

BT Response to the Ofcom Consultation Document on the Spectrum Framework Review

Executive Summary

- 1 BT has read with interest the Ofcom consultation document on the Spectrum Framework Review (SFR). We see this as a most important discussion document, and BT can support wholeheartedly the general principles of Ofcom's Spectrum Vision. Furthermore, BT interprets the 3 bullet points in §6.3 of the CD relating to fixed and mobile spectrum as a valuable and essential extension of this vision. However, we have found several areas of detail elsewhere within the Consultation Document that we believe require further consideration.
- 2 In particular, BT does not believe that the material in §3.5 and Annex H yet represents a workable solution to the management of spectrum rights, interference and change of use. We believe that they could lead to a complex and burdensome spectrum environment, and therefore question whether they could result in a workable spectrum market on a scale that would create the significant economic benefits which Ofcom have stated, and we agree, should be possible.
- 3 BT has noted that in the recently published *Ofcom Statement on Liberalisation* the proposals in the *Spectrum Framework Review* are positioned as an approach that could be explored in the future. There are further elements of this statement that indicate that Ofcom remains convinced of the need to proceed with care. BT would urge that Ofcom does indeed retain this as its guiding principle.
- 4 If we interpret the Liberalisation Statement correctly, then BT could certainly offer support the approach set out within its pages. Time would therefore seem to be available to test and refine the "two tier rights" concepts, and BT would suggest that a full and frank industry discussion or working group may assist in achieving the required balance between progress and confidence levels. However, if the "two tier rights" concepts were intended to become the "more flexible" licence regime at an early stage, then our concerns as described within this response would remain firmly in place.
- 5 The SFR, and its introduction of the new element of *restrictive rights* that include the need to gain the approval of *neighbouring users*, is concurrent with the Statement on Liberalisation. Given this concurrence, BT believes it would be very helpful if Ofcom could confirm its intention to continue with the "twin track" approach to liberalisation involving both licence specific change of use by negotiation with Ofcom and the concept of generic licences with inherent usage flexibility. Furthermore, this confirmation could usefully include clarification as to the breadth of the scope of such licences, as originally set out in the liberalisation consultation document.
- 6 Returning to the proposals within the SFR itself, a key factor in our concern is Ofcom's move away from undertaking the evaluation of proposed changes of use. The implication in the SFR is that other neighbouring spectrum users, perhaps with competitive interests, determine the acceptability of such changes. Under such a system BT believes that there would need to be at least a laid-down process for such discussions with legal and regulatory safeguards, time scales and a route to appeal against unreasonable objections.

- 7 We believe much depends on how *specific rights*, *current use* and *change of use* are finally to be defined, as these will govern what will be possible within existing rights, and the extent to which the restrictive rights would come in to play. The full detail of this has clearly yet to be developed and until such time as the proposals become clear BT reserves its position over acceptance of the concepts and application of this two tier rights system.
- 8 BT would therefore encourage Ofcom to provide some practical examples of *specific rights*, such as might be applied to the different licence classes, in particular the more generic licences that were foreseen as methods of achieving liberalisation in the context of the Liberalisation consultation and recent statement.
- 9 Where change of use is to be dependent on bilateral negotiations, BT believes that clear guidance, and adequate basic information, would need to be available to allow the determination of which neighbours would need to be consulted for any such prospective change.
- 10 For an operator to value a spectrum opportunity and plan and self-certify the compliance of his system, and to be able to demonstrate such compliance to Ofcom or other spectrum users, it is vital that a licensee has clear and unambiguous rights and obligations independent of any other spectrum user. The present proposals do not give confidence that this will be achieved.
- 11 Annex H discusses how physical licence boundaries will be defined in geographical terms, and how the signal level limits at these boundaries will be controlled. BT supports the method for the geographical definition of such boundaries.
- 12 However, BT considers that greater pragmatism must be introduced into the setting of boundary signal level limits for licences, including practical time percentages for which the interference limits should not be exceeded. These will maximise spectrum efficiency and allow advantage to be taken the statistical benefits of interference mitigation practices and new technologies such as adaptive antennas.
- 13 BT sees significant difficulties in using a propagation model as the *final arbiter* in interference resolution, and cannot support that, but we can see the benefits of allowing propagation model results to provide evidence in such cases. In this context we question the suitability of Recommendation ITU-R P.1546. We suggest that if propagation models were to play a role in the application of spectrum rights, then a Recommendation such as ITU-R P.452, which in our view has better capabilities and greater scope for refinement, would be preferable. Its implementation would need to be carefully done with specified terrain and clutter databases (which would need to be generally available) and have the broad support of the spectrum user community.
- 14 BT suggests that there should be a periodic review of spectrum requirements for licence-exempt devices, and that any such review should take a wider remit, i.e. extending beyond traditional licence-exempt communications applications.
- 15 We believe it would be helpful if the SFR clarified how the concept of administrative incentive pricing will be used within the new framework and more precisely what its role will be beyond the current proposals that are the subject of a further separate and concurrent consultation.

