OFFICE OF COMMUNICATIONS

Low power licence-exemption limits above 10GHz

Consultation

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Contents

Section 1

Executive summary

1.1 This is a consultation on increasing the power levels below which devices will be exempt from licensing in the frequency bands above 10GHz.

1.2 In the Licence Exempt Framework Review published in 2007, we put forward a number of suggestions to better manage the radio spectrum used by licence-exempt devices. These included the introduction of politeness protocols, opening higher frequency bands for licence-exempt usage and increasing the limit set by UWB regulations for very low power licence-exempt devices at higher frequencies. We said that we would issue further consultations in each of these areas, with associated impact assessments, where relevant.

1.3 Since then we have issued consultations in many of these areas. This document forms the consultation into the setting of low power licence-exempt limits.

1.4 Subject to a recent EC decision, ultra-wideband (UWB) transmissions at power spectral densities below specific limits, are exempt from licensing and may operate on a non-interference, non-protected basis.

1.5 It is logical to conclude that any device that transmits at a power spectral density which is lower than the UWB limits would, at worst, cause as much interference as a UWB device. Consequently, it follows that any such transmitter, irrespective of its bandwidth, would be a likely candidate for licence-exemption. However, the UWB limits were only given detailed consideration up to 10.6GHz and simply extended at the same level above 10.6GHz.

1.6 We further note that the path loss experienced by radio waves grows as a function of frequency. In fact, ignoring atmospheric absorption effects, the free-space radio link-budget deteriorates with the square of frequency for a specific receiver antenna gain. This implies that a high-frequency high-power transmitter will generate the same amount of co-channel interference as a low-frequency low-power transmitter.

1.7 Based on the above arguments, we believe that the UWB limits above 10GHz could be increased without causing harmful interference. We propose that such limits could be equivalent to the UWB limits (including all operational constraints), extrapolated appropriately for frequencies above 10.6 GHz to account for increased path loss with frequency.

1.8 We anticipate such limits would not have a significant impact on existing users of spectrum but might encourage industrial research and development and bring benefits to consumers and citizens through increased competition in the provision of new and innovative radio communication goods and services.

Section 2

Introduction

2.1 In the LEFR we noted that the UWB legislation extended indefinitely above 10.6GHz at a constant level. However, because of the physical properties of radio transmission the reception of radio signals becomes progressively more difficult at higher frequencies. We suggested in the LEFR that increasing the UWB limit above 10.6GHz in line with these physical properties would not increase the interference levels above those experienced below 10.6GHz but would enable the use of very low powered devices at these frequencies. This consultation considers this issue in more detail.

2.2 The EC Decision 2007/131/EC defines equipment using UWB technology as:

> "… equipment incorporating, as an integral part or as an accessory, technology for short-range radiocommunication, involving the intentional generation and transmission of radio-frequency energy that spreads over a frequency range wider than 50 MHz, which may overlap several frequency bands allocated to radiocommunication services;".

2.3 The devices permitted under this Decision are exempt from individual licensing and operate on a non-interference, non-protected basis, with EIRP spectral density requirements as specified in Table 2-1 as long as they conform to a number of restrictions including their use being limited to indoors.

2.4 Note that the rather low power levels for frequencies beyond 10.6 GHz are defined in order to protect passive services (such as radio astronomy and earth exploration satellites) operating in the 10.6-10.7 band.

Frequency range (GHz)	Maximum mean EIRP density (dBm/MHz)	Maximum peak EIRP density (dBm/50MHz)
< 1.6	–90	–50
1.6 to 3.4	–85	–45
3.4 to 3.8	–85[1]	–45
3.8 to 4.2	–70	–30
4.2 to 4.8	–70[2]	–30[3]
4.8 to 6	–70	–30
6 to 8.5	–41.3	–0
8.5 to 10.6	–65	–25
> 10.6	–85	–45

Table 2-1: UWB equivalent isotropic radiated power (EIRP) requirements.

2.5 In the LEFR we concluded that any device that transmits at a power spectral density which is lower than the UWB limits would, at worst, cause only as much interference

[1] A maximum mean EIRP density of –41.3 dBm/MHz is allowed in the 3.4 to 4.8 GHz bands provided that a low duty cycle restriction is applied in which the sum of all transmitted signals is less than 5% of the time each second and less than 0.5% of the time each hour, and provided that each transmitted signal does not exceed 5 milliseconds.

