Consultation title: Low power licence-exemption limits above GHz

To : **Professor William Webb**
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Name of respondent: **John Parker**

Representing: **FS Spectrum Managers Association**

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Name : John Parker   Date: 30th October 2008

FS Spectrum Managers Association

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

30th October 2008

Dear Professor Webb,

The FS Spectrum Managers Association is pleased to submit this response to Ofcom's consultation document on "*Low power licence-exemption limits above 10 GHz*" issued on the 8th August 2008.

We have significant concerns relating to the power levels proposed for licence exempt (LE) devices, as they could result in harmful interference into licensed services within bands managed by our members. Our analysis shows that the proposals in the consultation are based upon assumptions which are not valid for the case of terrestrial services with directional antennas.

Our services use highly directional antennas for which the gain increases in frequency, balancing the effects of the increase in free space path loss for higher frequencies. As the analysis enclosed shows, the proposal to increase the power levels at higher frequencies could cause significant levels of interference.

We therefore strongly suggest that Ofcom uses the ultra wideband (UWB) limits for all bands shared with the fixed service, description as "Option 1" in the consultation document.

If you have any questions regarding this response please do not hesitate to contact us.

Yours sincerely,

John Parker

FS Spectrum Managers Association

Background to the FS Spectrum Managers Association

The FS Spectrum Managers Association is a group of UK organisations which are responsible for the management blocks of spectrum which can be used for fixed services including either point to point or point to multi-point.

The Associations includes those organisations which own blocks of spectrum bought at auction either in November 2000 or in February 2008 which give rights to transmit in the bands suitable for fixed service systems including:

- 10 GHz
- 28 GHz
- 32 GHz
- 40 GHz

The current membership of the FS Spectrum Managers Association is:

- Red-M Ltd
- Transfinite Systems Ltd

This document is the agreed contribution from all FS Spectrum Managers Association members.

Answers to Specific Questions in the Consultation Document

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

Answer: We feel that the conclusions reached regarding the Fixed Service are not correct for the reasons given in the following section.

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

Answer: The FS Spectrum Managers Association has no comments regarding the approach relating to broadcast satellite service.

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

Answer: The FS Spectrum Managers Association has no comments regarding the approach relating to radionavigation and location services.

Q4: Is this approach to meteorological aids appropriate?

Answer: The FS Spectrum Managers Association has no comments regarding the approach relating to meteorological aids service.

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

Answer: We do not agree for reasons given in the following section

Analysis of Interference from LE devices into the Fixed Service

Variation in Parameters by Frequency

The proposals within the consultation document are that it is acceptable for power levels for LE devices to increase with frequency to account for:

> *"…the deterioration in free space radio propagation link-budget with the square of frequency for a specific receiver antenna gain".*

This statement assumes that the gain at either end of the link remains constant. However this is not the case when one or either end of the link uses a parabolic antenna, in which case the gain also increases with the square of frequency, as shown in the figure below.

