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Advancing Astronomy and Geophysics

RAS Submission to OFCOM on Ultra Wideband (2005)

The Royal Astronomical Society has over 3000 members, both professional and amateur scientists in the areas of astronomy and geophysics. We welcome the opportunity to respond to Ofcom's consultation on Ultra Wideband*. We are representing the interests of radio astronomers, space satellite and spacecraft scientists and weather radar scientists in a general sense, knowing that each specialist area is making their own detailed response.

Our main conclusions are:
Q3: criteria other than economic, namely scientific use are important,
Q4: frequencies of astronomical objects cannot be changed, so new technologies must be adapted to accommodate their frequencies,
Q6: physical isolation already exists and radio astronomy is affected by pollution,
Q7 and Q4: expansion of the bands will have a significant further impact.

The government values a scientifically literate work-force, and acknowledges that astronomy contributes significantly to this. The UK is a world-leader in scientific research using radio astronomy. The UN Member States (nationally, internationally and with industry) should cooperate to implement suitable regulations to preserve quiet frequency bands for radio astronomy and remote sensing from space, and to develop and implement, as a matter of urgency, practical technical solutions to reduce unwanted radio emissions and other undesirable side-effects from telecommunications satellites. UN Member States should cooperate to explore new mechanisms to protect selected regions of Earth and space from radio emissions (radio quiet zones) and to develop innovative techniques that will optimise the conditions for scientific and space activities to share the radio spectrum and coexist in space. (From 'Preserving the Astronomical Sky' recommendations).

The frequencies of interest to the RAS include
Radio Astronomy frequencies including 2.69 – 2.70 GHz, 4.6 – 7 GHz, 8.4 – 8.5 GHz;
MERLIN operates between 0.151GHz and 24GHz, across the UK and in cooperation with radio telescopes in Europe and America;
Space satellites and spacecraft frequencies including 2.02 – 2.3 GHz (S-band), 7.14 – 8.5 GHz (X-band);
Weather radar including 3.0765 GHz.

The facilities of interest include
MERLIN: Lovell Telescope and MkII Telescope at Jodrell Bank Cheshire, radio telescope at Defford Great Malvern, 32m telescope at Cambridge, radio telescope at Pickmere Cheshire, radio telescope at Darnhall Cheshire, radio telescope at Knocklin Shropshire
Ryle telescope (8 -13m dishes) and AMI array (10 - 3.7m dishes) at Cambridge

CCLRC: Rutherford Appleton Laboratory 12m antenna for communication and data taking from space satellites and Chilbolton Observatory 25m antenna with rain radar (CAMRa)

Q3. Do you agree with the economic study? Are there other studies that Ofcom should be conducting?

It may be that Ofcom is correct in interpreting its statutory duty about 'optimal use of the radio spectrum' to be an economic assessment, but other criteria, such as scientific use and the impact of loss of access to the radio spectrum are also important. Many important discoveries, such as pulsars and most recently a 'dark galaxy' have been made using UK radio telescopes. This type of assessment could be conducted in collaboration with other specialist groups with the necessary expertise to assist Ofcom with the study.

Q4. Is there a better way that future use of the spectrum could be taken into account?

It is impossible to change the frequency of an astronomical object's emission, or the existing agreed frequencies of space satellites, so the new technologies must be adapted to accommodate these frequencies. The "3G expansion band" around 2.5 to 2.69 GHz is an example of this case, since it overlaps an astronomical band at 2.69GHz used by radio telescopes in the UK (in the MERLIN network), Europe and America.

Q6. Would it be possible to achieve sufficient isolation between radio astronomy and UWB through practical methods of physical isolation?

As we have all discovered with mobile phones, asking people not to use devices in certain places takes a lot of persuasion. Radio telescopes and antennae were built in isolated places, so the physical isolation has taken place. The benefit to the UK of undertaking radio astronomy is that it is not time-dependent or weather-dependent, so observing can take place during the day as well as at night. Astronomy and satellite communications depend on the reliable detection of weak signals, and every effort should be made to avoid unnecessary interference.

Q7. Are there any other options that we should consider?

Allowing UWB to migrate to the 6 to 10.6 GHz bands will not help scientific work, since radio astronomers work in the C band from 4.7 to 7 GHz, which contains important spectral lines, and there is another band of scientific importance at 8.4 to 8.5 GHz, all used by the MERLIN network. Space satellites use the X band, around 7.145 to 8.5 GHz for communication and data downlink.