[2] A limit of –41.3 dBm/Hz is allowed until 31 December 2010.

[3] A limit of 0 dBm/50MHz is allowed until 31 December 2010.

as a UWB device. Consequently, any such device, irrespective of its transmission bandwidth, would be a candidate for licence-exemption.

Section 3

The LEFR proposals

3.1 In the LEFR we set out an analysis that used Monte Carlo simulation to predict the acceptable levels of interference depending on the likely proximity of interfering devices. We then scaled this according to frequency with the positive gradients (20 dB per decade) of the limits on EIRP spectral density accounting for the deterioration in free-space radio propagation link-budget with the square of frequency for a specific receiver antenna gain[4]. This implies that ever increasing EIRP spectral densities can be tolerated at higher frequencies, with incumbent receivers still only experiencing a fixed marginal degradation in their performance (equivalent to a 5% rise in the noise floor with a probability of 0.1% for the above example). The result is shown in Figure 3-1.

3.2 We noted that these limits on transmission power were conservative, in the sense that they are based on a somewhat strict definition of acceptable interference, and a generic aggregation scenario involving statistical models of path loss, shadowing, and interferer locations. Higher limits could result if one explicitly accounted for the additional radio isolation which often exists between an interferer and victim receiver caused by geographic separation, or by severe attenuation (shadowing) at high frequencies due to obstacles such as walls. Furthermore, directional antennas are frequently used at frequencies above 3 GHz as a means of boosting the link-budget in the face of increasing path loss. The use of directional antennas, at the incumbent receiver or the interfering transmitter, can also help mitigate interference and further increase the limits on EIRP spectral density.

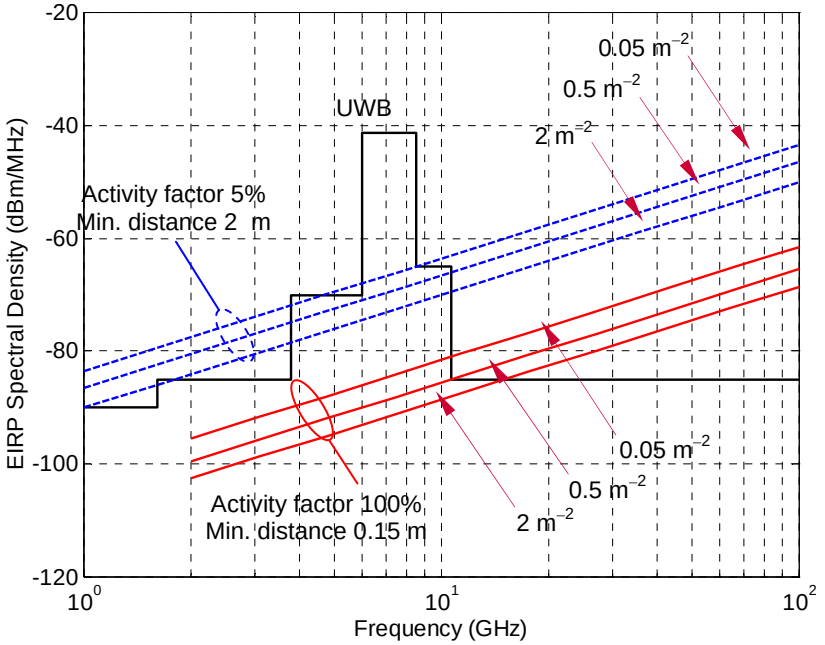

Figure 3-1: Limits on mean EIRP spectral density, subject to constraints on aggregate interference

[4] Other frequency-dependent attenuation effects due to gaseous and water vapour absorption may be ignored over short distances.

3.3 The potential to relax the transmission constraints as a function of frequency is indeed evident from the UWB limits for emissions in the 3.8–6 GHz and 8.5–10.6 GHz ranges, defined to allow co-existence with applications such as point-to-point fixed links. One may envisage the extension of these limits, based on a 20 dB per decade gradient, as a lower-bound for licensing at frequencies beyond 10.6 GHz. At frequencies below 10.6 GHz, the UWB mask itself would set the lower bound.

