

1<sup>st</sup> September 2005

**Intellect's Response to**  
**Independent Audit of Spectrum Holdings**  
**'Emerging Issues' Consultation Document**  
**(Due Date 1<sup>st</sup> September 2005)**

Intellect's membership includes companies that currently supply equipment used by the public services, companies that would have an interest in sharing spectrum with the public services, and companies that potentially wish to be involved in facilitating the sharing of spectrum between the public and private services.

Intellect has consulted widely amongst its membership in producing this response text, and a significant number of our members have provided specific inputs to this response.

Intellect considers that the audit is a valuable step towards more efficient use of the Radio Frequency spectrum, provided that the important requirements of the public service, for safety-related applications, national security, the emergency services and similar organizations are not compromised thereby.

Appropriate research and careful preparation will, however, be required to make the optimum longer-term use of the opportunities for spectral sharing.

Intellect members have specifically addressed the issues and opportunities which they believe will be involved in significantly increasing spectral sharing opportunities. This response therefore comprises two parts. The first part is a summary of the results of our study of possible sharing mechanisms and the second comprises Intellect's answers to the specific questions asked in the consultation document.

## **An Approach to Sharing of Publicly-Held Radar Spectrum with Civil Communications**

### **Background**

It is recognised that civil and military users can have valid reasons for requiring wide frequency allocations, namely for such purposes as improved detection, clutter suppression, interference mitigation and providing high-resolution data for target recognition.

The investigation which led to the conclusions detailed below concentrated on radar, and on the S-band (around 3GHz) since this is the portion of the spectrum that is of most value to communication systems in the near future.

Top-level models of several possible schemes have been identified. The following is not a complete list and it is important to note that these suggestions have not yet been worked through in detail.

## **Possible Sharing Schemes**

### **Lease and Revert**

Civil operators may lease spectrum for use with reversion to MoD during times of emergency - this is somewhat like the model by which the new RAF tankers will be chartered to civilian operators in peacetime. This, of course, would require that the civil operators would be able to relinquish the spectrum when required during such an emergency and to be able to guarantee that it had been relinquished. It is possible that sharing with such secondary users may raise concerns regarding the reaction time for them to withdraw or move channels in an emergency. Consideration should therefore be given in the licences to a standard clause that in exceptional circumstances 'Harmful Interference' from Primary Users should be expected with no/little notice. Systems could be designed to identify the change in circumstance and 'Detect and Avoid' gracefully. This could be assisted by the employment of a coded beacon by the Primary users (which would also facilitate exercises to verify the facility)

### **Simultaneous Use**

In some cases it might be possible to design the radars so that they can cope with low-level interference from communications systems in the same band. For example this may be achieved by modest, but pre-planned improvements to the transmitter power or to the receiver sensitivity. Specific channels could be allocated for separate radar and communications systems use if co-existence is not possible, or alternatively large scale geographical separation could be utilised.

### **Cooperative Sharing**

Another model might be that the radar transmissions might 'ask' for permission to transmit a pulse, in the same way as a communications system asks for a slot in a time/frequency division multiplex system. A future network architecture might accommodate both radar and communications transmitters, with the relative priority given to each changing in times of emergency. So far most 'cognitive' protocols have been developed for communications applications, so further research may be needed to assess their potential for sharing with radar – perhaps as referred to in 'Lease and Revert' above.

It should also be recognised that in some circumstances, i.e. in some frequency bands and/or some localities, spectrum sharing might not be possible, for example near a busy airfield the radars might already be using the spectrum intensively.

## **Areas for further study**

It is important to recognise that any sharing scheme will be much more efficient if it is planned properly. Radar and communications networks will need to be designed from the outset to operate together, rather than trying to 'fit' an existing, stand-alone, communications system into a band currently operated by a 'stand alone' radar system. It is realised that a properly planned approach will take longer to implement than an ad-hoc scheme. However its greater efficiency will support the aim of using the spectrum more efficiently and hence increasing its value, thus increasing the amount of revenue which the MoD can obtain by allowing it to be shared.

