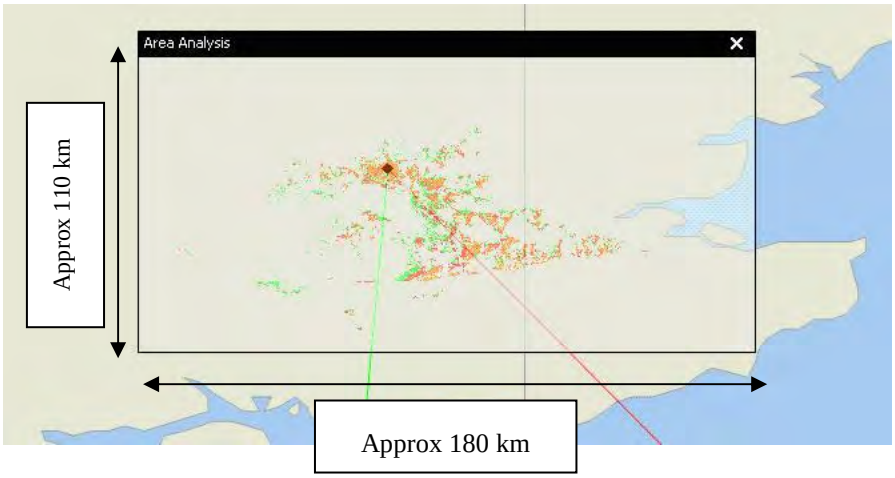



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Terminal Station deployment to an Earth Station site NW of London

FIGURE 3(c)

**BWA Mobile Station e.i.r.p. density 0 dBW/MHz, height 1.5 m**

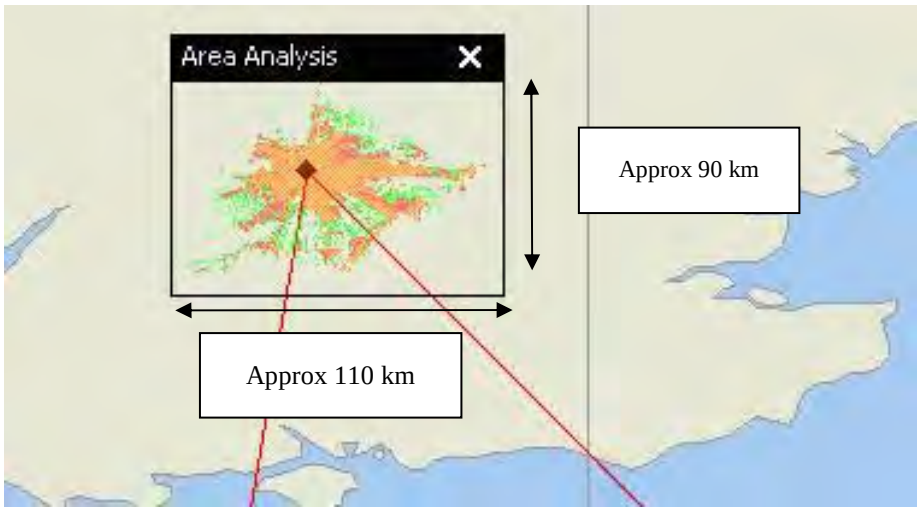



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Nomadic Station deployment to an Earth Station site NW of London

FIGURE 4(a)

**BWA Base Station e.i.r.p. density 23 dBW/MHz, height 20 m**

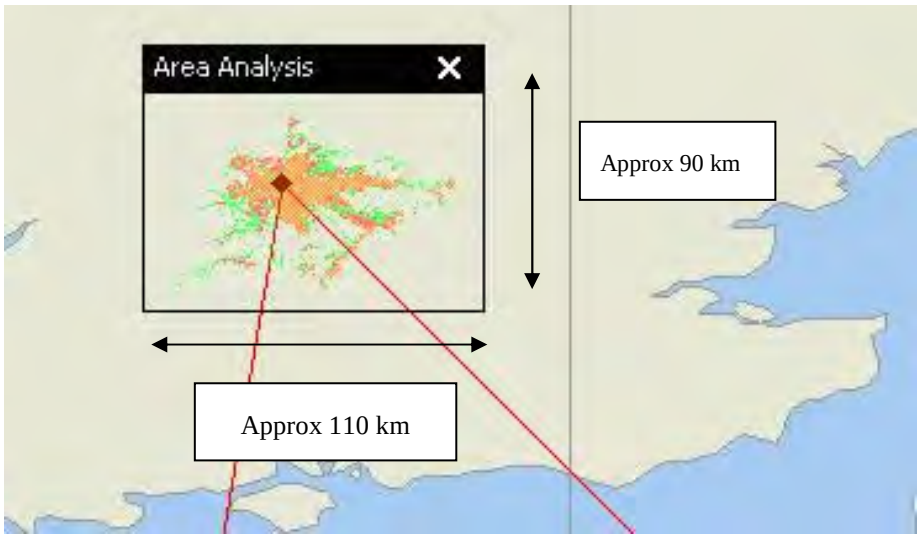



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Central Station deployment to an Earth Station site NW of Oxford

FIGURE 4(b)

**BWA Terminal Station e.i.r.p. density 20 dBW/MHz, height 10 m**

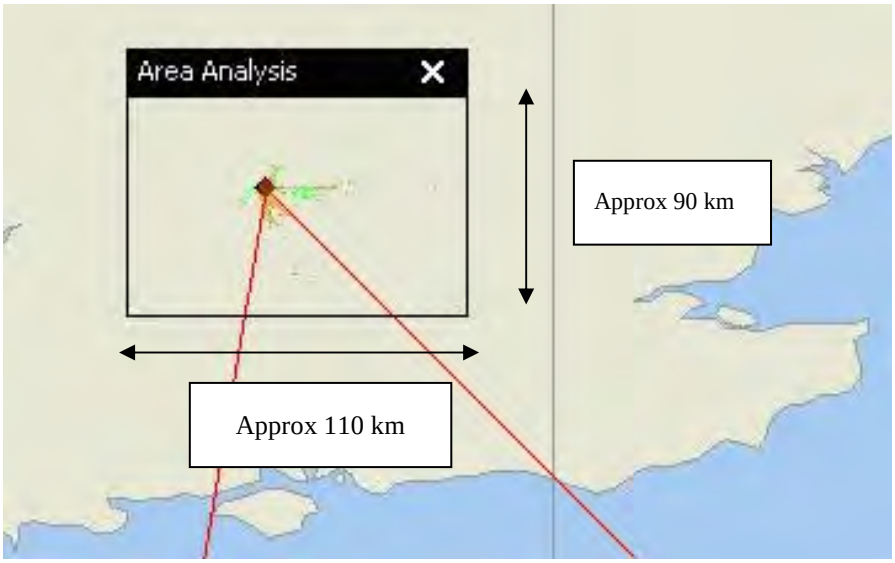



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Terminal Station deployment to an Earth Station site NW of Oxford

FIGURE 4(c)

**BWA Mobile Station e.i.r.p. density 0 dBW/MHz, height 1.5 m**

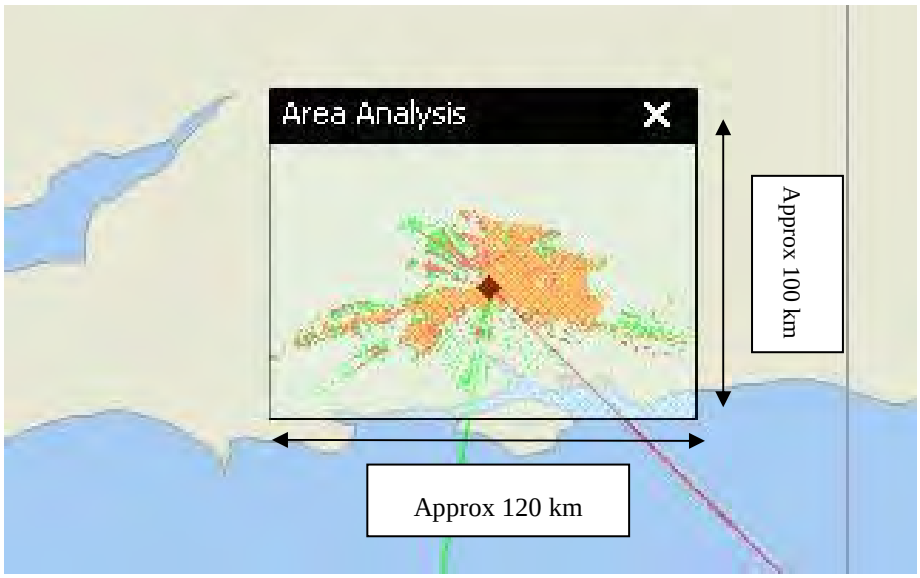



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Nomadic Station deployment to an Earth Station site NW of Oxford

FIGURE 5(a)

**BWA Base Station e.i.r.p. density 23 dBW/MHz, height 20 m**

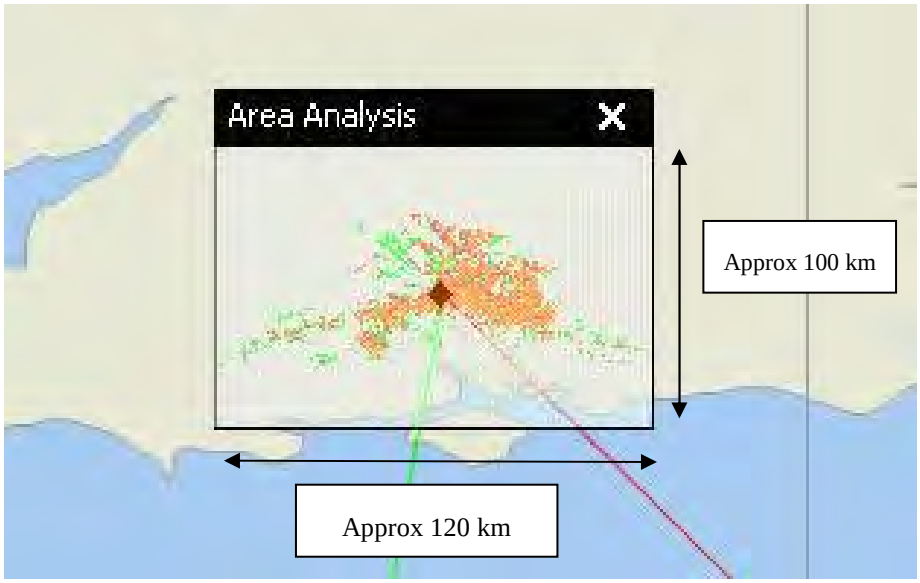



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Central Station deployment to an Earth Station site NW of Winchester

FIGURE 5(b)