3.4 Based on the above analysis, the LEFR recommended a generic power spectral density lower bound for the licensing of radio devices which:

1) is equal to the UWB limits on power spectral density for frequencies below 10.6 GHz;

2) is equal to $-85 + 20\log(f_{\mathrm{GHz}}/10.6)$ dBm/MHz (mean EIRP density), or
$-45 + 20\log(f_{\mathrm{GHz}}/10.6)$ dBm/50MHz (peak EIRP density),

for frequencies above 10.6 GHz which are subject to Footnote 5.340, or which support sensitive services such as radio astronomy and earth exploration satellites; and

3) is equal to $-65 + 20\log(f_{\mathrm{GHz}}/10.6)$ dBm/MHz (mean EIRP density), or
$-25 + 20\log(f_{\mathrm{GHz}}/10.6)$ dBm/50MHz (peak EIRP density),

for all other frequencies above 10.6 GHz,

3.5 where f_{GHz} represents frequency in units of GHz. Transmissions at levels below the specified limits may be exempt from licensing, subject to compliance with all UWB operational restrictions (other than minimum bandwidth) as specified in EC Decision 2007/131/EC. These include a restriction on fixed outdoor usage and usage in vehicles. The proposed mean EIRP spectral density limits are illustrated in Figure 3-2 with labels corresponding to the above recommendations.

3.6 It is important to note that even the highest level that we are proposing above 10GHz is an extrapolation from a relatively low UWB level. Below 10GHz levels of up to -41dBm have been allowed in some bands. We are suggesting an extrapolation from -65dBm, providing 24dB of additional protection. Further, if the difference in frequency between 5GHz and 10GHz is taken into account another 6dB margin is provided by not increasing levels between 5GHz and 10GHz.

3.7 Hence, our proposals for the highest levels of emission above 10GHz are effectively 30dB below the levels proposed for UWB between 3GHz and 5GHz. This appears appropriately conservative at present.

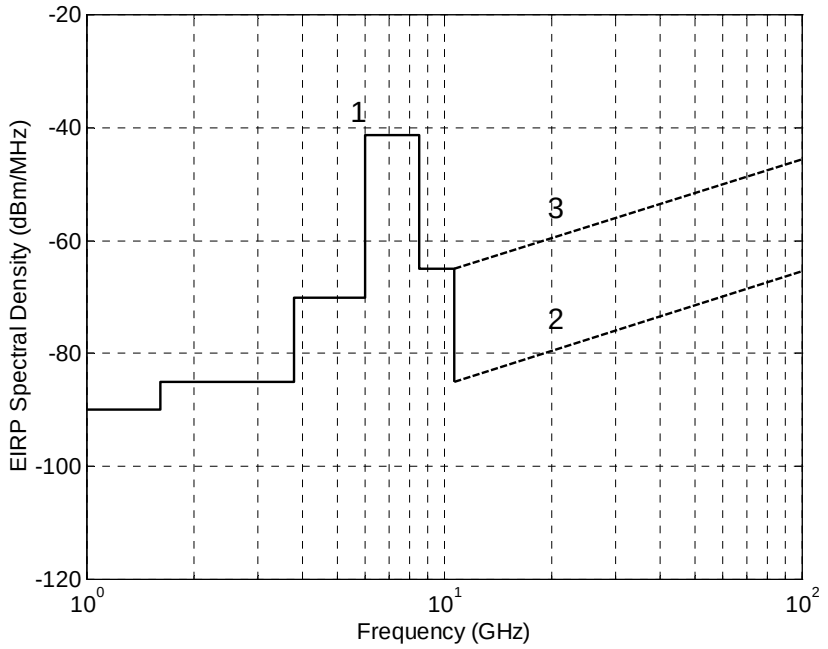

Figure 3-2: Proposed mean EIRP spectral density lower bounds for the licensing of radio devices.

Section 4

Affected services

Introduction

4.1 In this section we consider each of the significant uses of spectrum in the bands above 10GHz and assess the possible impact of the proposed limits on them.