BT Response to the Ofcom Consultation Document on the Spectrum Framework Review

Contents

Executive Summary	1
Contents.....	3
1 Introduction.....	4
2 General comments.....	4
3 The Ofcom Spectrum Vision.....	5
4 The concepts and application of <i>specific rights</i> and <i>restrictive rights</i>	5
4.1 Headline reaction.....	5
4.2 Working with spectrum rights to facilitate liberalisation.....	6
4.3 Working with neighbouring spectrum users.....	8
5 Annex H of the CD.....	9
5.1 Table H.1.....	10
5.3 Section H.2.....	11
5.4 Section H.3.....	11
5.4.1 <i>Maximum in-band power</i>	11
5.4.1 <i>Limits at geographical boundaries</i>	12
6 Recommendation ITU-R P.1546.....	14
7 Spectrum for Licence exempt applications.....	15
8 Administrative Incentive Pricing.....	16
Conclusions.....	16
Appendix 1 – answers to the questions in the consultation document.....	18

BT Response to the Ofcom Consultation Document on the Spectrum Framework Review

1 Introduction

BT has read with interest Ofcom's Consultation Document¹ (CD) on the Spectrum Framework Review. We believe that this document represents a potentially important milestone along the road to a more flexible and accessible spectrum environment for the UK. Much of the content of the CD summarises Ofcom's earlier philosophy and policy on spectrum management, and the trends in management of the spectrum that Ofcom seeks to achieve in regard to *command and control*, *market led* and *licence exempt* spectrum. We generally support this material (as has been indicated in our responses to earlier related consultations). However, as discussed below, we have found several important issues within the text that prevent BT from offering unqualified support to the proposals.

Notwithstanding our support for many proposals within the earlier documentation, we now find significant difficulties with key detailed implementation aspects of the concepts and proposed use of *Specific Rights* and *Restrictive Rights* as currently described. We see these as an undesirable move away from earlier objectives. We discuss these difficulties in §4 below. We have particular concerns relating to the more detailed material in §4.5 and Annex H of the CD, including the use of an implementation of Recommendation ITU-R P.1546 as the *final arbiter* for resolving interference issues at geographical boundaries. These topics are covered in §5 and §6 below.

Whilst we see no immediate problem with the proposals relating to spectrum for licence-exempt applications, BT believes that the issue of how much spectrum should be available for such applications needs to be revisited at a relatively early stage and then periodically. We provide our arguments for this in §7 below. If a process for regular review is intended, BT could support the near-term proposals in the CD.

Finally, we comment briefly on the issue of administrative incentive pricing in §8 before addressing the specific questions raised in the consultation document in §9 and Appendix 1.

Our overall conclusions are summarised at the end of the main text.

2 General comments

We find that the Consultation Document provides a broad mix of Ofcom's philosophy, policy and exploratory spectrum management ideas relating to a new, more liberal and progressive, spectrum environment. In responses to earlier consultations we have favourably, indeed strongly, supported Ofcom's evolving ideas on spectrum trading and liberalisation, and we have requested that Ofcom approaches the release of spectrum into this framework in a strategic manner. We are pleased to note that this latter point is now beginning to be addressed by the consultation on the Spectrum Framework Implementation Plan² recently published. We generally welcome that plan, and will respond separately to the associated consultation.