**BWA Terminal Station e.i.r.p. density 20 dBW/MHz, height 10 m**

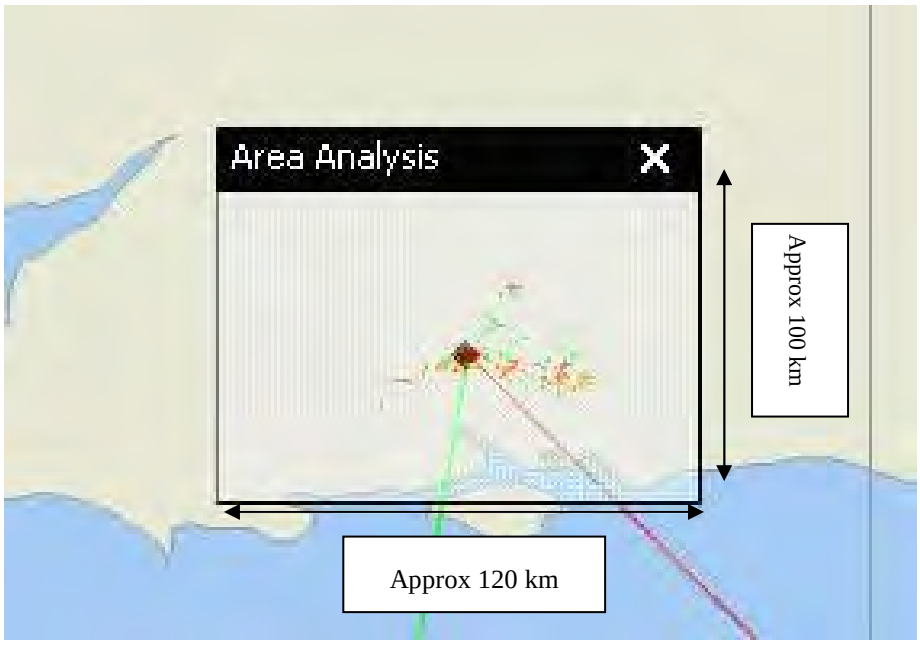



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Terminal Station deployment to an Earth Station site NW of Winchester

FIGURE 5(c)

**BWA Mobile Station e.i.r.p. density 0 dBW/MHz, height 1.5 m**

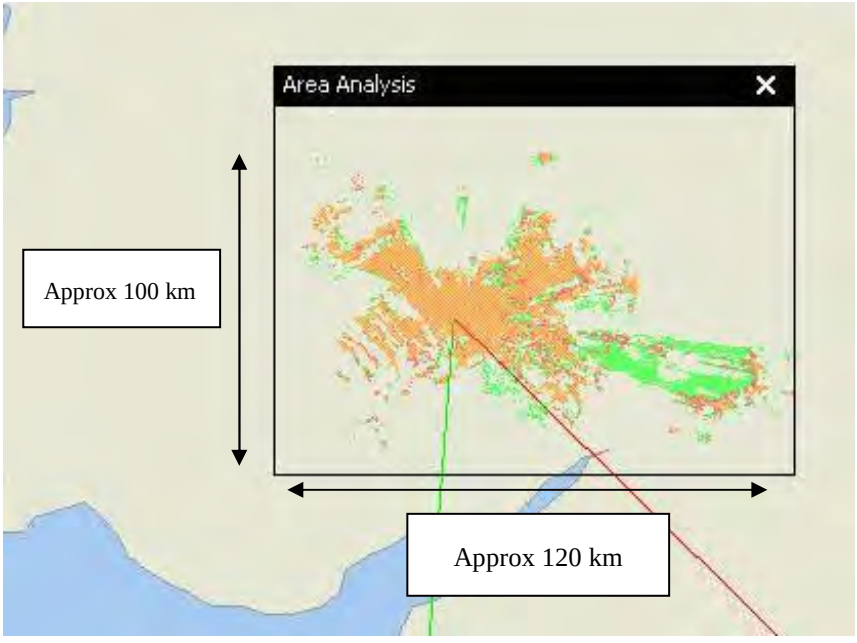



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Nomadic Station deployment to an Earth Station site NW of Winchester

FIGURE 6(a)

**BWA Base Station e.i.r.p. density 23 dBW/MHz, height 20 m**

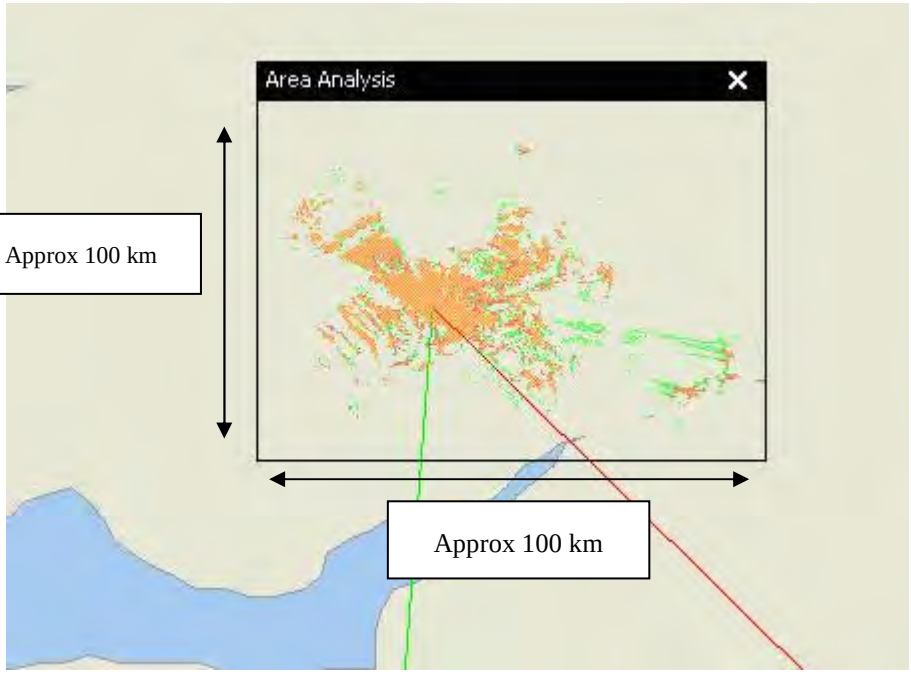



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Central Station deployment to an Earth Station site in the Wye Valley

FIGURE 6(b)

**BWA Terminal Station e.i.r.p. density 20 dBW/MHz, height 10 m**

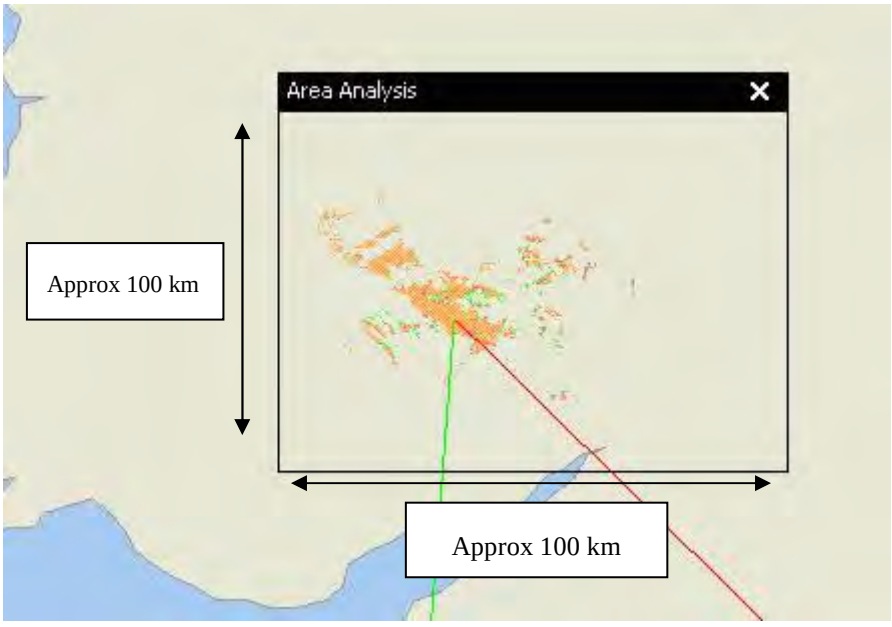



| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Terminal Station deployment to an Earth Station site in the Wye Valley

FIGURE 6(c)

**BWA Mobile Station e.i.r.p. density 0 dBW/MHz, height 1.5 m**




| I/N (dB) | Colour |
|---|---|
| -10 | |
| -5 | |
| -4.99 | |
| 0.0 | |
| 0.01 | |
| 20 | |

Area analysis for long term Interference from Nomadic Station deployment to an Earth Station site in the Wye Valley

# Compatibility of WiMAX terminals with satellite Earth stations

## Freedom 4

**2103\WESC\R\2.0**

**8 December 2008**

# Table of Contents

# 1 INTRODUCTION

Freedom4 have a licence to operate wireless local loop (WLL) services in the band 3605 – 3689 MHz paired with 3925-4009 MHz. The company hopes to change the terms of the current licence to allow terminal device mobility which, inter alia, would allow the use of the WiMAX mobile standards.

Part of the licensed band is shared with the downlinks to satellite earth stations, and the Freedom4 licence contains an obligation to protect these services. The work presented in this document was undertaken to quantify the separation distances required between WiMAX terminals and Earth station receivers at different probabilities and %-times.

The work was undertaken by Aegis to support the proposed submission by Freedom4 to Ofcom seeking a change in licence conditions

# 2 MODELLING

The requirement is an understanding of the decay of field strength from one, or many, WiMAX terminals under realistic conditions. While it would be possible to produce location-specific predictions (i.e. contour plots), such information would not allow general conclusions to be drawn.

It was therefore decided to make use of Monte-Carlo modelling methods to gather statistics of path loss over a large number of arbitrary, but realistic, paths.

Such Monte-Carlo modelling will allow an understanding of the location variability of interference; the temporal variability will be accounted for by running the propagation model for different %-times.

## 2.1 Propagation model

The ITU-R has produced a propagation model specifically for the purpose of evaluating interference between fixed link services and satellite earth stations. This ‘Recommendation P.452’ was developed based on measurements made predominantly over paths of more than 100km, where the main interference mechanism is ducting at small percentage times.

The key parts of the model are algorithms for the short-term ducting mechanism, and for diffraction, which is the dominant mechanism at median time and over shorter paths.

A relevant shortcoming of the P.452 model is that it does not include a realistic clutter model; In the applications originally envisaged for the model, both the Earth station and fixed link antennas would be expected to be in elevated, clear locations. In the UK, most earth stations are offered some protection by the local geography, and many are situated away from urban areas. Generally WiMAX base stations and

user terminals will be in cluttered locations, particularly in the case of laptop terminals, suggesting that the P.452 model may be overly cautions.

The current version of P.452 is version 13 (August 2007), and this is the model used in the study.

## 2.2 Monte Carlo model

The model has been configured to predict the interference at a chosen Earth station (real or hypothetical) from a population of WiMAX transmitters distributed randomly over a defined area.

For the case of interference from WiMAX base stations, each location is chosen at random (see Figure 2.1), and assumed to radiate omnidirectionally, but with a realistic vertical radiation pattern with appropriate downtilt. The aerial height may be either fixed or randomly chosen between defined limits.


**Figure 2.1: randomly distributed WiMAX base stations**

For the case of interference from user terminals, virtual 'base station' locations are generated randomly, as before. The active transmitters, however, are located not at these locations but randomly within a defined radius (e.g. 1km) of the virtual base station location (see Figure 2.2, where base stations are in blue, user terminals red). Where the user terminal has a directional antenna (i.e. the ProST equipment), this is

assumed to point at the base station location. The number of user terminals (e.g. 3) to be distributed around each base station is set at the start of the run; the interference from each set of user terminals is then aggregated at the Earth station receiver.