The bandplan above 10GHz

4.2 This section presents a simplified plan of the use of the spectrum above 10GHz. Full details can be found in the UK Frequency Allocation Table (FAT).[5]

4.3 The key users of the bands from 10GHz to 20GHz are shown below.

[5] http://www.ofcom.org.uk/radiocomms/isu/ukfat/ukfat07.pdf

Frequency (GHz)	Main Usage
10.6-10.68	Satellite earth exploration
10.68-10.7	Radio astronomy
10.7-11.7	Fixed links Fixed Satellite, (space to Earth)
11.7-12.5	Fixed links and Fixed and Broadcasting satellite
12.5-12.75	Fixed Satellite (space to Earth)
12.75-13.25	Fixed links and Fixed Satellite, (earth to space links)
13.25-13.4	Aeronautical radionavigation
13.4-13.75	Earth exploration satellite
13.75-14	Earth to space satellite links
14-14.5	Fixed and fixed to satellite (earth to space links)
14.5-15.35	Fixed links
15.35-15.4	Earth exploration and radio astronomy
15.4-17.20	Radionavigation and radiolocation
17.2-17.3	Earth exploration satellite (space to Earth)
17.3-18.1	Fixed and fixed satellite (space to Earth)
18.1-18.4	Meteorological satellite (space to Earth)
18.4-18.8	Earth exploration
18.8-20	Fixed and fixed satellite (space to Earth)

4.4 The key users of the bands from 20GHz to 40GHz are shown below.

Frequency (GHz)	Main Usage
20-21.2	Fixed satellite (space to Earth)
21.2-21.4	Earth exploration satellite
21.4-22.01	Fixed and Broadcasting Satellite
22.01-22.21	Radio astronomy
22.21-22.5	Earth exploration satellite and radio astronomy
22.5-23.6	Fixed
22.81-22.86	Radio astronomy
23.07-23.12	Fixed
23.6-24	Earth exploration satellite and radio astronomy
24-24.05	Amateur and amateur satellite
24.05-24.25	Radiolocation
24.25-25.5	Fixed
25.5-27	Earth exploration satellite
27-29.5	Fixed
29.5-31	Fixed to satellite
31-31.3	Fixed
31.3-31.5	Earth exploration satellite and radio astronomy
31.5-33.4	Fixed
33.4-35.5	Radiolocation
35.5-36	Meteorological aids
36-37	Earth exploration satellite
37-40	Fixed

4.5 The key users of the bands from 40GHz to 100GHz are shown below.

Frequency (GHz)	Main Usage
40-40.5	Fixed
40.5-42.5	Broadcast satellite
42.5-43.5	Fixed and radio astronomy
43.5-47	Mobile
47-47.2	Amateur
47.2-50.2	Fixed
50.2-50.4	Earth exploration satellite
50.4-52.6	Fixed
52.6-59.3	Earth exploration satellite
59.3-65	Fixed
65-66	Earth exploration satellite
66-71	Inter-satellite
71-74	Fixed
74-76	Broadcasting, broadcast satellite amateur and amateur satellite
76-77.5	Radioastronomy
77.5-78	Amateur
78-81	Radioastronomy and radiolocation
81-86	Fixed
86-92	Earth exploration satellite and radioastronomy
92-95	Fixed
95-100	Mobile satellite, radionavigation and radioastronomy

4.6 The key users of the bands above 100GHz are shown below.

Frequency (GHz)	Main Usage
100-102	Earth exploration satellite
102-134	A mix of fixed and earth exploration satellite
134-136	Amateur and amateur satellite
136-200	A mix of radioastronomy, radiolocation, fixed and earth exploration
200-275	A mix of radioastronomy, radiolocation, fixed earth exploration amateur and amateur satellite

4.7 These tables show us that the users of the bands above 10GHz are:

- Satellite earth exploration (both active and passive).
- Fixed links.
- Broadcasting satellites.
- Space to earth and earth to space fixed links.
- Radionavigation.
- Radiolocation.
- Amateur and Amateur satellite.
- Meteorological aids.
- Meteorological satellite.
- Radio astronomy.

4.8 Some of these services were considered as part of the work performed in evaluating UWB in the bands 3-10GHz. These are shown, and the conclusions drawn there, briefly outlined below.