¹ *Spectrum Framework Review – A consultation on Ofcom's views as to how spectrum should be managed*, Ofcom, 23rd November 2004

² *Spectrum Framework Review: Implementation Plan*, Ofcom, 13th January 2005

We note the statistical approach to apportioning the spectrum between *command and control*, *market led* and *licence-exempt* domains. However, it is as yet difficult for BT to comment on the relevance of the proportions suggested because the location of the spectrum, the consequent availability of technologies and equipment upon which to build applications, and the specific nature of spectrum engineering issues associated with bands in each domain are important to forming a judgement of what is proposed in this context. We believe that Ofcom's generally philosophy looks appropriate. However, we cannot endorse the proportions suggested until more of this detail finally becomes available.

3 The Ofcom Spectrum Vision

BT welcomes and strongly supports Ofcom's over-arching spectrum vision as set out in §1.7 of the Consultation Document. Furthermore, BT interprets the 3 bullet points in §6.3 of the CD relating to fixed and mobile spectrum as a valuable and essential extension of this vision.

We believe that these challenging goals, taken together, present powerful objectives for Ofcom and the UK radio and communications industries to pursue if innovative ideas for wireless broadband communications and other radio applications are to be forthcoming. Additionally, if these ideas are to be of timely and real benefit to consumers and professional users of the spectrum, it is essential that early action is taken and we applaud Ofcom's determination to introduce early measures.

4 The concepts and application of *specific rights* and *restrictive rights*

4.1 Headline reaction

BT believes that the material in §4.5 and §H.1, H.2 and H.3 of Annex H as yet falls short of a workable solution to the management of interference and change of use.

The proposals suggest that the management of the market-led element of the spectrum be based on a new concept of dual spectrum rights, i.e. the *specific rights* determined by virtue of current use and detailed in individual WT licences, and the generic *restrictive rights* that immediately become applicable upon change of use. To establish realistic *specific rights* for a proposed changed use the licensee or prospective licensee must seek the agreement of all *neighbouring users* to the parameters of the proposed new use. Whilst this is theoretically workable, it is the practical reality that concerns us.

From the outset there has been a generally accepted view that, for a liberalised spectrum market to be successful, the burdens of the administrative and technical processes, the timescales and the costs involved would all need to be kept to a low minimum. Indeed, Ofcom correctly recognises the importance of this in §3.44 of the *Spectrum Liberalisation Statement*. BT sees these current proposals (which we see as a change of direction since the consultation on spectrum liberalisation) as moving away from this underpinning principle and towards a more complex and burdensome approach to dealing with change. We therefore believe that they might only be viable for a few significant changes of use for which the workload, costs, time and commercial risks are justified, and even so will fail to deliver one of the principle original aims of spectrum trading/liberalisation which was to foster a speedier response to market demand.

A key factor in our concern is the apparent move away from Ofcom undertaking evaluations of proposed changes of use, with the inherent impartiality that this offers, and the concepts of generic spectrum masks that help to provide a clear and unambiguous statement of spectrum rights. The implication now is that it is primarily other neighbouring spectrum users, perhaps with competitive

interests, which determine the acceptability and parameters of such changes. We believe a hid-down process for such discussions would be essential with legal and regulatory safeguards, timescales and a route to appeal against unreasonable objections and that this would need to be a central role of Ofcom going forward.

On balance we believe that the new approach as outlined will be unlikely to stimulate the dynamic spectrum environment originally envisaged, and further developed in the earlier discussions on spectrum trading and spectrum liberalisation. We question whether they would result in a workable market on a scale that could create significant economic benefits for the UK (Licence holders will not have a valuable asset since they will not be able to “offer” change of use and “neighbours” may have non-pecuniary reasons for thwarting change).

4.2 Working with spectrum rights to facilitate liberalisation

At the beginning of Paragraph H.1 of Annex H, Ofcom states its belief “that the best mechanism for implementing change of use is through technology-neutral spectrum usage rights. These will allow users to understand their ability to change their technology or usage without needing prior approval from Ofcom or expensive interference studies”. BT fully supports this statement, as we believe it effectively encapsulates the original intentions of liberalisation. However, BT believes that the proposed use of the specific and restrictive rights, as documented in this CD, will not, in themselves, lead to a practical fulfilment of this ideal.