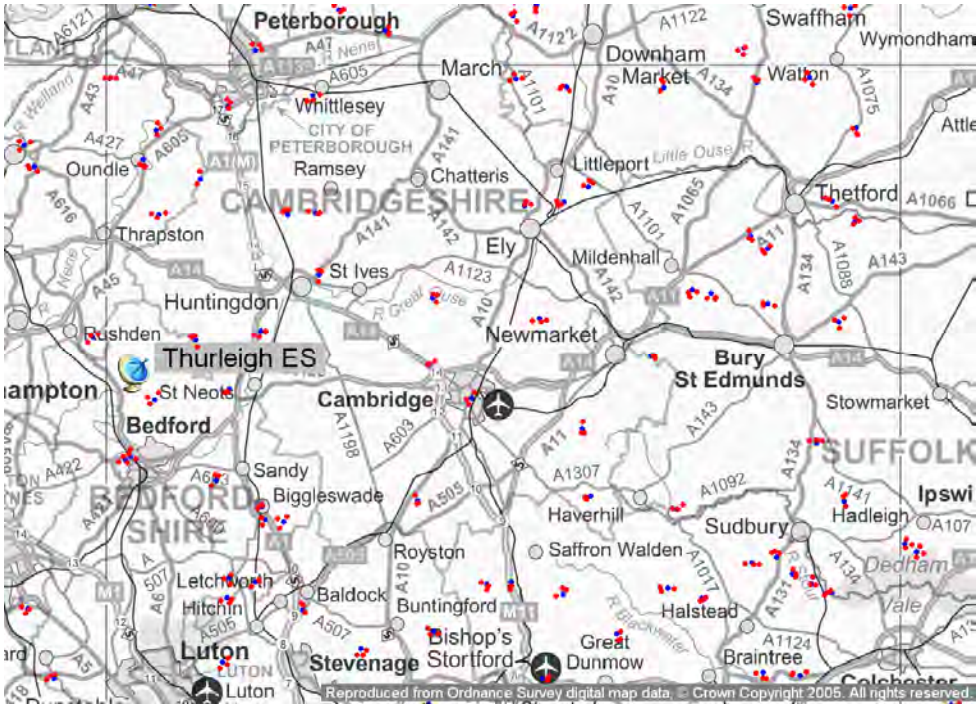



**Figure 2.2: randomly distributed WiMAX subscriber terminals**

The interference from each base station, or the aggregate interference from the subscriber terminals associated with each base station is recorded, and associated with the base station (or virtual base station) range from the victim receiver, allowing plots to be drawn showing the statistical relationship between interference power and pathlength.

## 2.3 System parameters

The primary aim of the present study is to demonstrate that the interference environment will be dominated by power received from WiMAX base stations, thus simplifying co-ordination.

To allow the power from multiple user terminals to be aggregated it is convenient to perform the modelling in terms of realistic transmitter characteristics and interference criteria, rather than to compare the respective path losses. The system parameters used in the modelling are described and tabulated below.

### 2.3.1 Earth station

The Monte Carlo simulations are made with respect to the existing satellite Earth station at Thurleigh, north of Bedford. The dish height, diameter and gain are assumptions.

| | |
|---|---|
| NGR | TL 03630 61161 |
| Latitude / longitude | 52.2394° N, 0.4840° W |
| Antenna diameter | 4m |
| Antenna feed height agl | 4m |
| Antenna gain | 41.5 dBi (at 3650 MHz) |

It is assumed that the Earth station antenna pattern is represented by that given in Appendix 7 or the Radio Regulations. This has a roll-off of 29-25 log(θ), where θ is the off-axis angle, and reaches a sidelobe envelope of -10dBi at θ=36°. The antenna exhibits 0 dBi gain at 14.5°.

The assumptions made regarding the Earth station antenna represent a plausible worst case, as it is believed that all operational antennas have a diameter larger than 4m. This will increase the directivity of the antenna, resulting in a lower gain towards the horizon.

For an earth station in the southern UK, the ***maximum*** gain towards the horizon will therefore generally be between 0dBi and -8dBi, and for most azimuths the sidelobe gain of -10dBi will apply. The -10dBi figure will generally be used, as it is not appropriate to assume any particular Earth station pointing direction.

The Monte Carlo calculations, and the contours plotted in Annex B are based on the interference limits given in ITU-R Recommendation **SF.1006** (section 2.1).

Pr(20%) = -158.6 dBW/MHz

Pr(0.005%) = -150.9 dBW/MHz

### 2.3.2 WiMAX terminals

Four types of WiMAX terminals will be considered. The service is provided by outdoor base stations, while user terminals may consist of an indoor terminal with switched, low-gain antennas (‘EasyST’), a fixed, outdoor terminal with directional antenna (‘ProST’) or a laptop computer with suitable transceiver.

The base station antennas are assumed to conform to the radiation patterns given in ETSI specification EN 302 085 “Antennas for point-to-multipoint fixed radio systems in the 3 GHz to 11 GHz band”. As the base stations are generally configured to use three 120° sector antennas, an omnidirectional horizontal pattern is assumed. The vertical pattern is modelled explicitly, however, and a 4° downtilt assumed, with the following characteristics:

| **Off-boresight angle (θ)** | **Relative attenuation** |
|---|---|
| **< -5°** | **3 dB** |
| -5° to -4° | -3 (θ+4) dB |
| -4° to 4° | 0 dB |
| 4° to 10° | 1.667 (θ-4) dB |
| >10° | -10dB |

The ProST antenna pattern is assumed to be the same as that of the base station antenna (CS2), with the difference that it is necessary to model the horizontal pattern explicitly. A sector angle of 120° is assumed, giving a radiation pattern (from EN 302 085, with α=60° and $f_0$=3.65 MHz) of:

| **Off-boresight angle (θ)** | **Relative attenuation** |
|---|---|
| <65° | 0 dB |
| 65°-140° | (θ-65) x -0.2667 dB |
| 140° - 170° | -20 dB |
| 170° - 180° | -25 dB |

The EasyST antenna pattern is modelled in the way as the ProST. In practice, the effective radiation pattern will be almost entirely determined by the structure and clutter of the building within which the terminal is located.

The transmit parameters assumed for each type of terminal are tabulated below.

| | Base | EasyST | ProST | Laptop |
|---|---|---|---|---|
| Deployment | outdoor | indoor | outdoor | outdoor |
| Height (agl) | 15m | 3m | 5m | 1.5 m |
| Antenna | 16 dBi | 6dBi | 16 dBi | 0 dBi |
| Eirp / 10 MHz | 22 dBW[1] | -1 dBW | 9 dBW | 0 dBW |
| Building loss[2] | 0 dB | 10 dB | 0 dB | 0 dB |
| Effective eirp (dBW/MHz) | 12 dBW | -21 dBW | -1 dBW | -10 dBW |

In all cases, it is assumed that three consumer units are transmitting simultaneously to each base station. NB: Power control is employed in the Freedom4 system, and this will reduce the levels of exported interference; this might be taken into account should further modelling be required.

### 2.3.3 Summary

Based on the figures above, the following path losses are required.

| 20% time | Base | EasyST | ProST | Laptop |
|---|---|---|---|---|
| Eirp (dBW/MHz) | 12 | -21 | -1 | -10 |
| Limit (-10dBi) (dBW/MHz) | -148.6 | -148.6 | -148.6 | -148.6 |
| Pathloss (dB) | 160.6 | 127.6 | 157.6 | 143.6 |

| .005% time | Base | EasyST | ProST | Laptop |
|---|---|---|---|---|
| Eirp (dBW/MHz) | 12 | -21 | -1 | -10 |
| Limit (-10dBi) (dBW/MHz) | -140.9 | -140.9 | -140.9 | -140.9 |
| Pathloss (dB) | 152.9 | 119.9 | 139.9 | 130.9 |

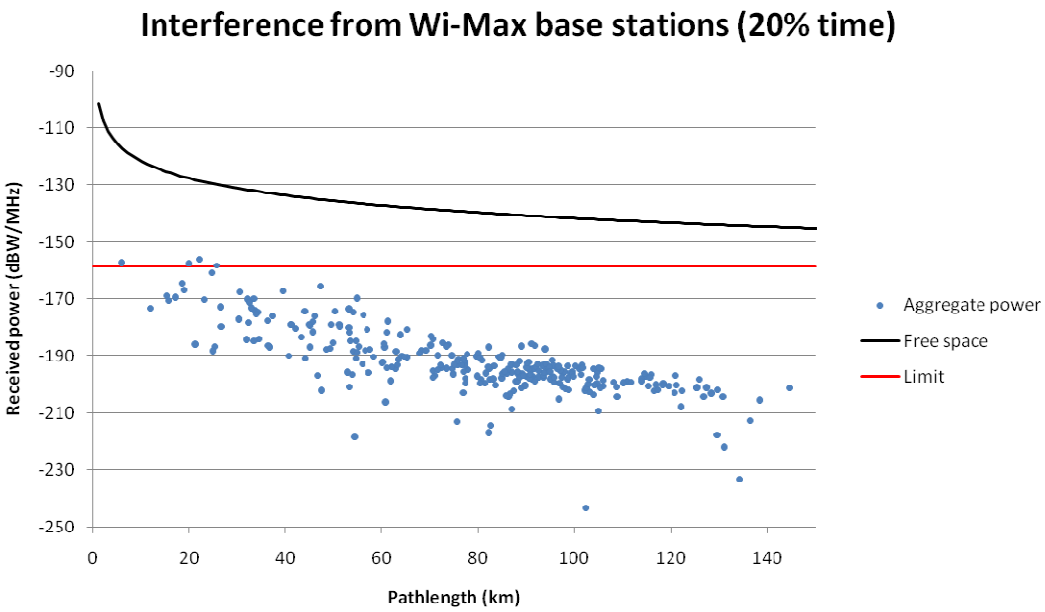
[1] Current licence permits 14dBW/ MHz, to an overall maximum of 22dBW. For a 10 MHz system, the latter limit will apply. An increase to 21dBW/MHz is being sought, which would allow a total power (for a 10 MHz system) of 31 dBW (1.3 kW)

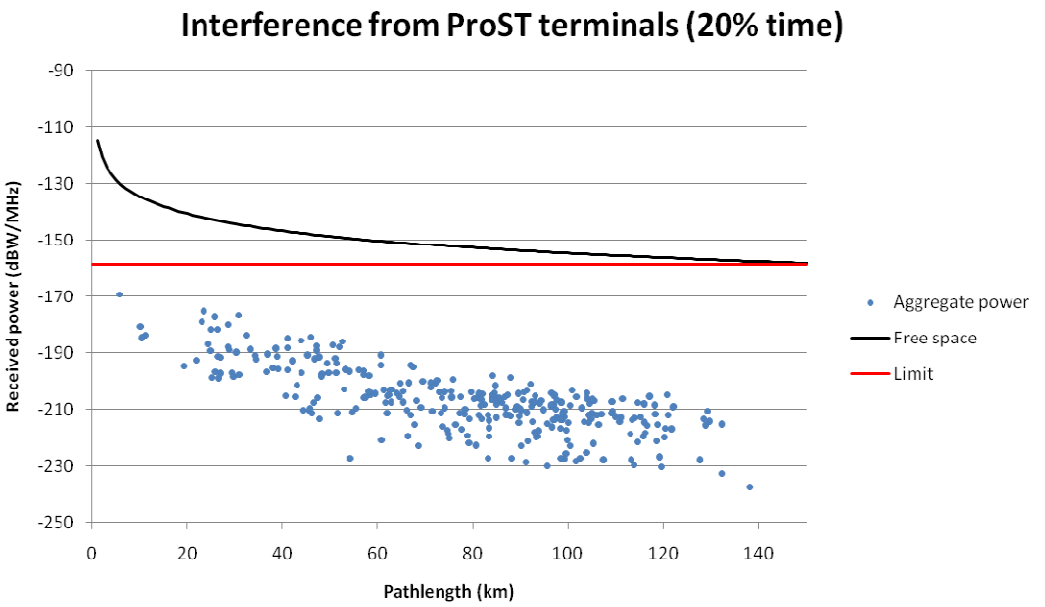
[2] A fixed value of 10dB has been used for initial modelling. This is a representative median value, based on measurements made by Aegis Systems. Further modelling may include a full statistical distribution for this parameter.