Service	Conclusions reached (for power levels 30dB greater than proposed in this document)
Fixed links	Interference was very unlikely given the directional nature of the link and the restriction of devices to indoor usage.
Earth exploration satellites	Many of the services will not experience any significant interference. However, there is some risk that passive earth observation may be slightly affected.
Radioastronomy	There is a potential for interference from UWB devices some distance away.
Fixed satellite services	Uplink services will be unaffected. There is some risk of interference to downlink services, although this is considered small.
Aeronautical radar	There is some concern for interference with primary and secondary radars, particularly if UWB signals can enter the main beam of the radar. Distance and bearing services appear to be largely compatible with UWB. However, subsequent work showed that interference was unlikely to be problematic in practice.

4.9 Broadly, from this table, we conclude that in the bands used by fixed links and fixed satellite services the “standard” limit proposed in Section 3 can apply, whereas for earth exploration satellites and radioastronomy the lower protected limit should apply.

Q1: Do you agree with this assessment of the services that do not need further analysis

4.10 The services not considered (because they were not key users of the bands below 10GHz) but listed above are broadcasting satellites, radionavigation and radiolocation and meteorological aids. Amateur usage in these bands is considered to reflect more professional type equipment deployment at such frequencies and hence has not been considered in separate detail; for example amateur satellite systems are considered equally at risk as other satellite systems.

4.11 Each of these services is considered separately in the following sections in order to assess their susceptibility to interference.

Section 5

Broadcast and Fixed (direct to home) satellites

5.1 We consider that the worst case of interference that might occur is when a receiving satellite dish is mounted on the outside wall of a house and a UWB device is in use either in the same house, or in a house “across the street” which is located close to the direction of the satellite antenna orientation.

5.2 In both cases the path loss between the UWB device and the antenna is comprised of the free space path loss, the building penetration loss and the antenna discrimination of the satellite dish. Our estimate of these parameters is given below.

Parameter	**UWB device in same building**		**UWB device in different building**	
	12 GHz	20.2 GHz	12 GHz	20.2 GHz
Free space loss (dB)	60	64.4	74	78.4
Building penetration (dB)	20	22	5	6
Antenna discrimination (dB)	0	0	5	5
Total loss (dB)	80.0	86.4	84.0	89.4

5.3 In calculating the free space loss we have used the formula

$$\text{Loss} = -27.6 + 20\text{Log}(d) + 20\text{Log}(f)$$

5.4 Where d is the distance in metres and f the frequency in MHz. For the device in the same building we have assumed d could be as small as 2m for a device located in the room adjacent to the wall on which the satellite dish is mounted. For the device in the different building we have assumed d is a minimum of 10m corresponding to houses located very close to the street. We have used a frequency of 12GHz and 20.2 GHz.

5.5 In determining the antenna discrimination we have assumed that in the same building the signal could enter the back lobe of the antenna. Across the street we have assumed that the UWB signal is effectively travelling horizontally while the antenna is pointing at 25 degrees from the horizontal. We have assumed the worst case of the antenna pointing towards the house across the street. We have used ITU recommendation ITU-R BO.1213 (1995) to derive antenna discrimination from angle.

5.6 At 12GHz we have suggested that the UWB emission limits could be -64dBm/MHz. Taking the worst case (smallest) path loss of 80dB this results in an interfering signal at the receiver of -144dBm/MHz.

5.7 For a typical satellite receiver the noise floor is around -147dBW/MHz or -117dBm/MHz. Allowing for a I/N ratio of 20dB this suggests that the maximum interfering signal should be -137dBm/MHz. As can be seen, the worst case interfering signal is some 7dB below this suggesting that the probability of interference will not be significant.

5.8 Similarly at 20.2 GHz we have suggested that the UWB emission limits could be -59.4 dBm/MHz. Taking the worst case (smallest) path loss of 86.4dB this results in an interfering signal at the receiver of -145.8dBm/MHz and the interfering signal is some 8dB below the interference criteria and again we conclude that the probability of interference will not be significant.

5.9 This analysis is based on a single UWB device. However, it is possible to envisage situations where more than one device is active in the same area. When we considered UWB emissions below 10GHz we noted that in almost all cases, the UWB device closest to the victim receiver dominated the interference. For example, a device located at 3m away, compared to 2m, would have a 3dB greater loss, and one located 4m away, a 6dB greater loss. This means, for example, that were there five devices in the room, one 2m from the receiver and the other four at 4m from the receiver then this would approximately add 3dB to the interference received from a single device. We consider the likelihood of five devices in a room all transmitting simultaneously to be very low.