It should also be recognised that the ideas for band sharing outlined above, and similarly other models which may be imagined, currently lack technical and economic detail. Research would therefore be needed to define these details. These could be seen as an investment, which would easily be repaid by the economic benefits of better use of the spectrum.

## **Answers to Consultation Questions**

The remainder of this response comprises Intellect's answers to the specific questions asked in the consultation document.

*Q1: To judge potential demand, we would welcome views on the bands highlighted – listed in Annex C and detailed in the chapters on Ministry of Defence, Aeronautical and Fixed Links. Would possibilities for (i) sharing (including timelimited and ad hoc sharing) or (ii) freed up bandwidth in these bands be of interest to other users? Are there other bands the Audit should examine?*

The possibilities for sharing in parts of the spectrum around 2-4GHz are probably the most significant in the shorter term, as they include the bands into which future mobile/broadband wireless access services would wish to operate. The frequencies between about 100MHz and 1GHz are interesting from the point of view of future 'counter stealth' radar systems which would wish to move into the band in the longer term. Clearly, these would expect to have to share it with other users, both public- and private-service. Allocation in the other bands up to 10GHz are also under pressure from multiple potential users and include the majority of civil applications, which are subject to international treaty obligations. Bands at higher frequency are under less pressure, because of the higher cost of manufacturing systems operating at these frequencies, and also their greater susceptibility to degradation of performance in poor weather.

If frequencies currently under the control of MoD are shared with other users, this may reduce the ability of the defence industry to obtain access for test and development. Such access is required to develop, test, trial and demonstrate equipment in typical conditions. Some of this work can be carried out under reduced radiation conditions, however the remainder must be carried out at full operational power. Some limitation in operational frequency is possible, as are some limits on the direction of radiation and in some instances, the location of the equipment. Access to MoD frequencies for MoD contracts has always been negotiable, but sharing of bands with other users may give rise to significant restrictions or prevent access. These requirements of the defence industry would then become an additional example of the potential problems discussed in our

response to Question 12. A similar scenario exists with civil applications, such as airport and marine radar.

The public sector itself is likely to have increasing need for spectrum in the future since it, like the private sector, will want to exploit the capability of higher bandwidth communications, for example to share real-time imagery (from video or other sources) between multiple users. High reliability links for surgical telepresence at accident scenes, as well as increased operational awareness for police surveillance operations come to mind as examples.

## **Public Sector Spectrum: acquisition and trading**

*Q2: Do you agree that public bodies should in general expect to meet future spectrum needs through the market? Are the process and criteria outlined a suitable means of deciding whether an administrative assignment should be made if this is not possible?*

Intellect's members are generally keen to exploit opportunities which might be made available by more efficient and flexible use of the spectrum, such as it would be hoped would be achieved by increased use of market forces to determine spectral needs. They would not, however, wish this to lead to any compromise to the integrity of Important Public Services, which would probably be more appropriately maintained by using mechanisms other than 'the market' to allocate their spectrum. Examples of Services which should be protected in this way are:

- Communications for the Emergency Services (Fire, Police, Ambulance and Coastguard)
- Communications and Radar for Air Traffic Control
- Communications and Radar for Maritime Vessel Traffic Management
- Essential Security Applications such as surveillance of UK air-space
- Communications used by providers of other services similar to those provided by the emergency services, such as the Royal National Lifeboat Institution (RNLI)
- Educational Services, including those required to give efficient (i.e. broadband) access to the Internet to those living away from centres of population
- Services for which the UK has international treaty obligations to make spectrum available.

There is a well recognised need to mitigate the undesirable consequences for society which could arise from an unfettered free-market approach in many aspects of service provision. Consider, for example, the obligations imposed on public utilities to provide a universal service, such as the uniform costs across the country of mail and telephone services. It is essential that this need should be explicitly recognised in any consideration of how publicly-held spectrum should be used, since in the modern world communications are something to which all citizens and organizations need access in the same way as they do to other essential services.