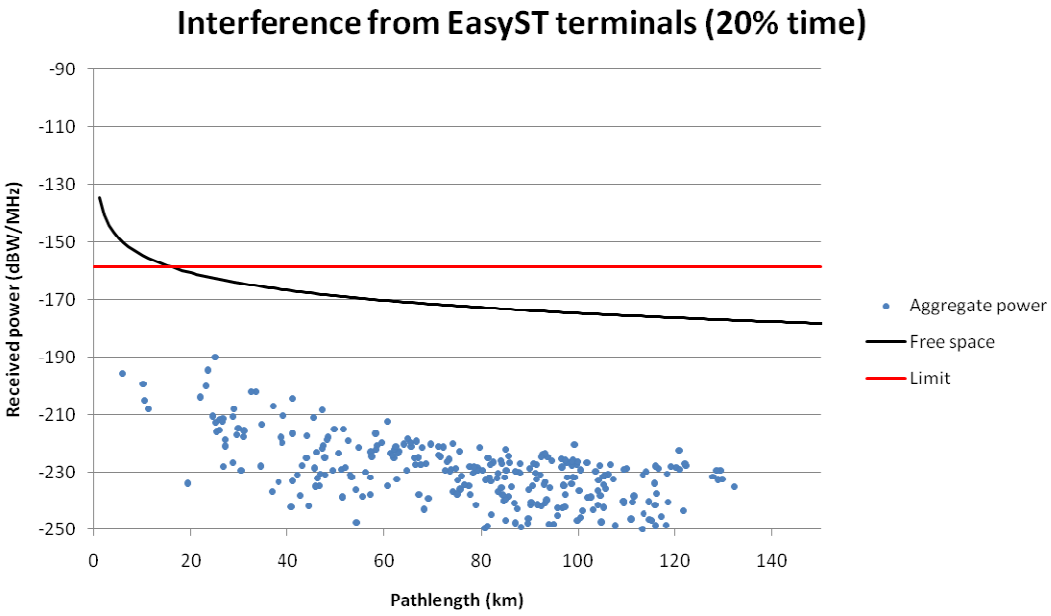
# 3 MODELLING RESULTS

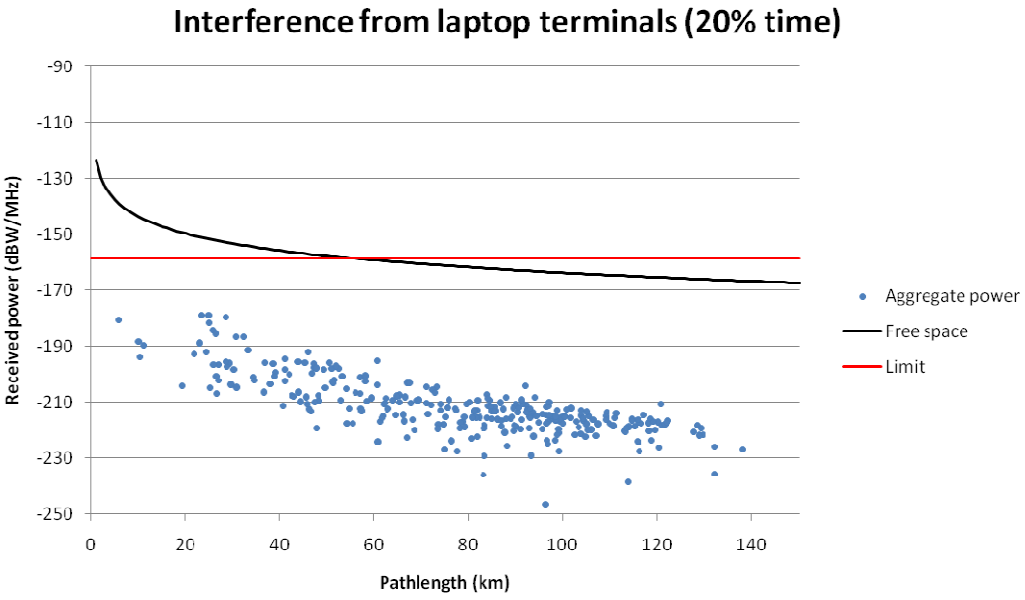
## 3.1 Long-term interference (20% time)

Recommendation SF.1006 requires that long-term interference be evaluated on the basis of the path loss not exceeded for 20% time.

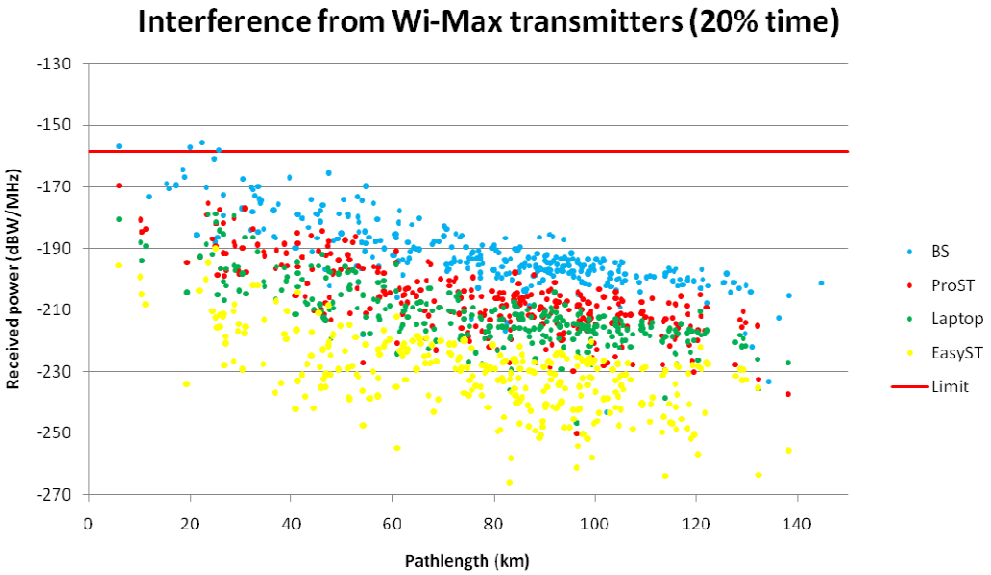




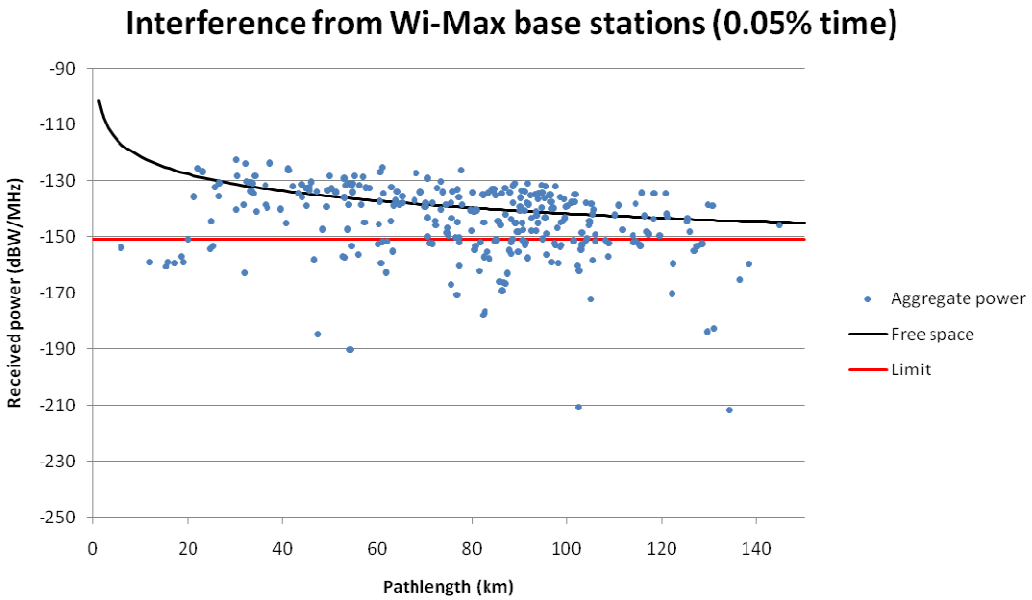



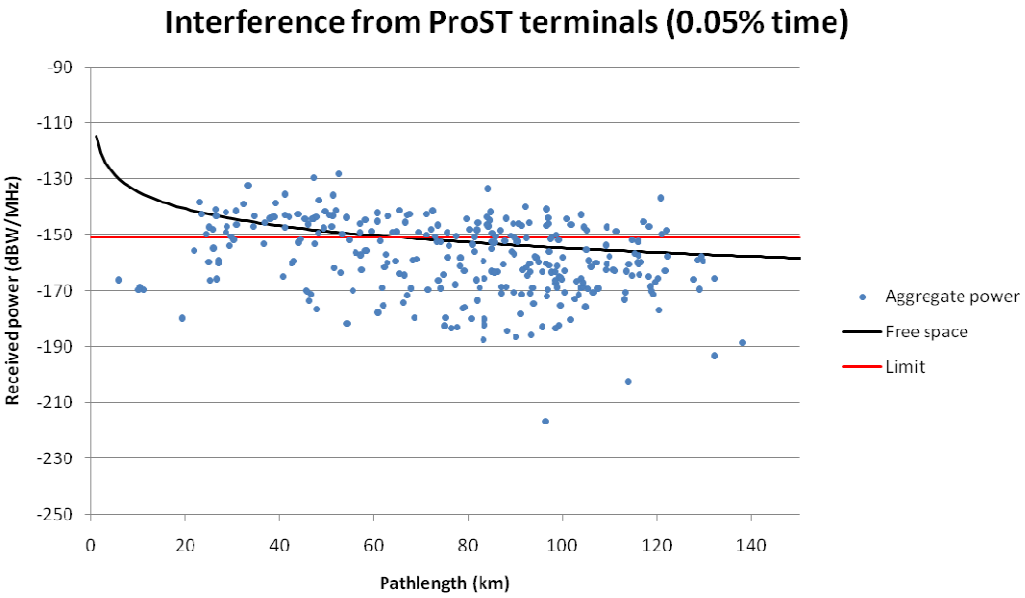

The data from the four figures above has been re-plotted below for ease of comparison.