5.10 Next we note that a single device is some 7-8dB below the level at which interference might occur. Hence, even if three other devices were also 2m away from the victim receiver, this would still not raise the level to the threshold point. If the scenario set out about of four additional devices, 4m away, were to occur, the total emissions would still be 5dB below this limit. Hence, the presence of multiple devices would not affect our conclusions.

Q2: Is this analysis of the risk of interference to direct to home receivers correct?

Section 6

Radionavigation and location

Introduction

6.1 Our understanding is that devices in this category at frequencies above 10GHz essentially comprise radars. When considering radar use below 10GHz we concluded that radars were unlikely to be affected by UWB emissions in practice. Nevertheless, we provide some sample calculations here.

Modelling

6.2 The noise floor for a radar device is given by the ITU[6] as:

$$N = -144 \text{ dBm} + 10 \log B_{IF}(\text{kHz}) + NF$$

6.3 where NF is the Noise Figure and B_{IF} the receiver bandwidth. Practical levels for NF, depending on the band and application, may be around 11dB. So, for a radar with a 20MHz bandwidth we can derive:

$$N = -144 \text{ dBm} + 43 + 11 = -90 \text{ dBm} = \text{-}103 \text{ dBm/MHz}$$

6.4 A further margin is then required to ensure that the noise floor is not materially changed; this is often taken to be around 10dB (but could be as low as 6dB). Assuming 10dB[7] then the signal level which any interference must fall below is -113dBm/MHz.

6.5 As indicated above, at, for example, 15GHz, the allowed UWB limits might be -62dBm/MHz. Hence, assuming a radar antenna gain of say 45dB, a path loss of at least

$$Path\ loss = -62 \text{ dBm/MHz} + 45 + 113 \text{ dBm/MHz} = 96 \text{ dB}$$

6.6 would be needed to afford adequate protection. Using free space propagation, this path loss occurs at some 15m at these frequencies. It seems highly unlikely that a UWB device would come within the main lobe coupling of a radar at such distances. Further, due to the specialised applications and locations of such radars and given the restriction to UWB usage, interference is highly unlikely to be an issue. It should also be borne in mind that we have not taken into account mitigation such as building losses or hardware/cable losses which increase and become more significant at such frequencies. We do not believe that aggregate interference (ie from multiple low power devices) is likely to be an issue, primarily due in general, to the narrow horizontal beamwidths of such radars. Hence, we conclude that there is no likelihood of interference occurring with these proposed power levels.

Q3: Is this analysis of the risk of interference to radionavigation and location correct?

[6] See ITU-R M.1461-1.

[7] A higher value of protection is taken here than might be the case, for example, when considering the interference between two licensed users, since the interference is coming from a licence-exempt application.

Section 7

Meteorological aids

7.1 As far as we are aware, there is no use of the meteorological aids bands above 10GHz in the UK at present.

7.2 It may be that the relevant bodies wish to use these bands in future, but without some understanding of the equipment and applications that might be deployed it is not possible to definitively assess whether there would be any interference from UWB-type devices.

7.3 However, given that the studies presented here have shown that there is no likelihood of interference into satellite services or fixed links our view is that there is equally little likelihood of interference into the sort of applications likely to be deployed as meteorological aids.

Q4: Is this approach to meteorological aids appropriate?

Section 8

Proposed low-power limits above 10GHz

Proposals

8.1 As mentioned at the start of this document, the UWB regulation effectively sets a lower limit below which devices are exempt from licensing. The UWB limit was given careful consideration below 10GHz but was simply set at a flat level above 10GHz. However, consideration of the ever decreasing propagation at higher frequencies suggests that instead of a flat limit, a gradually rising limit should be used above 10GHz. In this document we have proposed two different rising limits, the first extrapolated from a relatively low level of UWB radiation and suitable for most services and the second extrapolated from a very low level of UWB radiation and suitable for services that need additional protection. Here we term the first of these the “standard” limit and the second the “reduced” limit.

8.2 The discussion to date in this document shows that for most services the proposed “standard” limit on licence-exempt emissions should apply. The only services where a reduced limit are those where the study for UWB showed there might be a problem as discussed in Section 4, namely earth exploration satellite and radio astronomy. We consider the bands where these are allocated above 10GHz to be those shown in the tables below.