The restrictive rights (at least as set out in Table H.1), are “technology neutral” in as much as they apply in all cases of proposed change of use. They do nothing, however, to help the user to *understand their ability to change their technology*, as this ability will be largely influenced by the attitudes and behaviours of neighbouring spectrum users. The restrictive rights are therefore of little practical use in themselves, except perhaps for testing (probably only then in indoor test chambers in many cases). Indeed, Ofcom states in §H.2 that the restrictive rights in Table H.1 *are too restrictive to allow efficient use if applied directly*. An admission that they do not of themselves represent “technology neutral” rights under which any change of use with alternative technology could be put into effect.

The impact of the *restrictive rights* concept on Ofcom’s previously announced proposals to employ two routes to spectrum liberalisation are unclear. In §1.4 of this CD, re-iterating ideas contained within the Consultation Document on *Spectrum Liberalisation*³, Ofcom indicates that it could implement spectrum liberalisation using two mechanisms: -

- i) ***Individual licence variation.*** Essentially intended for evolving existing licences. Ofcom indicated in the Liberalisation Consultation Document (§3.17) that it would... *give guidance to applicants about the considerations it would apply in considering requests, which will include a technical assessment of the impact of the change on the spectrum quality of other spectrum users.*

The implication in the liberalisation CD was that (in the early days of liberalisation at least) Ofcom would have a pivotal role in the evaluation of proposed changes of use, and BT was fully supportive of this function for Ofcom as it would be a key catalyst for innovation. This present CD implies that, with the introduction of the restrictive rights concept, Ofcom would no longer see itself in this role. Instead, a user proposing change would be obliged to enter into discussion with a range of neighbouring users in order to recover from the limitations of

³ *Spectrum Liberalisation – A consultation on proposals to reduce or remove certain restrictions on spectrum use.* Ofcom, 17th September 2004.

the restrictive rights. We believe that, because of the many commercial, procedural, cost and delay problems potentially associated with such dialogues (see §4.3 below), this would be an unfortunate change of approach.

BT believes that an initial evaluation by Ofcom, within a commercially confidential and “competition neutral” framework, and with the prospect in some cases of changing use within existing rights without involving wide-ranging consultations, would be a strong enabler for the early introduction of innovation and change. We strongly encourage Ofcom to retain this approach.

- ii) **Generic licence change** to (progressively) make licences intrinsically more flexible and targeted at future releases of spectrum by Ofcom.

In our response to the liberalisation consultation BT indicated that we saw such “generic” licences (which we assumed would operate via emission masks around the spectrum blocks) as the essential longer-term foundation for a flexible and liberalised spectrum environment. However, Ofcom indicate in the 3rd paragraph of §H.1 of this CD that “...a single set of spectrum usage rights will not provide the flexibility it (Ofcom) seeks”, and that “...a change of use within current de-facto levels would in many cases result in interference. Whilst not specifically made in the context of generic licences, these words might lead to the impression that Ofcom is now less certain that change of use could be achieved within generic rights as originally envisaged. If this is the case, it must cast some doubt on the viability of the proposed new *generic licence classes* referred to in §1.4, and hence reduces the prospects for a straightforward and inexpensive liberalised spectrum market.

In the 2nd paragraph under the sub-heading “Trading and Liberalisation” within §4.5 of this present CD, Ofcom now appears to highlight difficulties within both routes to liberalisation. Nevertheless the two routes to liberalisation are re-stated in their original form in the more recent Consultation Document² on the *Spectrum Framework Review: Implementation Plan*. To BT there now appeared to be a lack of clarity now as to the status of, and Ofcom’s commitment to, the “twin track” liberalisation approach within the various related consultation documents.

In this context we were pleased to receive Ofcom’s *Liberalisation Statement*⁴ (the *Statement*) that was issued on 26th January 2005, and we find aspects of this new text relevant to the discussion of this present CD. These aspects are summarised in §1.8-§1.12 and, briefly determine there will be:-

- 1) The opportunity for early change of use agreed with Ofcom on a case-by case basis (§1.9);
- 2) “Generic flexibility” later in 2005 (§1.11);
- 3) In time, a more radical redefinition of spectrum rights as per any results from the Spectrum Framework Review CD (§1.11).

Whereas the *Spectrum Framework Review* implied that the two tier spectrum rights might be the only route to change of use, and that the discussion with neighbours would be mandatory, the *Statement* clearly positions these ideas as something to be explored for the future. Given our concerns, we find this change of emphasis to be very positive, and to offer greater potential for the eventual adoption of the new ideas.