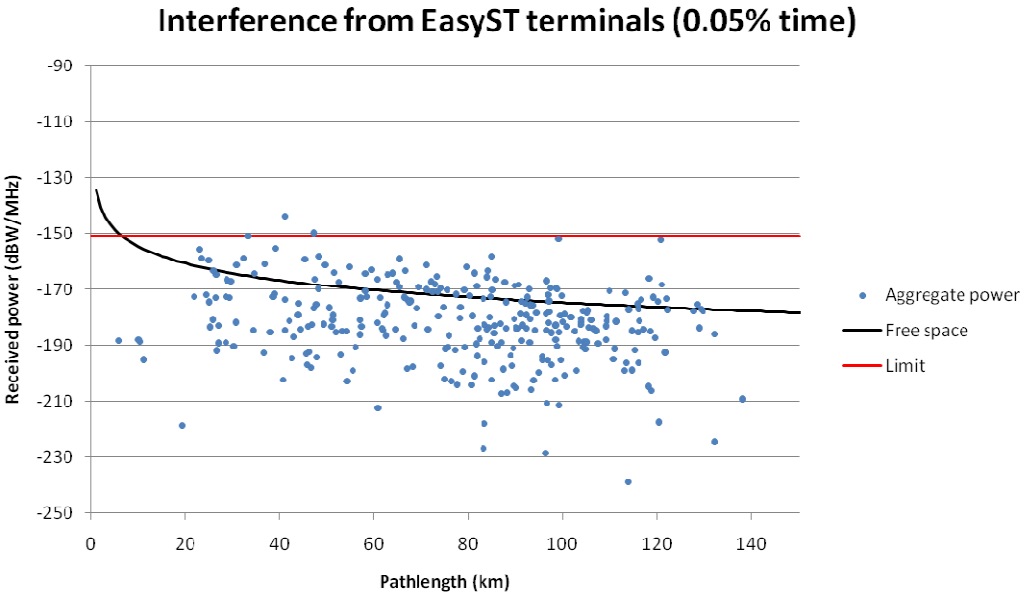


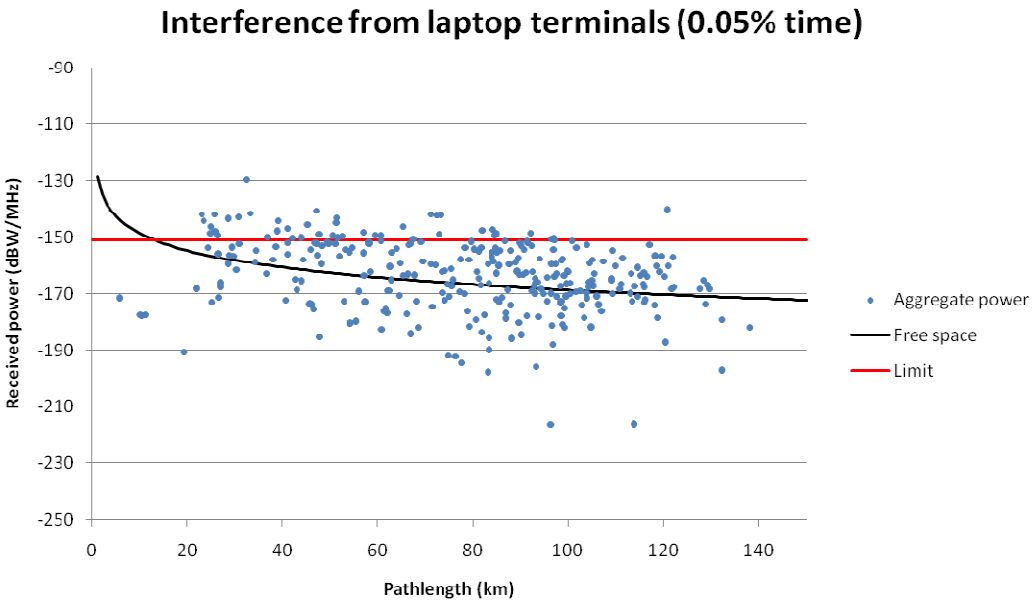

## 3.2 Short-term interference (0.05% time)

For anything beyond the shortest ranges, it is the interference propagated during ducting conditions that will determine the interference environment of an Earth station. The following Monte Carlo results were generated with the propagation model set to 0.05% time. While the 20%-time results (above) are somewhat enhanced due to changes in refractivity effectively 'flattening' the earth, at 0.05% time the mechanism is that of coupling into stable 'ducts' in the troposphere' through which energy can propagate with losses close to free space.

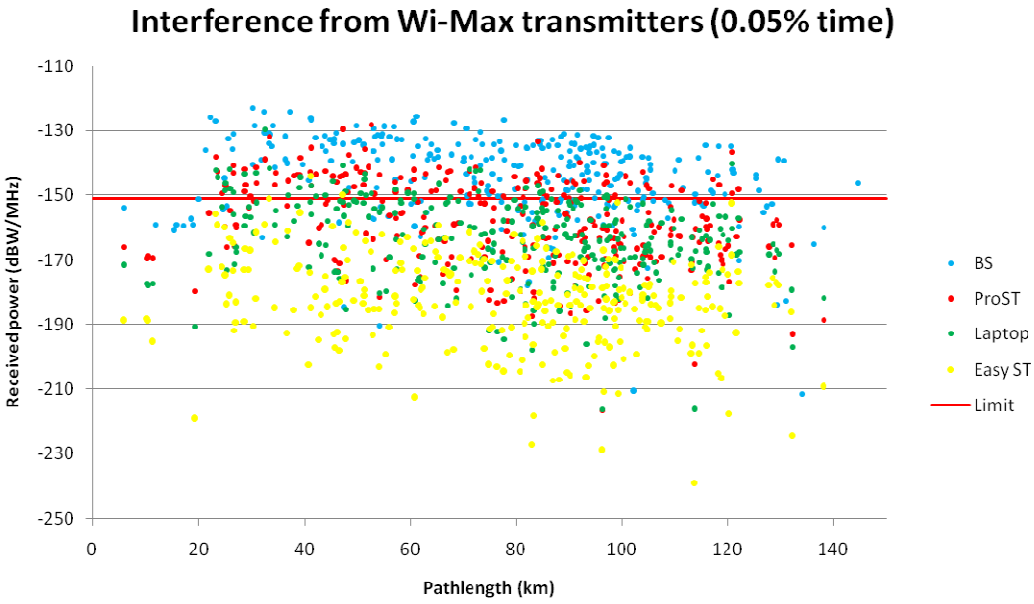



Interference from ProST terminals (0.05% time)
Received power (dBW/MHz)
-90
-110
-130
-150
-170
-190
-210
-230
-250
0
20
40
60
80
100
120
140
Pathlength (km)
Aggregate power
Free space
Limit


Interference from EasyST terminals (0.05% time)
Received power (dBW/MHz)
-90
-110
-130
-150
-170
-190
-210
-230
-250
0
20
40
60
80
100
120
140
Pathlength (km)
Aggregate power
Free space
Limit




As above, all the data for 0.05% time has been replotted on a single chart, below.




# 4 CONCLUSIONS

In all cases it is clear that the interference environment at the victim Earth station receiver is dominated by the energy from the Base stations. Furthermore, the compatibility of the two systems is almost entirely determined by the interference predicted at 0.05% time.

Interference from base stations is some 15-20dB greater than that from the aggregate population of 'laptop' or 'EasyST' terminals around each base station. It therefore follows that, if the base station has been successfully co-ordinated with a

given Earth station, no harmful interference will be caused by the operation of such terminals. It should be borne in mind that if, at a later date, base stations with an EIRP greater than the 12dBW/MHz assumed here were to be successfully coordinated, the relative interfering effect of the subscriber terminal would diminish.

This 20dB margin implies that the number of simultaneously-transmitting terminals supported by the base station could be increased a hundred-fold (from 3 to 300) without the possibility of interference occurring. Note that the maximum realistically expected with an operational WiMAX network is less than ten, and the maximum the standard supports is 35. Given the limited coverage of each base station (<1km radius) and the constraints of the WiMAX system, such a density of terminals is quite unrealistic.

In the plots of Section 3.2, the short-term limit is frequently exceeded by up to 20dB. No specific account has been taken of local shielding at either terminal (Recommendation P.452 does not include a detailed clutter model) and actual interference levels would be expected to be significantly lower.

It may be noted that a contribution by Ofcom to the ITU-R[3] made the point, supported by predictions, that: "***...if BWA base stations and terminal devices have been coordinated with registered earth stations, the probability of interference from nomadic BWA devices to the Earth station is negligible***".

[3] ITU-R document 4A/39 (1st April, 2008)

# A ANNEX A: WiMAX COVERAGE AREA PREDICTIONS

Although not a formal part of the study, it was considered prudent to configure the modelling software to generate coverage predictions for an existing WiMAX network, and to compare this with existing, independant, coverage estimates. This will give assurance that the modelling is realistic.

Predictions have been made of the coverage area of three existing Freedom4 base station sites in Milton Keynes, detailed in Table A1.

| | | | |
|---|---|---|---|
| Site name | Linford Wood | Council offices | Bletchley BT |
| Location (NGR) | SP 84497 40171 | SP 85085 39053 | SP 88020 34141 |
| Aerial height (agl) | 14.6m | 19.0m | 29.9m |
| Antenna | CS2 3 sector, 16dBi, 4° downtilt | | |
| Power | 18dBW | | |

**Table A1: Base station locations**

Coverage has been predicted for the downlink to ProST user terminals, with the system parameters as detailed in Table A2.

| ***Downlink*** | **ProST** |
|---|---|
| BS power (eirp) | 18 dBW |
| Required rx input | -128.6 dBW (-98.6dBm) |
| RX aerial height (agl) | 2 metres |
| Rx aerial gain | 16 dBi |
| Building loss | 0 dB |
| Maximum path loss | 162.6 dB |

**Table A2: System parameters**

No explicit allowance is made for factors such as feeder loss or additional margin to protect against interference or pathloss variations, but the plot shown below in Figure A1 is for received signal levels at the absolute limit (-98.6dBm) and at 10dB and 20dB above this value.

It should be noted that the propagation model used for these calculations differs from P.452 in that a detailed clutter algorithm is used, based on empirical data gathered by Aegis at 3.4 GHz.

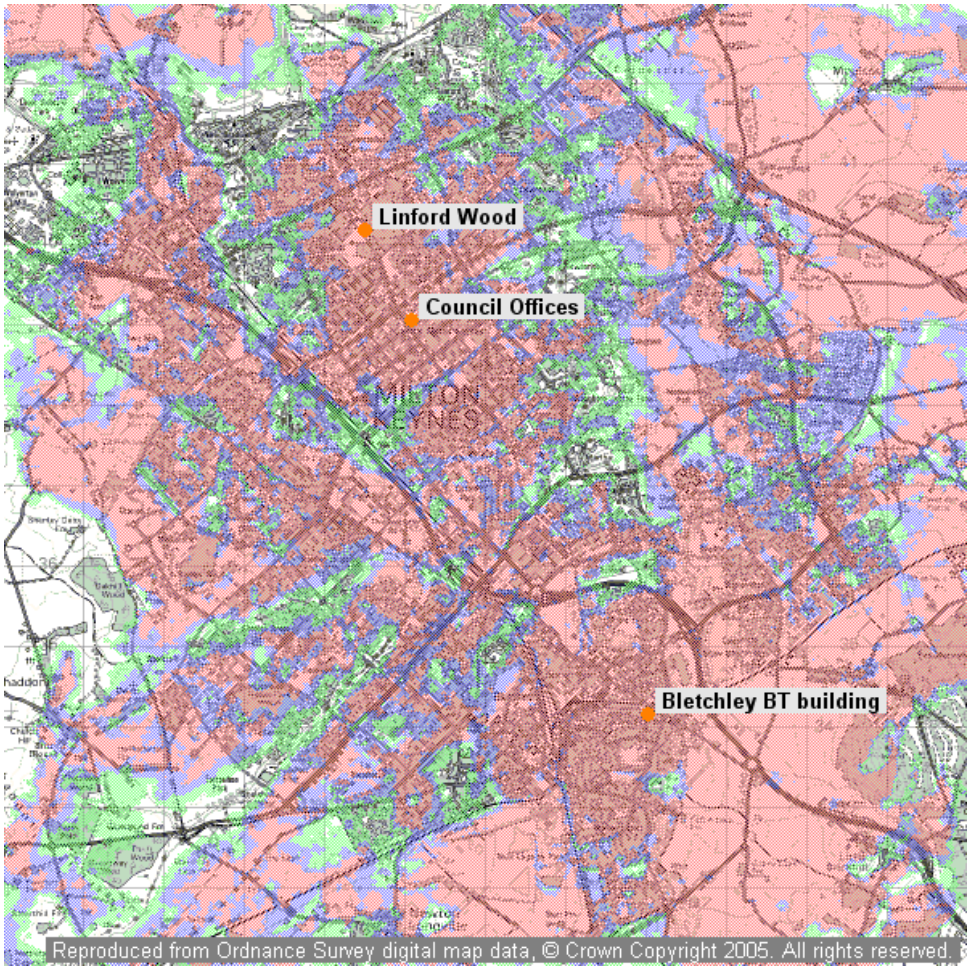



**Figure A1: Predicted coverage of Milton Keynes (ProST received levels of -98.6dBm,-88.6dBm and -78.6dBm)**

For clarity, the plot of received signal strength at the -78.6dBm level only is given in Figure A2, which may be compared with the Freedom4 coverage prediction reproduced in Figure A3.