Frequency (GHz)	**Main Usage**
10.6-10.68	Earth exploration satellite and radio astronomy
10.68-10.7	Earth exploration satellite and radio astronomy
13.4-13.75	Earth exploration satellite
15.35-15.4	Earth exploration satellite and radio astronomy
17.2-17.3	Earth exploration satellite
18.6-18.8	Earth exploration satellite

Table 8-1: Bands where a reduced limit applies between 10GHz and 20GHz

Frequency (GHz)	Main Usage
21.2-21.4	Earth exploration satellite
22.01-22.21	Radio astronomy
22.21-22.5	Earth exploration satellite and radio astronomy
22.81-22.86	Radio astronomy
23.07-23.12	Radio astronomy
23.6-24	Earth exploration satellite and radio astronomy
25.5-27	Earth exploration satellite
31.3-31.5	Earth exploration satellite and radio astronomy
31.5-31.8	Earth exploration satellite
36-37	Earth exploration satellite

Table 8-2: Bands where a reduced limit applies between 20GHz and 40GHz

Frequency (GHz)	Main Usage
42.5-43.5	Radio astronomy
50.2-50.4	Earth exploration satellite
52.6-59.3	Earth exploration satellite
65-66	Earth exploration satellite
76-77.5	Radioastronomy
78-81	Radioastronomy and radiolocation
86-92	Earth exploration satellite and radioastronomy
95-100	Mobile satellite, radionavigation and radioastronomy

Table 8-3: Bands where a reduced limit applies between 40GHz and 100GHz

8.3 Above 100GHz there are many bands where earth exploration or radioastronomy is allocated. However, we also note that in the LEFR we discussed making many of the frequencies above 100GHz available for licence-exempt usage. For these reasons we do not consider it necessary to extend these low power limits above 100GHz at this point, but will revise this in the future as appropriate.

8.4 To be clear, for frequencies between 10.6GHz and 100GHz not mentioned in Tables 9-1 to 9-3, low power devices will be exempt from licensing if they operate below the following power levels:

$-65 + 20 \log(f_{GHz}/10.6)$ dBm/MHz (mean EIRP density), or
$-25 + 20 \log(f_{GHz}/10.6)$ dBm/50MHz (peak EIRP density),

8.5 For frequencies between 10.6 GHz and 100GHz and which are mentioned in the Tables 9-1 to 9-3, low power devices will be exempt from licensing if they operate below the following power levels

$-85 + 20\log(f_{GHz}/10.6)$ dBm/MHz (mean EIRP density), or
$-45 + 20 \log(f_{GHz}/10.6)$ dBm/50MHz (peak EIRP density),

8.6 In all these equations f_{GHz} represents frequency in units of GHz.

Q5: Do you agree with the proposed licence-exemption limits set out above?

Next steps

8.7 Depending on the responses to this consultation we will pursue two approaches.

8.8 We will input our thinking into ongoing European and international work as we believe that harmonisation of licence-exempt devices is important. We will seek to influence such work so that an increased limit for low power devices above 10GHz is implemented as widely as possible.

8.9 We may also seek to amend appropriate statutory instruments and other legislation as needed in order to allow these increased low-power limits in the UK. We have not set a timescale for this as it will depend on the responses to this consultation and any international activity that might have a bearing on our work.

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 31 October 2008**.

A1.2 Ofcom strongly prefers to receive responses using the online web form at http://www.ofcom.org.uk/consult/condocs, 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 william.webb@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.

Professor William Webb
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

Fax: 020 7981 3730

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

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

Confidentiality

A1.7 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.

A1.8 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.

A1.9 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at http://www.ofcom.org.uk/about/accoun/disclaimer/

Next steps

A1.10 Following the end of the consultation period, Ofcom intends to publish a statement before the end of 2008.

A1.11 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

A1.12 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.

A1.13 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.

A1.14 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
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149 St. Vincent Street
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Tel: 0141 229 7401
Fax: 0141 229 7433

Email vicki.nash@ofcom.org.uk

Annex 2

Ofcom's consultation principles

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

Before the consultation

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

During the consultation

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

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

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

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

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

After the consultation

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

Annex 3

Consultation response cover sheet

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

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

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

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

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

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing ☐

Whole response ☐

Part of the response ☐

Name/contact details/job title ☐

Organisation ☐

If there is no separate annex, which parts?