In addition, “discussions with neighbours” are positioned as a 3rd, voluntary, route to liberalisation for the time being.

⁴ A *Statement on Spectrum Liberalisation – implementation in 2005*, Ofcom, 26 January 2005.

BT believes that this scenario from the *Statement* would provide a far better opportunity to explore and refine the *restrictive* and *specific* rights concepts in practical situations without the potential pressures and difficulties discussed above. If, in the longer term, a way of applying of the *restrictive* and *specific* rights emerged that was satisfactory to the spectrum user community, and which avoided the potential worries, then thought could be given to bringing these further into the foreground.

If we interpret the Liberalisation Statement correctly, then BT could certainly offer support the approach set out within its pages. If time was thereby made available to test and refine the “two tier rights”, then BT might be minded to moderate our concerns over them to some extent. However, if the latter approach is intended to become the “more flexible” licence regime at an early stage, then our concerns must remain in place.

4.3 Working with neighbouring spectrum users

BT believes that the process and rules for agreeing change with neighbouring users is an important area for further attention, particularly given the significance this activity hastaken on in these latest proposals. We indicate below some of the detail behind our concerns, which (as already noted in §4.2 above) lead us to believe that there might need to be a laiddown process for such discussions with legal and regulatory safeguards, timetables and perhaps a process for appeal against unreasonable objections.

The discussions required with “neighbours” to move towards a new set of specific rights would inevitably and quickly become technology and application specific, as dealing with specific interference scenarios would surely be the only way to secure agreement towards new specific rights. Indeed, the discussions are likely only to be possible with the very *...expensive interference studies...* that Ofcom believes will be avoided by its suggested approach. On the contrary, BT believes that “neighbours” could demand full and detailed evidence of the new interference conditions before entering into discussions about change. The current debate over UWB has illustrated the sensitivities that can arise over the possibilities of interference. Given also how highly charged the discussions have become in the UK and Europe when relating to any change of use and flexibility in technology choice, it is difficult to see how such studies and discussions could proceed in a timely and objective manner outside a neutral Ofcom designed framework, creating potentially high up-front costs for those seeking to achieve change.

The new ideas on discussions with neighbours are not fully developed in the CD, but the following issues come to mind: -

- BT believes that criteria needs to be provided to indicate which *neighbouring users* would need to be consulted under the envisaged circumstances. The scope of *neighbouring users* would need to embrace those in both the geophysical and the spectrum domains, yet without such criteria there would be a potentially wide range of players involved in a discussion of what may be a relatively insignificant change of use. Therefore, it will be important to provide objective guidance as to how wide the search should be within either the frequency or the geophysical domains, and such information would be essential to minimise the risk of avoidable disputes;
 - In the spectrum domain, *neighbouring users* could be co-frequency, partial co-frequency, adjacent channel or beyond the immediate adjacent channel. In §H.2 of Annex H of the CD, Ofcom suggests inclusion, by way of example, those neighbours within $\pm 10\text{MHz}$ of an assignment (assumed to mean the frequency

boundaries of an assignment). Indeed – with CDMA technologies the “next but one” neighbour, “next but two” neighbour etc. may also have valid concerns;

- In the geophysical domain, *neighbouring users* could be found within the same licence area (where spectrum is shared) beyond local, overlapping, adjacent, national or international boundaries, and/or in space, or in scientific, aeronautical or maritime or military environments etc.;
- There appears to be no obligation for *neighbouring users* to enter in to discussions. A *neighbouring user* may have no incentive (other than money) to enter into discussions, or may not wish to enter such discussions for any number of reasons. Incentive payments (or “compensation” as the CD refers to them) to persuade players to join the discussion will further inflate the cost of trading and liberalisation and ultimately use of spectrum.
- Even with incentives, some *neighbouring users* could be discouraged by the uncertain workload and costs that might be incurred, and the time and effort required to recover those costs;
- A *neighbouring user* could demand unreasonable interference protection, unless Ofcom provides technical ground-rules. If developed in a way acceptable to the spectrum user community, *Spectrum Quality Benchmarks* might be helpful as a test of reasonableness. The concept of *Benchmark Spectrum Quality* introduced in the *Liberalisation Consultation* (and further referred to in the *Implementation Plan CD*) would need further development if it were to serve this purpose;
- A *neighbouring user* could effectively hold power of veto over a proposed change of use, without needing to provide justification for such action. It is unclear whether Competition rules etc. could be expected to cover such actions if the two parties or envisaged uses are in different market areas;
- As costs, cost recovery and commercial risks may be involved, players might need to enter into contractual arrangements even for the discussion phase;