The above list of important services is not exhaustive, moreover Intellect does not believe that all publicly-held spectrum falls into this category. For example it would be inappropriate to place all the military radar spectrum on the same footing as that used for Civil Air Traffic Control. Even where spectrum is used for a Public Service, that would not necessarily preclude it being used more efficiently than is the case at present, providing that the first essential consideration, that of maintaining its integrity, is still met.

The most important treaty obligations are those arising from the UK's membership of the International Telecommunications Union (ITU) and of NATO.

The providers of these public services do not necessarily have all the expertise required to assess their spectrum needs themselves, nor would it be cost-effective for them to acquire that capability. Hence it is better if they are protected from the need for incentive pricing. It may be most appropriate for Ofcom to be given responsibility for ensuring that important services have 'adequate' access to spectrum, or, for Ofcom to assess and the DTI to affirm that such access is required.

The discussion on spectral sharing in the first part of this response also highlighted the need for more research to find the best ways of sharing spectrum.

*Q3: Public sector demand: We would also welcome input into this consultation on likely future demand in the public sector and fixed links areas we have covered in this document.*

Although spectrum use will become more efficient, there will be an increasing demand for more spectrum above 9GHz for higher-resolution radars. This will correspondingly require more bandwidth for the individual radars, although this need not be on an exclusive basis. These demands are likely to begin to appear within the next five years. Work is beginning to see how well such systems can work if the spectrum is not continuous, i.e. if there are 'gaps' in the radar spectrum to account for the needs of other users. As noted in our response to Question 1, the Defence Industry and MoD need access to spectrum in all frequency bands for Test and Development purposes.

*Q4: Commercial market intelligence: In order that we do not overlook important future requirements below the 80% of users that our demand study is examining, we would be interested to hear views on likely future commercial demand, specifically those which may fall below the scope of the commercial study.*

Intellect believes that its members' interests are covered under the '80%' being covered by the 'demand' study. However it is important that consideration of commercial demand also includes smaller organisations, such as taxi firms, private security/delivery companies and voluntary emergency services which use spectrum as part of a mechanism for delivering a service other than electronic communications.

Intellect notes that, on the day on which this response has become due, the Audit has issued a report on the 'Study On Spectrum Demand For Non-Government Services.' The timing of this is unfortunate since if it has been issued somewhat earlier comments on it could have been included in this response. Its late appearance means, however, that there has not been enough time to assess it and this limits our ability to respond to the Audit's views.

*Q5. We would welcome views on what information Ofcom could usefully collect in furthering its role to ensure the efficient use of public sector spectrum.*

The issues which Intellect believes to be important for further study into spectral sharing have been detailed in the first part of this response. Other related work which should be taken into

account is being undertaken in ITU Working Party 8B which is examining the possibility of tightening-up the out-of-band and spurious emission characteristics of various radar systems. Improving the spectral efficiency of these systems, if it proves practicable, would improve the ability to share spectrum between existing and novel users. Other work is being sponsored by Ofcom to look at more effective use of the spectrum by civil radars.

Ofcom must be aware of the needs of the defence industry, since, as discussed above, any sharing or trading of spectrum currently held by the MoD may have a major impact on its ability to test and develop new systems.

*Q6: Licensing: We would be interested in views on the treatment of the Crown. Do you agree with the idea of using Recognised Spectrum Access (RSA) to define the rights of bodies covered by Crown immunity and enable tradability?*

Intellect does not believe that RSA is the appropriate mechanism to resolve this issue. Intellect believes that there are still many unanswered questions about the use of RSA.

Spectrum used by the Crown for essential or important public services needs better protection than can be provided by RSAs. Ofcom has previously proposed that these should apply to services operating in 'License Free' parts of the spectrum and it appears that the RSA cannot protect services within those parts of the spectrum. It would be more appropriate to manage those parts of the spectrum which support essential public services by a 'Command and Control' mechanism.

On the other hand, where the spectrum is not being used for such Important Services, Intellect believes that it should be managed in a manner which is closer to that of the commercial organisations with which the Crown may then wish to trade spectrum.

Some of the issues relating to how publicly-held spectrum might be regulated might themselves be resolved by considering how far the three approaches of 'Command and Control', 'License Free' and 'Spectrum Trading' should be mutually exclusive and whether it might be appropriate in some case to introduce 'hybrid' approaches.