The Freedom4 prediction does not extend to some of the outlying areas, and there are differences of detail in the urban coverage, probably due to differences in the clutter models applied. One significant discrepancy is to the south east of the Bletchley BT site, which is unserved in the Freedom4 prediction.

No attempt has been made to align the results of the two predictions, but the Aegis prediction shows coverage on a comparable scale to that of the Freedom4 prediction, which gives confidence in the interference prediction.

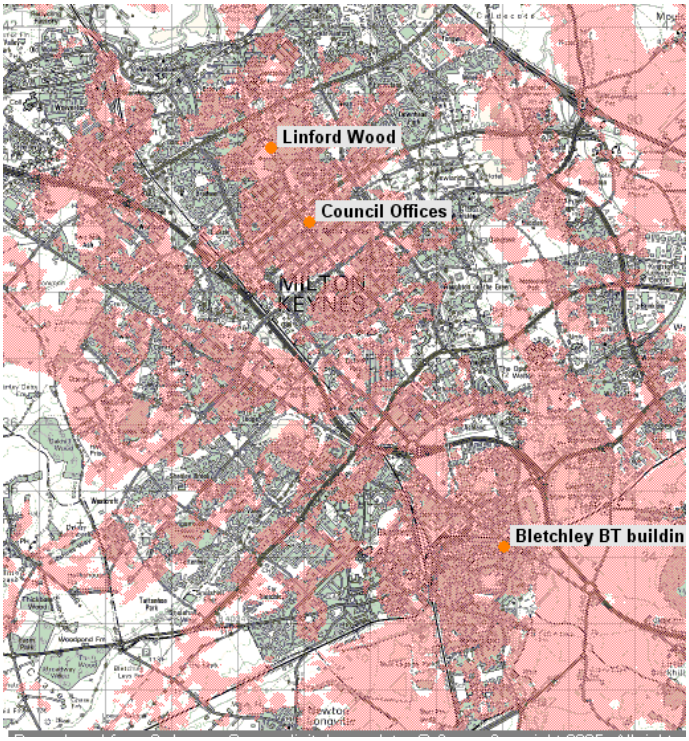



**Figure A2: Predicted coverage of Milton Keynes (ProST received level of -78.6dBm)**

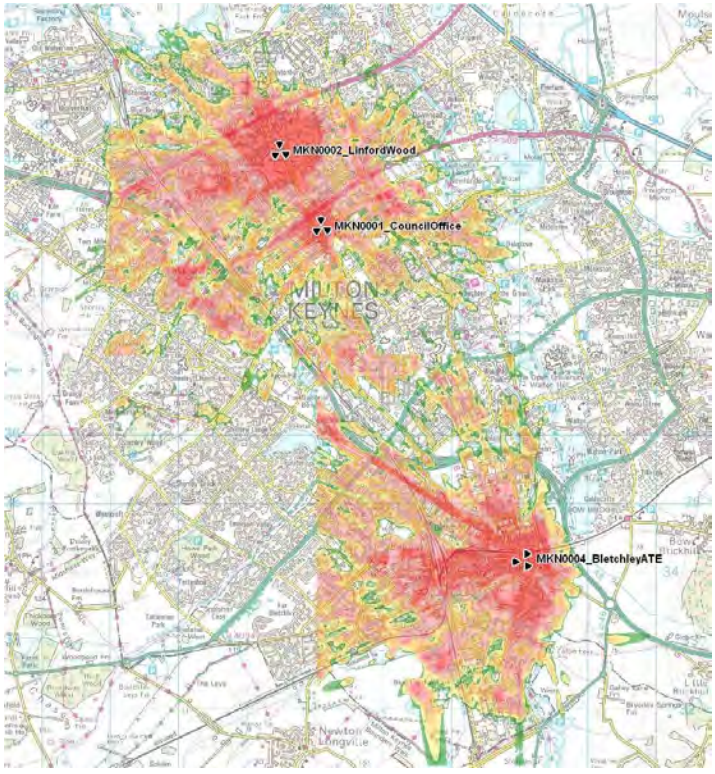



**Figure A3: Freedom4 coverage prediction (orange contour corresponds to ProST received level of -75dBm)**

# B ANNEX B: INTERFERENCE AREA PREDICTION

The primary purpose of this report has been to demonstrate the comparative interference effects of different WiMAX terminals on a statistical basis. It is of interest, however, to examine the area around specific Earth station sites that would be susceptible to interference from Freedom4 transmitters.

The predictions below have been made for the Thurleigh Earth station and represent the area within which interference might be expected from a WiMAX base station operating with the same parameters as given in section 2.3.2 (i.e. an EIRP of 12dBW/MHz and a 15m aerial height.

It is (arbitrarily) assumed that the ES antenna is pointed at a satellite at 20° E in the geostationary arc. This implies that the antenna will have an elevation of 27.3° at an azimuth of 155°.

The first plot (Figure B1) uses Recommendation P.452 to estimate the interference contour (-150.9dBW/MHz) which is shown in blue. The red contour represents an interfering field 10dB higher. The 20km distance at the P.452 algorithm assumes ducting to become significant can be clearly seen.

It can be seen that the Earth station at Thurleigh is potentially susceptible to interference from WiMAX base stations within a large area, including most of London. The P.452 model, however, does not account for clutter, as it is intended to flag co-ordination problems between elevated, uncluttered, terminals.

A second prediction has therefore been made using an algorithm which incorporates a clutter algorithm, validated using measurements made by Aegis at 3.4 GHz. This prediction is given in Figure B2. It can be seen that predicted interference levels are substantially reduced; it should also be borne in mind that the general clutter model used does not take into account the site-specific details of screening at the Earth station site.