BT believes that it will be important to derive a framework within which change of use using market mechanisms is not limited to the most significant changes only, i.e. those for which the cost of change could be justified, and that any such cost of change is not artificially inflated by the process itself. BT cites §3.43 and §3.44 of the *Liberalisation Statement* as somewhat supporting our concerns, and suggests that Ofcom and Industry need to work together to devise clear ground rules for such discussions that ensure fairness, proportionality and a requirement for behaviours and positions to be justifiable.

It may be possible to define *specific rights, current use and change of use* in a manner that minimises the impact of the above points. However the detail within this consultation is insufficient of itself to provide adequately high level of confidence that the proposals are robust.

5 Annex H of the CD

Annex H of the CD develops the technical aspects of the proposed concepts of specific rights and restrictive rights. It is this area in particular, which we believe needs the greatest care to have the best chance of gaining the important benefits of trading with liberalisation while reducing the potential risks to manageable levels. We believe the following areas need to be addressed: -

- **The illustrative example table of rights may need to be expanded to encompass the full range and variety of possible “uses” of the spectrum;**
- **The approach to managing interference at and beyond licence boundaries needs to become more realistic;**
- **The use of a propagation model as the “final arbiter” for interference disputes is we believe inappropriate and unacceptable, although it may provide helpful guidance;**
- **The suggested use of Recommendation ITU-R P.1546 for this work is, we believe, inappropriate.**

5.1 Table H.1

BT feels that the information in Table H.1 and the examples provided to illustrate the application of specific and restrictive rights are insufficient to allow a proper exploration of the viability of the suggested approach. We offer the following comments with a view to encouraging industry discussion to expand the information as necessary.

The selection of parameters in Table H.1 is clearly focused on systems with *base stations, mobiles, up-links* and *down-links*, but they cannot be considered generic to all systems (e.g. point-to-point links, earth stations etc.). The illustrative parameter set in the CD may not therefore adequately describe the problem space for the definition of specific rights. For example, location is often stipulated where formal frequency co-ordination is important, and the direction is also important for systems such as fixed links and earth stations. In a similar context we would raise the concept of “mesh” systems where there are no up-links and down-links in the conventional sense. Furthermore, as we discuss below, Specific Rights created via discussions with neighbouring users might be very complex indeed, even if this were not inherently a problem for a first change this would become increasing problematic over time with more change of use and ultimately, we believe, render the system unsustainable.

The numbers in Table H.1 are given in terms of dBm/MHz at a height of 1.5m above ground level, and 100m from the mast. At a point in space (e.g. 100m/1.5m) there is no measurable power, and thus the example figures in Table H.1 have no meaning unless they are associated with a defined measurement antenna (isotropic radiator, dipole etc) for which an effective aperture can be determined.

We understand these numbers are intended to represent powers received via a lossless isotropic radiator. However, BT believes that the preferable and most practical solution would be to retain methods accepted through custom and practice, and to express the required limits either as field strengths (dB μ V/m – generally used for point-to-area applications below about 3GHz) or as Power Flux Densities (dBW/m² – more suited to point-to-point and satellite related issues, especially above, say, 3GHz). Well-defined measurement techniques have been established for these parameters.

BT would encourage Ofcom to provide, or to work with industry to provide some fully representative examples of specific rights, as might be applied to the different licence classes that will be enabled for liberalisation.

On an editorial point, we have assumed that in Table H.1 the example frequency ranges specified should be within the Broadcast spectrum rather than the mobile satellite service and space science services bands as written.

5.3 Section H.2

BT believes that clear guidance, would need to be provided to allow the determination of which neighbours would need to be consulted for any prospective change of use, and that such parameters may be worthy of consultation in their own right.

This text relates to the modification of rights, and suggests that, for example, *...a cellular operator might “agree with all of those who hold spectrum within $\pm 10\text{MHz}$ of its assignments to modify its rights”*. Clearly, from this example, the matter of who needs to be consulted is subjective. For a player to attempt change of use, it would be necessary to have proper information and expertise available in order to work out which other spectrum users might be affected, even supposing there was a “right” answer. It would also need to be clear who would be the final arbiter of this and also at what point it would be tested.