## **Spectrum Pricing**

*Q7. Effectiveness of AIP:*

- *Do you agree that AIP should remain a primary mechanism for achieving efficient use of public sector spectrum?*
- *Do you think there is merit in these or other alternative mechanisms to achieve efficient use of public sector spectrum, in addition to or instead of AIP?*
- *How is this affected by Ofcom's proposals to move to greater market management of the spectrum?*

In previous consultations organized by Ofcom, Intellect had generally supported the use of AIP, provided, as mentioned before, that the integrity of Essential and Important Public Services and

also the UK's ability to meet its international treaty obligations, particularly to the International Telecommunications Union and NATO, are safeguarded.

An alternative preference amongst some Intellect members, however, is either for one or more commercial organisations, or a body such as Ofcom, to be contracted to manage the spectrum requirements of the public sector. It should be noted however that such contracts would have to relate to sections of the spectrum rather than to specific systems, since, particularly in the case of radar systems, many systems currently share the same section of spectrum.

Intellect believes, however, that if the publicly-held spectrum is managed by a commercial organisation, that organisation should not hold the rights to that spectrum nor reap the financial benefits from it, but instead be paid a management charge for its work.

It is important that if a decision is made on economic grounds to release publicly-held spectrum, then all the associated costs, for example replacing existing equipment, should be taken into account when assessing whether this will in fact lead to financial savings.

*Q8: Do you agree that there is merit and potential benefit in exploring changes in AIP:*

- *To ensure the prices are kept up to date and reflect the current alternative use (e.g. bands currently charged as fixed which may be suitable for future mobile use)*
- *To better reflect the real 'spectrum value curve' in and outside prime bands (c.f. band factor applied to commercial fixed links which is not applied to MoD fixed spectrum)*
- *To provide a stronger incentive to public bodies to make more efficient use of their holdings (e.g. disposal or sharing; accounting changes that could best tie costs directly to use)*

Intellect's view is that the relative immaturity of AIP means that, if that route is pursued in the future, further research is likely to lead to improvements in its operation.

One factor which may drive the need for further research could be a difficulty in establishing realistic 'prices' for the spectrum because of the need to extrapolate from the limited data now available to a price/supply curve for much larger sections of spectrum over a much wider range of frequencies.

Another factor which may drive research is the need, mentioned in our response to the previous question, to ensure that all the costs associated with releasing spectrum are taken into account in deciding how the AIP mechanism should operate.

It is too soon yet to know in what other directions improvements are likely to be needed or achievable.

*Q9: The Audit therefore thinks it is worth exploring the possibility of introducing a system of 'freehold rents' or 'retainers' for bands which the MoD is not currently using but continues to*

*hold a right to reclaim and would welcome views on the economic rationale for and possible level of such a charge.*

Intellect has no view on how the government should charge for spectrum internally, but the first part of this response suggests mechanisms, akin to some Private Finance Initiative (PFI) schemes, whereby spectrum could be used by private operators for most of the time but could revert to the public services in time of need. This may be an alternative to the process of 'freehold rents.'

As has been mentioned before, the MoD and the defence industry will still need access to additional spectrum for Testing and Development purposes, and the MoD need it for training purposes.

Intellect notes that MoD is currently charged approximately £50M per annum for spectrum, so extending the scope or level of these charges will inevitably affect the budget for manpower and equipment. A reduction in the equipment budget will, of course, directly affect the defence industry.

## **Sharing**

*Q10: Would the existence of a third party intermediary to facilitate sharing between public sector organisations and other public/commercial bodies be likely to increase the possibilities afforded by sharing? What roles should such a body have? Would individual users find it useful to be able to negotiate over sharing/trading arrangements either directly with the MoD or (an) organisation acting on their behalf?*

Intellect believes that a third-party intermediary with the specific job of facilitating spectral sharing would be *more* likely to be motivated to achieve significant sharing than government departments, where this might be only one of a large number of tasks that the latter were mandated to undertake.