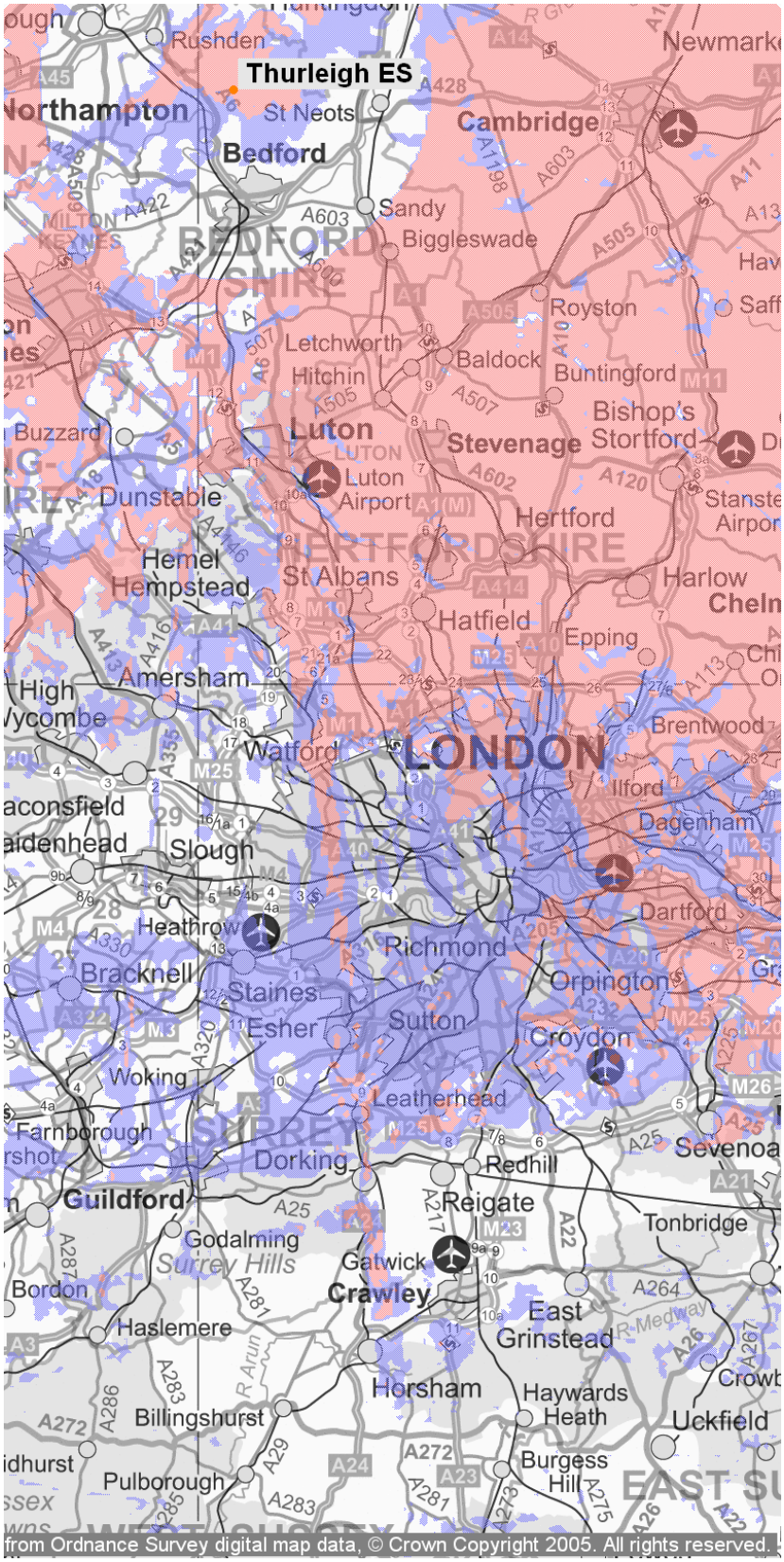



**Figure B1: Interference contour for Thurleigh ES**

**(WiMAX base tx, 0.05%, P.452)**

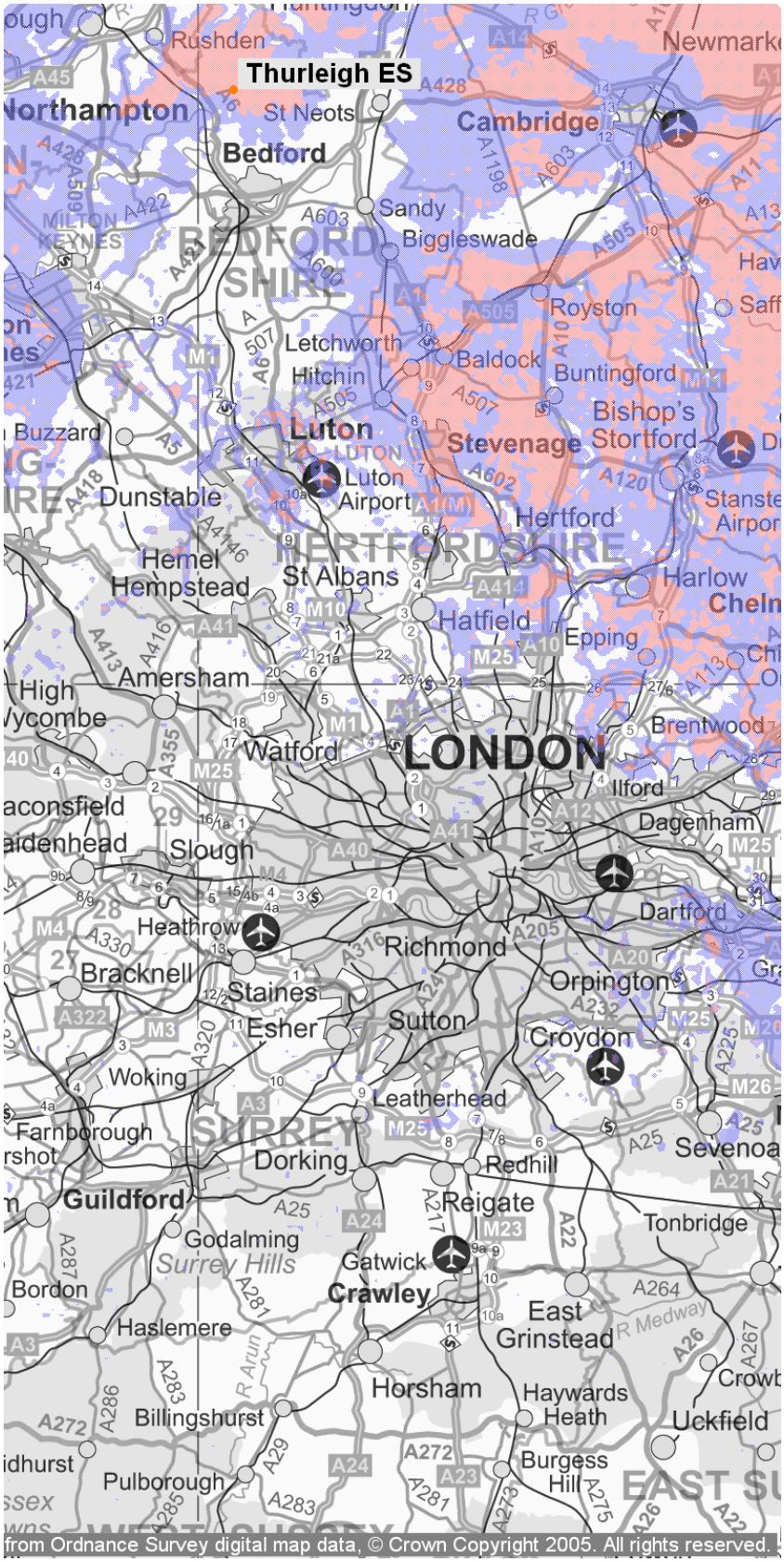



**Figure B2: Interference contour for Thurleigh ES**

**(WiMAX base tx, 0.05%, P.452 with clutter model)**

## TECHNICAL REQUIREMENTS

The Licensee shall ensure that the Radio Equipment performs in accordance with the following technical requirements.

……..

### x. Frequency bands of operation

The Licensee is authorised to operate the Radio Equipment in the following Permitted Frequency Bands of Operation:

a) Lower frequency band: 3605 - 3689 MHz

b) Upper frequency band: 3925 - 4009 MHz

### y. Maximum Radiated Spectral Power Density (EIRP)

Except where Ofcom specifies a lower limit in accordance with sub-paragraph 5(b) the Licensee is authorised to operate the Radio Equipment to the following EIRP limits:

a) Maximum central station EIRP per MHz of +23 dBW;

b) Maximum terminal station EIRP per MHz of +25 dBm;

### z. Permissible Out-of-Block Emissions

For out-of-block emissions, the maximum radiated spectral power density within the frequency ranges set out below as measured from the upper or lower frequencies of either of the Permitted Frequency Bands of Operation shall not exceed the following.

| Frequency offset measured from the edges of the frequency bands specified in 7(a) and 7(b) | Maximum radiated spectral power density EIRP (dBW/MHz) |
|---|---|
| -1.0 to 0.0 MHz | 23 |
| 0.0 to 0.6 MHz | $14 – (41.6 \times \Delta_{F1})$* |
| 0.6 to 1.0 MHz | -11 |
| 1.0 to 2.0 MHz | $9 – (20 \times \Delta_{F2})$** |
| 2.0 to 4.0 MHz | -31 |
| 4.0 MHz and above | -31 |

* Note: $\Delta_{F1}$ is the frequency offset from 0.0 MHz to 0.6 MHz from the band edge of the relevant Permitted Frequency Band.
** Note: $\Delta_{F2}$ is the frequency offset from 1.0 MHz to 2.0 MHz from the band edge of the relevant Permitted Frequency Band.

## Annex 9

# The effect of Freedom4 mobile terminals on fixed links

Due to the licence variation request made by Freedom4 it is necessary to assess the possible impact of mobile terminals on fixed links in adjacent spectrum in the 4 GHz band. The current co-ordination process was used as the basis of this analysis.

There are two criteria in the co-ordination with fixed links.

- Median wanted signal level at the receiver against the enhanced interferer signal level at the receiver.
- Faded wanted signal level at the receiver against the median interferer signal level at the receiver.

If either of these ratios is greater than the wanted to unwanted ratio (W/U) at the given frequency offset the co-ordination fails.

## Method

The propagation model used in the co-ordination process, ITU-R P.452, is reciprocal (i.e. the same loss is calculated between two points regardless of the direction of transmission) therefore it is possible to reverse engineer an interference zone where the co-ordination criteria will be breached by a mobile terminal.

The process was also undertaken for a generic base station to see if the base station interference zone would be large enough to prevent service to a mobile within the mobile interference zone. The two possible scenarios are illustrated in figures 1 and 2. In both figures:

- The purple area is the base station interference zone i.e. where a base station would fail co-ordination and therefore not be assigned.
- The pink area is the mobile terminal interference area where the fixed link receiver would suffer interference if a mobile terminal was transmitting at maximum power.
- The orange area is the area where a mobile terminal would receive service from a base station that has passed the co-ordination process.

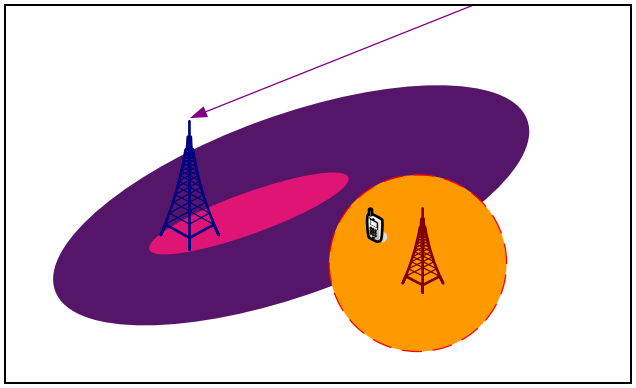


**Figure 1.** Interference zone case (a)

Case (a) a base station assigned just outside the base station interference zone will not provide service to a mobile terminal in the mobile terminal interference zone. In this case fixed links receivers will be protected by the co-ordination of the base stations.

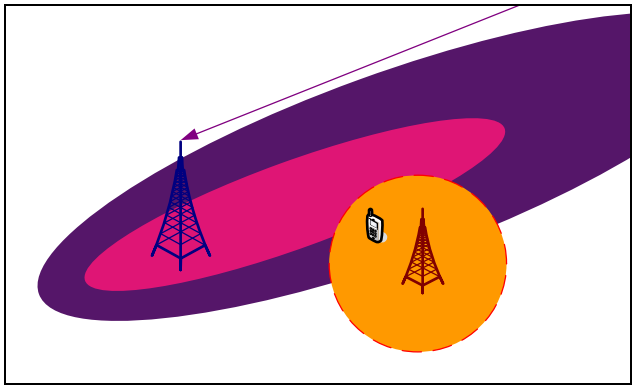


**Figure 2.** Interference zone case (b)

Case (b) the base station interference zone is not large enough to protect the receiver from interference as mobiles may enter the mobile terminal interference zone. In this case co-ordination of mobile terminals may be required.

Coverage was plotted using current fixed link data[25], including location, antenna height and configuration, to a receiver height of 1.5 meters for mobile terminals and 30 meters[26] for base stations.

For both the mobile terminal and base station cases two coverage plots were produced for each fixed link receiver one for median and the other enhanced propagation (0.01 or 0.001% dependant on link availability), these correspond to the two co-ordination criteria. Threshold levels were applied as calculated below.

The parameters used in the threshold calculation:

- **$Pwr_{Rx}$ :** Rx Level (this is calculated in the FWA co-ordination tool and has been taken from the database).

- **W/U** Wanted to unwanted ratio for the frequency offset for the link type.

[25] Licensed assignments on 13th March 2009.
[26] This value was chosen after investigating the effect of receiver height. Values between 15 and 50 metres were investigated using a single fixed link transmitter but due to the antenna configuration there was little difference in the exclusion zones produced.

- **$EIRP_{diff}$ :** EIRP difference between EIRP used to create coverage (1000 W) and the EIRP proposed
  - 25 dBm/MHz in 5 MHz ($10*\log_{10}(1000)$ - $(-5+10*\log_{10}(5))$ = 28.0103dB) for mobile terminal
  - 23 dBW/MHz in 5 MHz ($10*\log_{10}(1000)$ - $(23+10*\log_{10}(5))$ = 0.0103dB) for base station
- **f :** Frequency of link.
- **FM :** Fade margin of link.

## Median coverage threshold:

$$\textbf{Threshold} = Pwr_{Rx}(dBm) - W/U(dB) + EIRP_{diff}(dB) + 20*\log_{10}(f(MHz)) + 77.2 - FM(dB)$$

## Enhanced coverage threshold:

$$\textbf{Threshold} = Pwr_{Rx}(dBm) - W/U(dB) + EIRP_{diff}(dB) + 20*\log_{10}(f(MHz)) + 77.2$$

The interference zone is anywhere that **either** of the conditions is broken.

The fixed links were modelled as 155MBit/s links in 30 MHz channels.

The W/U for this system, shown in figure 5, have been calculated by creating the Net Filter Discrimination (NFD) from the receiver mask of the victim system and the transmit masks of the interfering system along with the co-channel W/U value of 37 dB taken from the technical frequency assignment criteria for 4GHz systems in Ofw446. The Freedom4 receiver and transmitter masks are shown in figures 3 and 4, taken from the relevant ETSI standards.