Q8. Are there any major technical studies that we have omitted?

The Consultative Committee for Space Data Systems (CCSDS), of which BNSC is the UK representative, has a document of 'recommendations for radio frequencies and modulation systems' covering earth stations and spacecraft and data relay satellite systems. Their recommendations should be included.

Q9. Have we made an accurate assessment of the existing studies?

The existing studies noted here are actually a single study, available in draft form. It appears to be trying to prove there is no problem, judging from Ofcom's analysis.

Q11. Have we proposed the most appropriate mask?

Ofcom's sharper roll-off below 3.1GHz is welcomed, although rain radar at 3.0765GHz will still be severely affected and even S-band communications with spacecraft (2.025GHz to 2.3GHz) could be affected, as well as radio astronomy in the 2.69 to 2.7 GHz band.

Q12. To what extent should we define parameters such as those listed above? What is the most appropriate definition for each of these parameters?

We support the approach recommended elsewhere that a mandated OFF-switch would give some possibility for UWB operation to be on a non-interference basis.

Dr Helen Walker
Astronomy Secretary of the Royal Astronomical Society

* One of Ofcom's key statutory duties is to ensure the optimal use of the radio spectrum under its management. Radio spectrum is a major asset to the UK, contributing some £24bn to the economy each year and underlying many aspects of our lives. Radio communication is critical to areas such as air travel, emergency services, cellular telephony, sound and television broadcasting, defence and our utilities.
A new technology called ultra wideband (UWB) has emerged which potentially could change some aspects of the use of the radio spectrum. Ofcom believes that it should develop a strategy towards UWB in order to meet its statutory duties, allow it to negotiate effectively at an international level and to optimise the benefits that UWB might deliver. This consultation document asks for views on our proposal that we work with European bodies to achieving a harmonised approach throughout Europe to UWB and consults on what view we should present to these bodies.

Outline of the issues

Though the concept of UWB dates back many decades, it was only in the late 1990s that technology had advanced sufficiently for it to be practical in consumer electronics. UWB allows a high data rate to be achieved with relatively simple equipment but results in transmissions spread across large parts of the spectrum used by others. UWB might be used to deliver wireless connections between DVD players, displays and speakers, for example, simplifying installation and removing the need for unsightly wires. It might provide a wireless high data rate link between digital cameras and computers or link computers, PDAs and other computing devices in a local area. Other more specialised applications of UWB include radars that can see through walls or can probe the ground to find anomalies such as cracks in runways. Predicting future applications is rarely accurate, but with its unusual properties UWB might open up many innovative uses.
In accordance with Ofcom's general philosophy of letting market mechanisms apply, we have looked at whether market mechanisms can be used to determine if UWB should be introduced. Specifically, we have assessed the possibility for interference agreements to be made between UWB users and current licence holders. As explained later, given the likely applications for UWB technology, we think it will be appropriate to exempt most UWB devices (when operated within defined limits) from a requirement to obtain a licence, ruling out any practical discussion with existing licence holders. Hence it falls to the regulator to decide whether, and under what circumstances, UWB should be permitted.
In coming to a decision as to whether UWB should be allowed it is necessary to consider the arguments both for and against it.

· **For**. Allowing UWB would seem to Ofcom to be broadly in line with our statutory duties, as long as the conditions which are applied to use of UWB technology are appropriate. Ofcom's view is that, under appropriate regulation, UWB could bring substantial net economic benefits to the UK as well as promoting innovation.

- **Against**. Allowing UWB might cause interference to existing licence holders or other authorised services and as a consequence, might degrade the service they offer, or increase the cost of providing these services to consumers. The potential for interference, and the likely level of any such interference, needs to be weighed carefully against the potential benefits of introducing UWB.

While in principle the arguments for UWB appear strong, determining the potential for interference through tech nical studies has not been conclusive to date. The studies undertaken so far are sensitive to assumptions around device penetration levels and on how much of the tolerable interference level is allowed to come from UWB. As an example, the current international norms provide for an interference level of up to 1% of the noise floor of a primary service to come from a secondary service. Under these norms UWB would only be allowed to transmit up to some portion of this interference allowance. We have evaluated the existing studies, many of which are based on the US spectrum mask, and have conducted a number of our own. Our provisional conclusions, as discussed further in this consultation document, are that:

· We agree with the technical studies that suggest, depending on the spectrum mask chosen, that there could be potential interference to 3G, broadband fixed wireless access and radio astronomy.