Whilst the major spectrum players may have appropriate in-house expertise that can be used to form a judgement on this, it will be important to ensure that new prospective users wishing to enter the market may be disadvantaged.

We would not support the general assertion in the 1st paragraph of §H.2 that *similar technologies are less likely to interfere*. This might not be the case, for example, with Time Division Duplex (TDD) technologies. For example, two operators with Wideband CDMA TDD systems in adjacent allocations could significantly impact on each other’s networks unless there was proper co-ordination and/or synchronisation.

5.4 Section H.3

5.4.1 Maximum in-band power

Ofcom seeks both specific and restrictive spectrum rights for which compliance can be demonstrated by relatively straightforward measurement. However, the text in this paragraph in §4.5 of the CD seems (to BT) appears to confuse the rights that might be conferred to a spectrum user in a licence (in which the restrictive rights are a subset of the specific rights), and the various tools and agreements that could be used in discussions between spectrum operators during proposed deployment within the “use” or for change of use. It would need to be clear that the rights thus generated would genuinely equate to a new set of valid specific rights which would invoke changes to all the affected user licences.

The legally binding rights and obligations of spectrum users must be clear and unambiguous. In a market-led environment this will be particularly important if users are to have confidence in the system. Uncertainties and approximations such as those implied in footnote 38 of the CD would, we suggest, be unacceptable in such an environment. It is an important aspect of any proposed new system that Spectrum users can clearly identify their rights before attempting to value a spectrum opportunity in order to have a chance of designing a network and building a view of that network’s extensibility potential. The initial or existing specific rights would need to be clearly understood, for example, at the time of a spectrum auction or a spectrum trade respectively, and should not be at the mercy of subsequent debates with neighbouring users about what constitutes ground height etc.

If a user’s specific spectrum rights were developed via agreements on what constitutes ground height or what is the appropriate measurement height etc., (which could be different in different directions, and which would certainly vary from location to location) then such information would need to become formally associated with the licence, as these rights would also be tradable with the licence. Under such circumstances, specific rights might not only become technology specific, but

also highly deployment and/or location specific. Furthermore, the specific rights of the neighbouring users would also need to be altered to reflect any agreements. The form of Table H.1 does not therefore represent a realistic picture of the specific rights that might emerge in many cases. The reality could be far more complex, and variable or even unstable.

In our view it would be preferable instead to keep separate the issues of straightforward rights that describe the technical boundaries on “use” (i.e. something akin to Table H.1), and any modifying bi-lateral, multi-lateral or international frequency co-ordination agreements used to adapt those basic rights for practical deployments. This is essentially what happens at present. Specific rights created as a result of all such discussions risk becoming far too complex, this being one reason for our concerns over the dual rights proposals.

§H.3 states that the levels measurable at 100m/1.5m ...*are the maximum signal strength, and any signal exceeding this level, for however short a period, would qualify as interference.* As all the signal level parameters, notably including the maximum in-band power allowed beyond geographical limits, are shown without any associated time percentage, we must for the time being assume that the ...*for however short a period...* requirement applies equally to the other limits as well.

If this is the correct interpretation of Ofcom’s intentions, then we fear the suggested approach is probably unrealistic. No measurement campaign or propagation model can provide certainty ...*for however short a period.* Even at 100m, sporadic and un-predictable multipath signal level enhancements from vehicles passing on yet to be built roads, buildings and other structures yet to be built, modified or removed, or moving foliage etc from vegetation yet to grow could theoretically enhance the signal levels in the future. Signal levels at 100m could therefore be environment-dependent, where the evolution of the environment is not under the control of the spectrum operator. Certainly, at the boundaries of licence areas, the signal could have considerable time variability due to a whole range of effects, including bulk atmospheric and anomalous propagation effects.

It will be important to develop these proposals further in order not only that there will be clear and unambiguous rights and obligations against which an operator can value spectrum and plan and self-certify the compliance of his system, but also to be able to demonstrate such compliance. Ultimately, particularly in a market environment, this must be possible independently from any other spectrum user.