One possible danger with this model is that when detailed negotiations and discussions are required between the present incumbent and the new user to obtain best use of the spectrum, the presence of an intermediary between them might be counter-productive due to it making direct communication between the actual users of the spectrum harder. Another approach would be to make this third party the final arbiter in such cases.

*Q11. The Audit team would welcome any views on how existing users can be assured that sharing will not compromise ongoing safety-critical or essential use, including through equipment standards, testing, management of liberalisation and appropriate operational and technical parameters.*

Intellect believes that important public service and safety-critical users must be protected from inappropriate commercial pressures. Intellect believes that any sharing of the spectrum currently occupied by such services would have to be preceded by detailed case-by-case studies of the potential impact of sharing. This can usefully be preceded by more generic studies into effective ways of sharing the spectrum, as proposed in the first part of this response. The outcomes of

such generic studies can inform the studies required in specific cases, as can other work on interference, such as that being undertaken in the ITU.

It should be noted that a preliminary requirement for any such studies must be agreed definitions of the terms 'safety critical' and 'essential.'

*Q12. The Audit would welcome any views on the effectiveness of the current T&D licence regime and how this might be improved. It would also welcome views from existing users on how much flexibility here would be considered reasonable.*

Intellect notes that ready access to Testing and Development licenses, particularly for Development, will of course still be essential when spectrum can be traded (as already commenced). This pre-supposes a balanced functioning market. In practice, spectrum rights are often bought by service sector companies late in the development cycle. These companies are likely to be different from equipment vendors and financially weaker SMEs/Academic development sources. These may well need to have T&D access *years* beforehand. T&D may be long term in nature so there also needs to be a favourable environment for the regular renewal of T&D licenses after their initial approval. The need to get permission from the current lessee of the spectrum therefore has the potential to impede future technological development and thus also to impede the functioning of the market for spectrum by reducing flexibility. It is easy to envisage that this may put UK developers of both commercial and public sector equipment at a competitive disadvantage and also ironically impede the development of more modern share-capable systems.

Whilst recent problems seem to have been due only to 'teething troubles,' the current regime is believed to have the potential for causing significant problems. If these start to occur it is possible that they will manifest themselves very rapidly, probably driven by some technical or commercial development in the fast-moving telecommunications markets. The possibility of introducing some sort of qualified 'right' of access to spectrum for development purposes should therefore be investigated before such potential problems materialise.

Access to spectrum outside the normal allocation bands will also be required for export equipment, evaluation of imported equipment and wide-band systems, such as for testing wide-band antennas. In the past, users of such spectrum co-operated with the regulator in ensuring that any unexpected interference due to the latter testing could be corrected rapidly (if necessary by switching off the test equipment) to protect the primary users. Therefore mechanism for making use of such co-operation needs to be retained within the new and more flexible regime. The technical regime for emissions and mitigation also needs to be reviewed in more detail.

In summary there is both complexity and uncertainty associated with the T&D process and Intellect would recommend a dedicated consultation on the topic

*Q13. The Audit team is interested in the potential for more sharing in the bands used by the public sector. Are there techniques or services in which you believe there is particular potential? For example, what are your views on the technological, operational and economic feasibility of sharing between radar and other technologies?*

As discussed in the first part of this response, Intellect believes that such sharing is possible in principle but that detailed study is needed into the technical and commercial mechanisms which could allow this to be achieved efficiently in practical cases.

## **Ministry of Defence**

*Q14. What impact does the possibility of restrictions to be imposed in a time of civil emergency have on the attractiveness of sharing MoD spectrum?*

The first part of this response suggests some mechanisms by which this might be achieved, but, as noted in our answer to the previous question, Intellect believes that more study is needed into the practical issues before this can be achieved efficiently.

## **Radar**

*Q15. Do you agree with the principle that AIP should be introduced for (i) aeronautical and (ii) maritime navigation radar? If so what are your views on the best way to determine and impose AIP charges on radar?*

Intellect does not believe that AIP is appropriate for aeronautical and maritime navigation radar, since the spectra which these use are covered by treaty obligations. 'Pricing' cannot be an 'Incentive' to the agencies which manage that spectrum because the treaties prevent them from reducing their usage whatever the financial incentives. In many cases aircraft and ships of non-UK origin may visit or overfly which would not be subject to any frequency sharing agreement or AIP mechanisms.