- We recognise the concerns expressed in relation to potential interference to other services including fixed links, satellite receivers and radar systems, but we believe that such interference is unlikely to be significant in practice or can be mitigated with relatively simple mechanisms.

  We believe that the risk of interference to 3G operators in their currently licensed spectrum can be reduced to insignificant levels by applying an appropriate mask outside the core UWB bands (which have been set in the US as 3.1 to 10 GHz). However, we cannot adopt this approach towards broadband fixed wireless access and radio astronomy, both of which use spectrum in the core UWB band, without potentially losing a substantial share of the estimated benefits. There are a number of possible solutions to mitigating the potential interference to broadband fixed wireless and radio astronomy which we would like to explore as part of this consultation including some new techniques recently offered for consideration in the relevant ITU-R forum.
  Bearing in mind the substantial economic benefits that might derive from adopting UWB, and subject to finding a way ahead in those areas where we remain concerned about possible interference, Ofcom's proposal is that if UWB is allowed it should be limited to the same in-band power levels as permitted in the US but with tighter out-of-band limits. Such a mask should, in Ofcom's view, protect key services while maximising consumer benefits. In this document we suggest a particular mask that we believe might achieve these aims, namely one where the allowed emission level falls from -41dBm/MHz at 3.1GHz to -85dBm/MHz at 2.1GHz.
  We are now consulting on whether UWB should be allowed or not, and if allowed what the most appropriate mask would be. Subject to the outcome of this consultation, we will commu nicate our opinion to the EC, CEPT and ITU in order to aid the process of reaching international agreement and standardisation on UWB.

The risks of inaction

We believe it is important to consult now on this issue. If we do not form a position soon then it is possible that UWB devices conforming to the US specification will be imported illegally into the UK, eg in electronic devices purchased over the Internet. It would be extremely difficult to detect and halt this process since it is typically not possible to detect a UWB device outside of the room in which it is transmitting. As discussed above, we consider the US specification to be inappropriate for the UK and wish to minimise the risks from the use of equipment conforming to this specification being used in the UK. We think that the best way to minimise the incentives for UK consumers to import US equipment is to reach a decision on the appropriate standard as soon as it is practical. This might involve a rapid development of a pan-European specification for UWB, encouraging manufacturers to build and distribute products within Europe, and possibly worldwide, conforming to our preferred specification. If we are not able to form a position soon we believe that the outcome for spectrum users in the UK could be significantly worse than it might otherwise have been.
The development of a pan-European specification for UWB is already being considered in a number of international fora. In order to be able to meaningfully contribute to this process, and at an appropriate time, Ofcom considers it is important to begin the consultation process with our stakeholders now. For example, and as discussed further in this document, it is likely that the European Commission will be considering this issue at a number of junctures throughout 2005, and Ofcom is seeking to be in a position where we can helpfully assist in the development of a European position on UWB as part of the European Commission's process.

Different types of UWB devices

There are a number of different types of UWB devices, based broadly on the application to which they are likely to be put. In this consultation document, we have grouped the devices into two categories:
· Generic devices that might be used for a wide range of applications such as personal area networks (PANs).

- Specific devices used for ground probing radar, 'through the wall' imaging and a number of other specialist applications.

  This document applies only to the former category. The latter set of devices are already allowed in the UK under licence and we are not proposing at this point to change this approach.

Key points for consultation

The key points we wish to gather opinion on are:

1. Whether it is appropriate for Ofcom to take a regulatory view on UWB.
    1. Whether Ofcom has considered all the appropriate evidence and has analysed it correctly.
    2. What our preference towards allowing UWB should be.
    3. What our strategy should be towards influencing and co-operating with international bodies.

Q1: Are these the appropriate topics to be consulting on?

After this consultation is complete, and subject to the responses and action in Europe, we envisage that a further round of more detailed consultation may be required to take into account responses to this document and fresh evidence expected to arise.

Footnotes:

1. Ofcom does not manage the entire spectrum. Some is managed by Government Departments- primarily the MoD and CAA.
2. The US regulator has already authorised UWB on a licence-exempt basis, with different legislation covering different classes of UWB devices such as ground probing radar, through-wall imaging and general communications systems.
3. UWB regulation sets out upper limits as to the amount of power that can be radiated at any particular frequency, considering frequencies both within the core band of 3.1 - 10.6GHz and outside of this band. This regulation is termed a "mask". The Federal Communications Commission (FCC) in the US has set out such a mask in its regulation of UWB