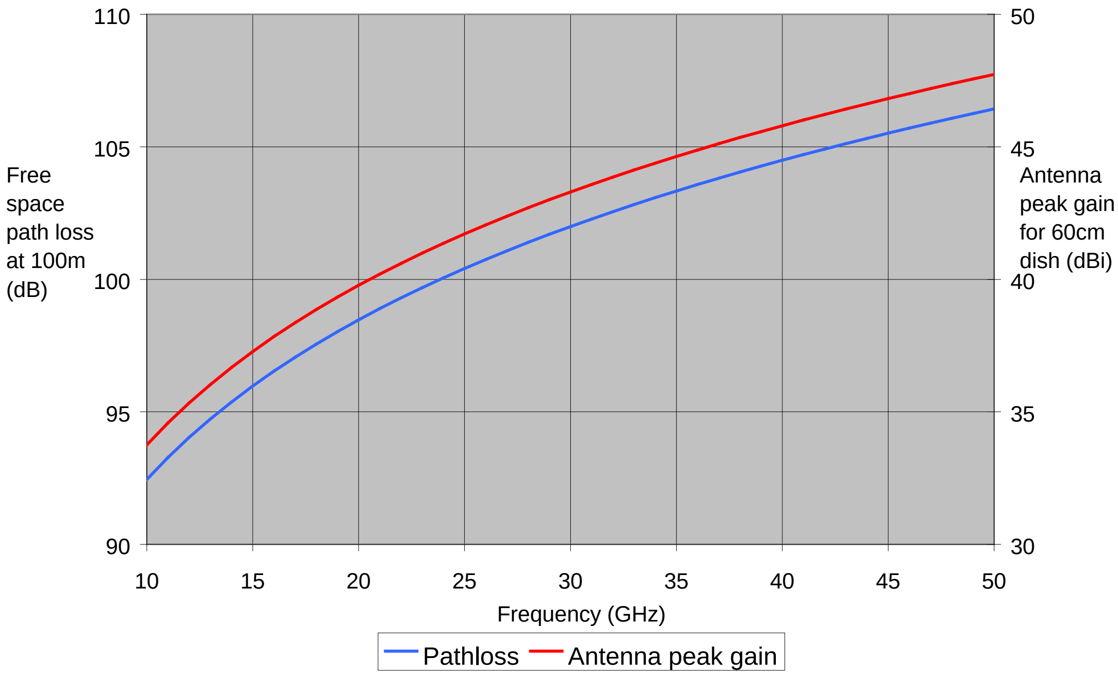


Figure 1: Impact of Varying Frequency on Free Space Path loss (blue line using left hand scale) and Antenna Peak Gain (red line using right hand scale)

Whereas other services use low gain or even isotropic antennas, the fixed service and some satellite services tend to use high gain directional antennas, typically parabolic in nature.

As satellite services point their antenna away from the horizon they are likely to receive interference far offaxis, where the gain is low. However fixed services are likely to receive the interference within their main beam, as in the figure below.

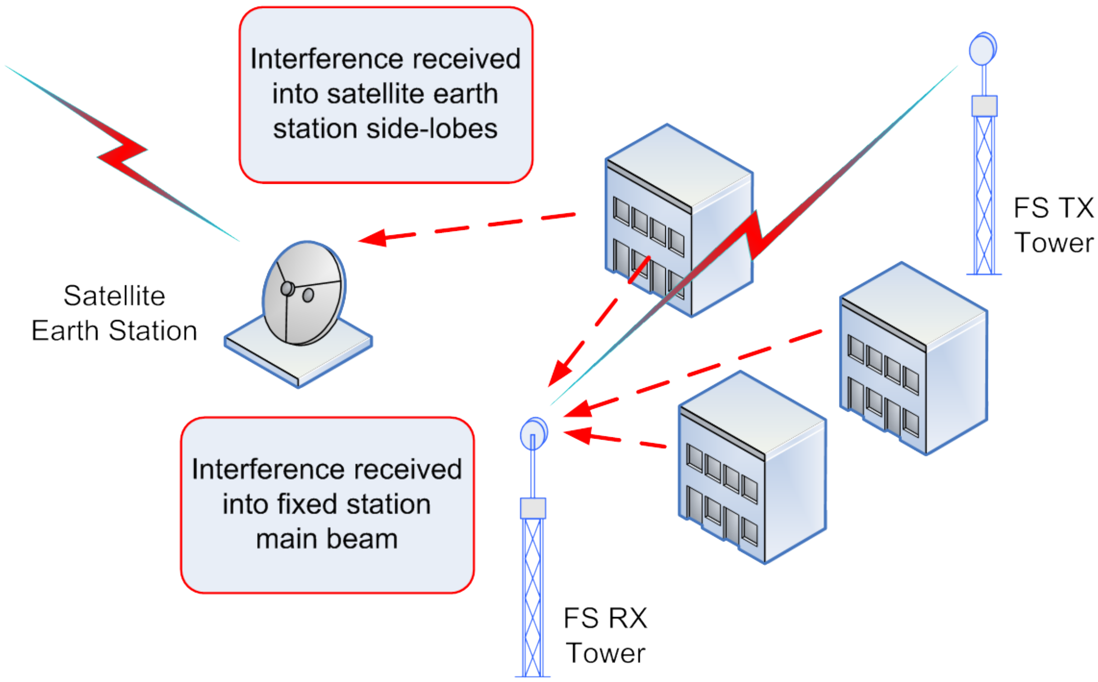


Figure 2: Antenna Gain for Interference from LE Devices

This means there is a greater potential for interference from LE devices into fixed service (FS) systems as:

- FS systems typically use a parabolic antenna whose gain will increase with frequency
- Interference can be received on or close to the main beam of this antenna

Interference Analysis

Analysis was undertaken to determine the potential for a single LE device operating at mean EIRP to cause interference into a point to point fixed link.

The following parameters were used:

RX dish size (m)	0.6
RX antenna efficiency	0.6
Separation distance (m)	100
Noise figure (dB)	4.0

A key issue is what would be a suitable threshold for harmful interference. A measure that is often used is the ratio of interference to noise, and for another co-primary service a value of I/N = -10 dB is often used. However this is not appropriate for non-co-primary LE devices, and so a tighter value of I/N = -20 dB was chosen.

Given the assumptions above plots of I/N against frequency were generated for two options:

- Option 1: Use the UWB limits for all frequencies
- Option 2: Extrapolate the UWB limits for frequencies above 10.6 GHz to take account of increased path loss

This analysis was done using the consultation assumptions, appropriate for isotropic to isotropic interference paths, and also for isotropic to parabolic antenna case which is more representative for sharing between LE and fixed service links.

Figure 3: I/N Analysis for Option 1 using Mean EIRP

Figure 4: I/N Analysis for Option 2 using Mean EIRP

The following points were noted:

- For both Option 1 and Option 2 for all frequencies, the I/N exceeded the threshold of -20 dB in the TX isotropic to RX parabolic scenario
- For Option 2, the I/N for high frequencies in the TX isotropic to RX parabolic scenario was close to zero dB

It was concluded that while both caused a degree of interference Option 2 could lead to significant levels of interference into point to point fixed links.

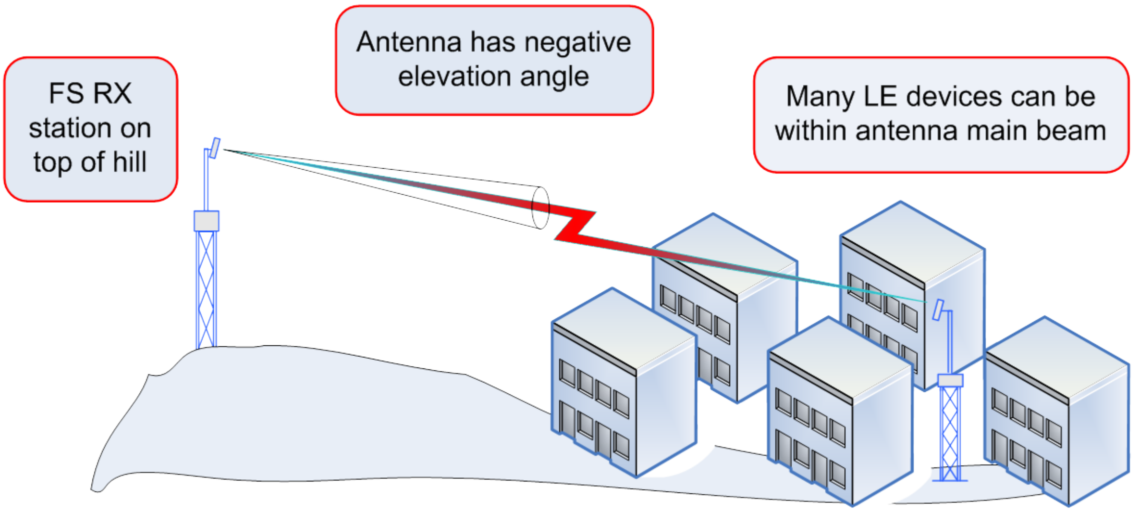
Adjustment Factors

The analysis was done based upon a single transmitter operating close to the main beam of the FS receiver at a distance of 100m. This scenario is not unlikely given high density urban areas, where LE devices are located in high rise buildings.