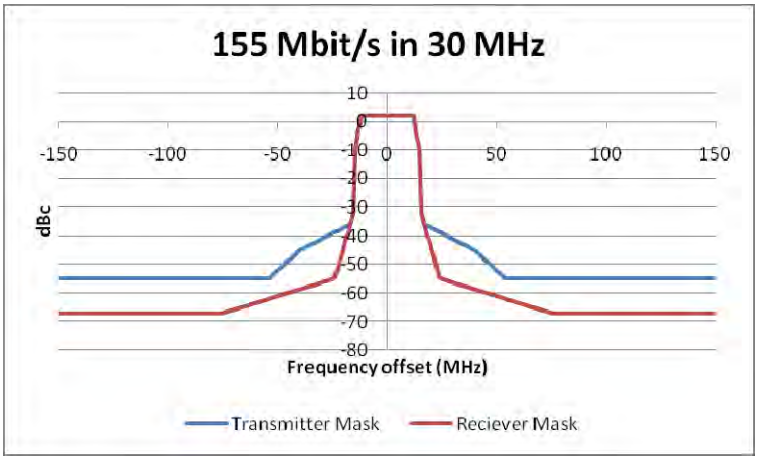



**Figure 3.** Frequency discrimination for a 155 MBit/s in 30 MHz system (EN 301 217).

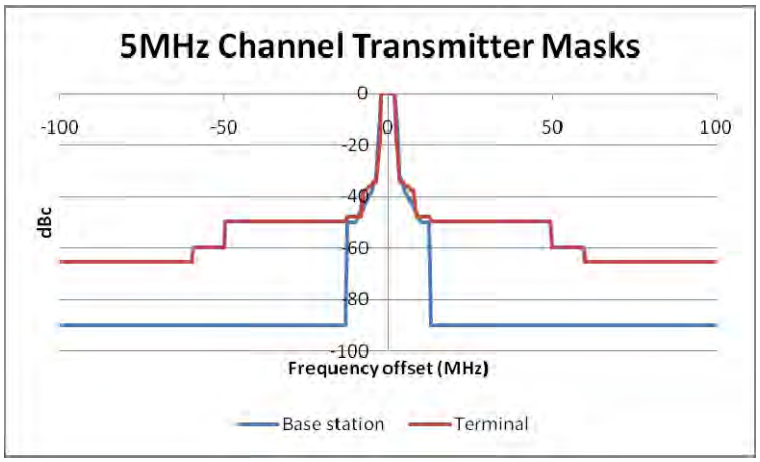



**Figure 4.** 5MHz transmitter masks for the Freedom4 system (Base: EN 301 390, system G. Terminal: TR 102 742).

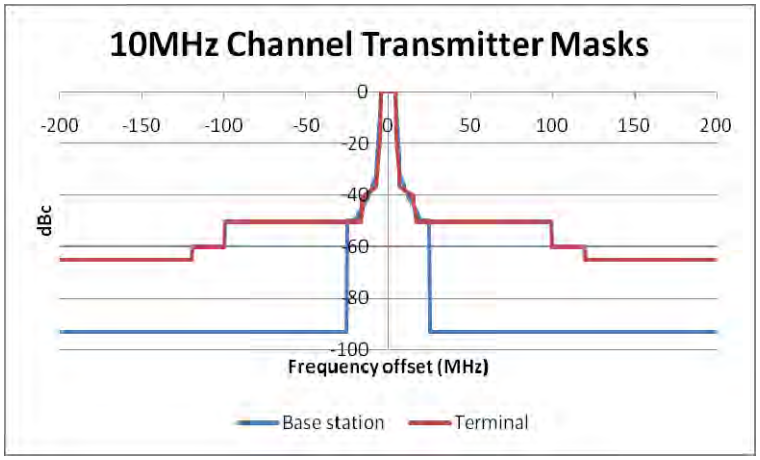



**Figure 5.** 10MHz transmitter masks for the Freedom4 system (Base: EN 301 390, system G. Terminal: TR 102 742).

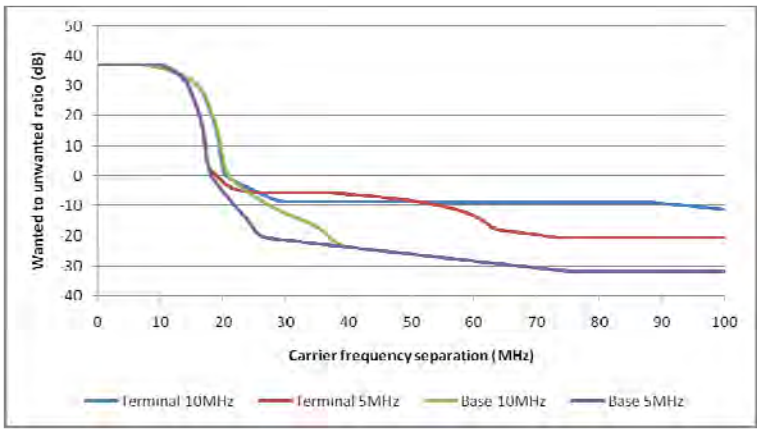



**Figure 6.** Wanted to unwanted ratios.

The areas where mobile terminals could cause interference when a base station has been successfully co-ordinated can be found by taking the base station interference zone and reducing it by the cell radius of the interfering system and comparing it to the mobile interference zone. This is illustrated in figure 6, the pink area is the area where mobile terminals could interfere with the fixed link receiver.

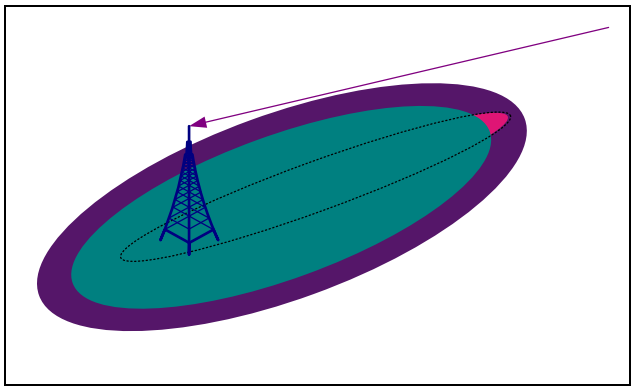


**Figure 7**. Mobile terminal interference area where a base station passes co-ordination.

Freedom4 have indicated that cell sizes are between 700m and 1km with an absolute maximum of 1.5km. A 1km cell size has been used in this analysis.

## Results

As frequency separation increases the W/U ratio decreases. This leads to an increase in the interference threshold i.e. the signal will need to be stronger to cause interference. As frequency separation increases the interference zones will decrease in size. Interference zones have been modelled for the Freedom4 channels adjacent to fixed links spectrum as this offers the worst case interference scenario.

The areas where a mobile terminal at maximum transmit power operating to a co-ordinated base station could cause interference for a cell size of 1km are given in table 1 for the three Freedom4 channels that are adjacent to the fixed links band for both 5 and 10 MHz Freedom4 systems.

| 5 MHz system | | | 10 MHz system | | |
|---|---|---|---|---|---|
| **Frequency (MHz)** | **Area ($km^2$) %** | **UK** | **Frequency (MHz)** | **Area ($km^2$) %** | **UK** |
| 3682.5 | 134.7 | 0.06 | 3680 | 147.1 | 0.06 |
| 3927.5 | 254.7 | 0.10 | 3930 | 97.5 | 0.04 |
| 4002.5 | 32.5 | 0.01 | 4000 | 163.8 | 0.07 |

**Table 1.** Areas where mobile terminals could cause interference to fixed links assuming a 1km cell size.

These areas generally fall along the boresight of the fixed links.

## Conclusions

The interference zones are very much dependant on the configuration of the fixed link receiver and the surrounding terrain.

There are relatively small disparate areas across the country, mainly in remote areas, where mobile terminals at the maximum transmit power could cause interference to a fixed link receiver when operating to a co-ordinated base station. Figure 8 gives an indication of the excess signal levels within the mobile interference zone which can be significant.

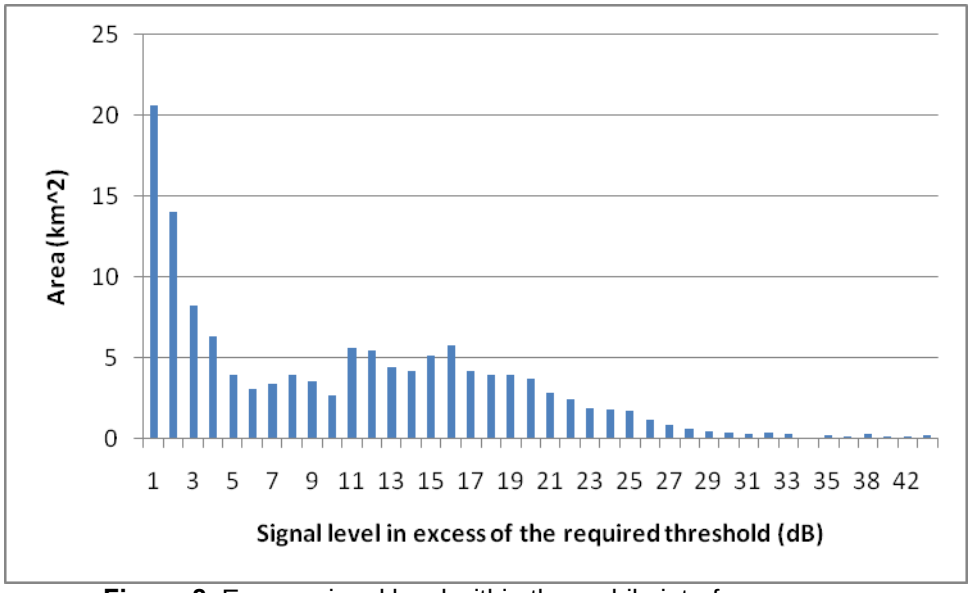



**Figure 8.** Excess signal level within the mobile interference zone for a 10MHz channel at 3680 MHz.

The Freedom4 mobile terminals will generally operate 'in the clutter' therefore it is likely that the interfering signal would have further loss due to it's environment, this is not considered in the analysis.

The areas of possible mobile terminal interference are based on the configuration and location of the victim systems and therefore the effect could be greatly mitigated by Freedom4 if they had access to fixed links data when they are planning their network.

Freedom4 have suggested that a detailed co-ordination zone of 5km around each FS receiver should be sufficient to protect from interference. The Freedom4 analysis did not take into account the different masks for the central stations and mobile terminals, the real fixed link antenna configuration or geography. This analysis indicates that using the current interference criteria there are areas that fall along the path of the link where a mobile terminal would fail co-ordination. These areas are very small but can be mitigated against by ensuring that no central station is established within 2km of the path of the link. This is illustrated in Figure 9.

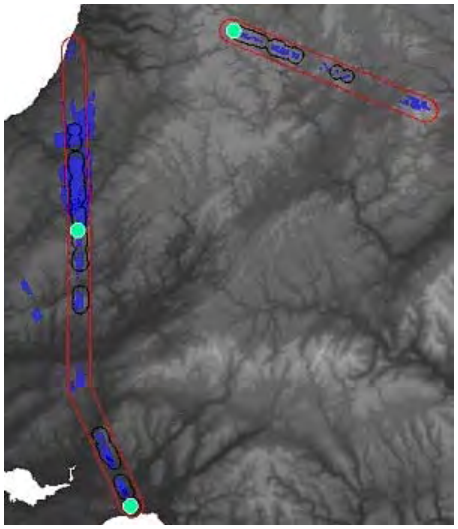


**Figure 9.** Exclusion zones 10MHz channels at 3680 MHz (cell size: 1km)
Blue – area where central station fails co-ordination at 23 dBW/MHz
Black outline – area where central stations must be excluded to mitigate mobile terminal interference
Red outline – suggested exclusion area for mitigation of mobile interference

It can be seen in Figure 9 that the red zone is larger than the required black zone. Looking at current deployments of fixed links they tend to be in remote areas therefore this would not be a major concern for Freedom4, with future deployments this may cause more concern but it would be possible to deploy central stations within the zone on a case-by-case basis where it is proven that the mobile interference zone is not impinged upon.