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

DECLARATION

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

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

Name

Signed (if hard copy)

Annex 4

Consultation question

Q1: Do you agree with this assessment of the services that do not need further analysis?

Q2: Is this analysis of the risk of interference to broadcasting satellite correct?

Q3: Is this analysis of the risk of interference to radionavigation and location correct?

Q4: Is this approach to meteorological aids appropriate?

Q5: Do you agree with the proposed licence-exemption limits set out above?

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

A5.3 Ultra-wideband (UWB) devices, as characterised by high-bandwidth transmissions at power spectral densities below specific limits, are exempt from licensing and may operate on a non-interference, non-protected basis. It is logical to conclude that any device that transmits at a power spectral density which is lower than the UWB limits would at worst cause as much interference as a UWB device. It follows that any such transmitter would also be a likely candidate for licence-exemption.

A5.4 We further note that, the path-loss experienced by radio waves grows as a function of frequency. This implies that a high-frequency high-power transmitter can contribute the same amount to a co-channel victim receiver's interference floor as a low-frequency low-power transmitter. Based on the above argument, we believe that the UWB limits on radiated power spectral density can be relaxed at frequencies above 10.6 GHz, with the implication that any transmitter radiating below the increased limits and conforming to the restrictions placed upon UWB devices including indoor use only, should be considered for exemption from licensing.

The citizen and/or consumer interest

A5.5 The introduction of a power limit below which devices are exempt from licensing offers the possibility of innovative new devices, which might be of value to citizens and consumers. These might include, for example, new high-speed short-range wireless systems.

A5.6 If the signals transmitted by such devices led to interference into existing services there might be some detriment to citizens and consumers. For example, if earth exploration satellite systems were not able to function optimally then the loss of the information they provide might have a negative impact on citizens. However, as shown in the consultation, we have taken care to ensure that our transmission limits are below the levels which would cause harmful interference.

Ofcom's policy objective

A5.7 The following options are considered for defining the emission power limits below which all transmissions should be considered for licence-exemption:

- **Option 1 –** Use the UWB limits for all frequencies.
- **Option 2** – Use the UWB limits for all frequencies below 10.6 GHz, but extrapolate the UWB limits for frequencies above 10.6 GHz in order to account for poorer radio propagation at higher frequencies.

A5.8 Ofcom is of the view that Option 1 is over-cautious, in that the UWB limits specify a constant emission limit for frequencies above 10.6 GHz. Given that the free-space radio propagation link-budget deteriorates with the square of frequency, such a limit implies far lower levels of received co-channel interference by incumbent users at higher frequencies than at lower frequencies.

A5.9 Ofcom prefers Option 2 and believes that there is room for relaxation of the UWB limits for frequencies above 10.6 GHz. There are an infinite number of possibilities with respect to the choice of radiation power limits below which devices may be exempt from licensing above 10.6 GHz. The UWB emission masks themselves represent an obvious choice for the definition of such limits. Two sets of limits are of particular interest:

- The UWB limits for 8.5–10.6 GHz (or indeed 3.8–6 GHz). These are defined such that the resulting emissions do not cause harmful interference towards incumbent services, from short-range local-area and personal-area networks, to point-to-point fixed links.
- The UWB limits for 10.6 GHz and above. These are defined to avoid harmful interference toward sensitive passive services in the 10.6–10.7 GHz band.

A5.10 Furthermore, one may note that the radio propagation link-budget deteriorates with the square of frequency for a specific receiver antenna gain. This means that a transmitter operating at a specific frequency can generate as much interference for a co-channel victim receiver, as a transmitter operating at half the frequency, and a quarter of the radiated power. This suggests that the two sets of UWB limits above can be extrapolated as a function of frequency based on a square-law, thereby defining radiated power limits for licence-exemption of devices operating co-channel with active and passive services respectively.

A5.11 Ofcom is aware that for both options it is possible that future applications will emerge which cannot operate economically in the presence of low-power licence-exempt devices. Ofcom believes that this is unlikely, and that the experience it will acquire by dealing with these issues for UWB at frequencies below 10.6 GHz will help assess the likelihood of this issue at frequencies above 10.6 GHz.