It is noted that a number of other factors could be taken into account, such as:

- Feed loss at the receiver
- Relative gain at the FS receive
- Indoor - outdoor loss
- Aggregation from single to multiple LE devices
- Variation of EIRP from mean

Some of these would decrease the interference level while others would increase it. There could be significant aggregation effects as many fixed links have a negative elevation angle and hence could have a main beam that covers a large number of LE transmitters, as in the figure below.



While the overall impact could be positive or negative or indeed neutral, it can not be assumed that significant advantages are available to mitigate interference.

The calculations below show how the various effects can result in a neutral overall impact on aggregate interference.

Feed loss (dB)	-2
Relative gain (dB)	-3
Indoor - outdoor loss (dB)	-5
Aggregation factor (dB)	+7
Variation of EIRP from mean (dB)	+3
Net impact (dB)	**0**

Aggregation and Maximum EIRP

Two key drivers of the level of interference are the numbers of units within the FS main beam and their activity levels. The proposed LE power limits would permit much greater levels of interference for short periods of time – up to 23 dB higher per MHz.

It is argued that this is acceptable as there are also controls on the mean power over both the timescale of a second and an hour.

However if there are large numbers of devices the probability is that at least one will be on maximum power for significant periods of time.

Within a limited geographic area there is likely to be similar types of user – for example mostly residential or mostly office. Hence they are likely to have similar diurnal variations in traffic, so in residential areas all users would likely to have maximum traffic in the evening if using the LE devices to stream high definition television.

Hence within a geographic area's busy hour there could be a significant number of simultaneously active LE devices. Within an urban hot spot such as dense residential there could be visible a hundred devices, and with increasing use of glass as a building material there could be minimal indoor to outdoor propagation loss.

With the permitted activity factors, this cluster of a hundred transmitters could result in interference into the FS main beam from:

- 5 LE devices simultaneously transmitting on maximum EIRP over a period of a second
- At least one LE device transmitting at maximum EIRP for half of every hour

As many performance requirements for fixed service systems are based upon metrics such as Errored Seconds (ES) and Severely Errored Seconds (SES), these timescales are of particular concern.

As noted previously, the maximum EIRP levels are significantly greater than that for mean, and hence would result in significantly greater interference, as in the figures below[1].

Figure 5: I/N Analysis for Option 1 using Maximum EIRP

Note that these levels would also be obtained from the aggregate effect of a large number of transmitters using the mean EIRP.

Figure 6: I/N Analysis for Option 2 using Maximum EIRP

The high levels of interference can be seen in all cases involving TX isotropic to RX parabolic.

It should be noted that by nature LE devices are hard to control once the authority to transmit has been given. In addition predictions of how such devices will be deployed and market forecasts have a history of *inaccuracy*.

For example at the time of the discussions with the ITU as to the regulatory framework for 5 GHz RLANs it was noted by equipment makers that the total deployment of 802.11 devices was less than 5 million (see ITU-R JEG 4A-8A-9B/12, 6th July 1999) and that *"With the benefit of hindsight we can conclude that the RLAN market for 2.4 GHz devices has not been growing at the prophesied rate"*

Yet from this slow beginning the installed base grew until WiFi alone is expected to top **one billion** for the first time in 2008, according to data from ABI Research. This represents a massive 200 times increase in deployed devices within a decade.

There is therefore significant uncertainty in the market forecasts for LE devices over the 15 year lifetime of the licences owned by the FS Spectrum Managers Association.

It would be extremely hard given the LE nature of the devices and lack of control on their deployment to impose post-ante controls on their usage. It is therefore highly advisable for Ofcom to use the precautionary principle[2], and not take risks with the UK's valuable spectrum, and therefore **reject Option 2**.

Precautionary principle: If an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action, Wikipedia,