In the longer term it might be possible to amend the ITU regulations, however this will be a slow process with potential for releasing only a small part of the total radar spectrum. Unless and until this is done, Intellect does not believe that AIP can serve any purpose in these bands.

*Q16. Do you think there is scope through means other than pricing (e.g. technical regulations, better co-ordination) to enhance the utilisation and economic efficiency of radar bands*

Intellect notes that Ofcom has sponsored a number of studies into making more efficient use of the radar spectrum, but, like the similar studies by the ITU, these have mostly been concerned with reducing the amount of out-of-band and spurious emissions.

In principle, the bandwidth is determined primarily by the need of the radar to resolve targets at slightly different ranges. Techniques have been proposed to obtain the required resolution with less bandwidth, but they are not as robust as the conventional approach and may therefore not be suitable for safety-related applications.

It is important to recognise that radars are actually very efficient at sharing spectrum. For example, hundreds of marine radars in relatively close proximity share a spectral allocation

which is only about twice the bandwidth of an individual emitter when it is on its shortest range scale.

## **Fixed links**

*Q17. The Audit team would like to hear from any prospective band managers who have considered band management in a fixed links band, to hear views on potential barriers*

Intellect considers that in general, the non-Government fixed links bands are efficiently managed by Ofcom and, taking into account the range of bands available, no significant congestion is apparent. Spectrum trading of individual licenses is already possible although we understand there has not been much take up yet. Liberalisation of use is generally not possible yet and spectrum property rights and interference protection rights are not yet fully defined. Intellect believes that these issues need to be resolved as a priority, rather than the question of who manages the fixed link spectrum. Intellect could support presently unused blocks of fixed link spectrum being made available to the market on a non discriminatory basis (auction) so that individual companies or a band manager could use the spectrum if they consider that a positive business case can be found.

*Q18. We would welcome views on the merits of the listed approaches to regulator intervention.*

Intellect believes the issues surrounding potential re-use of the fixed link spectrum should be left to the market. More 'interventionist' approaches, i.e. any action by the regulator, run the danger of mis-judging the true consequential costs of moving the fixed links to other frequencies.

*Q19. We would welcome views on whether a Technology “Spend to Save” scheme would be of benefit, and views on the Spectrum Efficiency Scheme generally, including whether its scope could usefully be expanded*

As discussed in the first part of this response, Intellect believes that a 'Spend to Save' scheme is the correct approach to obtaining the best spectral efficiency. The scheme should be extended to look explicitly at schemes to allow multiple users to share spectrum, because this will yield much greater benefits than only trying to reduce the spectrum used by individual systems. Whilst some Intellect members work under SES auspices, awareness amongst others and industry generally is not as high as it could be. The Ofcom website could provide greater details of current and future schemes to assist bidders, demonstrate value, and guide potential future sharers.

## **International**

*Q20. We would welcome views on whether the issues highlighted accurately represent those likely to be key at an international level in taking forward the Audit’s interests as outlined in this consultation document*

Intellect believes that it will be very difficult to persuade all the other appropriate parties to the treaties which define the UK's international obligations to adopt the same market-oriented view of spectrum use as has been adopted in the UK.

Intellect therefore believes that any attempt to apply the approaches being considered by the IASH/'the Audit' to spectrum towards which the UK has international obligations will take a very long time to come to fruition and that the Audit should concentrate on those parts of the spectrum to which those constraints do not apply.

Intellect believes that the most significant of these international obligations are those to the ITU, NATO and the EU.

Other international issues are:

- a) besides its treaty obligations to NATO, the MoD also needs access to spectrum used by its NATO partners so that they can exercise in the UK.
- b) Commercial equipment developers are much less likely to field equipment which uses released UK spectrum unless the same frequencies are available for them to use in their other markets abroad.
- c) As noted above, the defence industry needs access, for Testing and Development purposes, to spectrum used by its foreign customers.

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