5.4.1 Limits at geographical boundaries.

Annex H also discusses how licence boundaries will be defined in geographical terms, and how the signal level limits at these boundaries will be controlled. BT believes the geographical definition of boundaries to be sufficient but that the proposed methods of managing the signal levels at such boundaries may need to be reconsidered

Table H.1 is quite specific in quoting *in-band power allowed beyond geographical limits.* §H.3 then indicates that signal strength (presumably at as well as beyond the geographical boundaries) will be predicted using a propagation model (Rec. ITU-R P.1546⁵), rather than relying on measurements. We assume that by working with the propagation loss predicted by the propagation model, and by taking account of the antenna radiation pattern, modified, direction-dependent, *maximum permissible in-band powers* would be derived for measurement points at 100m/1.5m around the mast.

⁵ RECOMMENDATION ITU-R P.1546-1 *Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz*

As noted above, §H.2 of the CD implies that the regulatory requirement will be that the interference limits must never be exceeded...*for however short a period*. As already noted, no prediction model can predict a signal level to match this requirement. However of greater significance we believe is the implication that this is even being contemplated. In our view planning to such a requirement (or even trying to plan for 1-in-5, 1-in-10 or 1-in-20 year events) would lead to horrendous inefficiencies in the use of the spectrum, and should not be contemplated. The acceptance of a controlled statistical risk of interference has always been a part of sound spectrum management in order to have spectrum efficiency, previous consultations and responses have not, as far as we are aware, given any reason to suppose this needs to change.

Furthermore, the setting of extreme conditions for interference management (i.e. never exceeding a limit) could also negate the value of innovative technologies. For example, the use of adaptive antennas that instantaneously direct antenna beams towards currently active terminals, and which can also steer nulls towards potential interferers and interference victims, can dramatically reduce the probabilities of causing/receiving interference. However, a regulatory requirement that mandates that interference thresholds must never be exceeded, however small the probability, the statistical advantage has little meaning and this diminishes the value of such technologies. The new spectrum framework to be introduced by Ofcom is intended for the future, and should actively encourage the use of innovative techniques that result in interference mitigation.

For any boundary that is of any reasonable distance (say >10km) from a transmitter, the regulated limiting value would need to be associated with a percentage of time (of the worst month or average year) as the signal will become increasingly time variant with distance. Furthermore, the propagation model may not address all-important factors determining the signal level at the licence boundary. The appropriate time percentage would need to depend not just on the users systems and neighbouring systems involved but also on any international agreements in place (e.g. the ITU Radio Regulations or via international frequency co-ordination).

The propagation loss to the boundary is likely to be direction dependent because of distance, terrain and/or the presence of clutter. If the implication is that the boundary limits have to be met in every possible direction, then BT believes that this will be an impractical requirement because the granularity of terrain and clutter databases would prevent such precision.

BT believes that the regulatory requirements and rights for boundary limits should be described in terms of a maximum power flux density (dBW/m²) or field Strength (dB μ V/m) at and beyond the boundary. One traditional approach to verification has been to define a set of test points around a boundary at which the regulatory limits need to be met. We believe that Ofcom might need to create some kind of test point scenario along with the limiting signal strength values, so that compliance with the emission limits can be realistically tested and/or demonstrated.

The onus should then be on the licensee to take all reasonable steps to remain within these practical limits, but there should remain scope for inter-operator or inter-administration agreements to allow negotiation of higher or lower interference limits where for the parties believe that frequency co-ordination would be mutually advantageous. Co-ordination agreements should be allowed to vary levels about the specific limits in the licence *for the duration of such agreements*. This is different to varying the *specific rights* of the licence, as it is more akin to a mutually beneficial trading of rights than change of use.

It will be important that in a case where interference across a boundary is claimed by a victim and disputed by the alleged source, if no accurate prediction method exists, practical measurement will be the only sure way of resolving the situation. In the more difficult cases, witnessed measurement

at the victim station via the victim equipment would be the only sure way of convincing all parties. While such measurements might cause inconvenience, they would allow the problem to be resolved.

In BT's view, the setting of boundary conditions on licences, including practical time percentages for which interference should not be exceeded must continue to be governed by pragmatism and the art of the possible as it has throughout the current spectrum management regime. This will maximise spectrum efficiency and allow advantage to be taken of the statistical benefits of interference mitigation practices and new technologies. The right propagation models could be a powerful aid to discussions on interference resolution, but BT would be very concerned if a propagation model were to be determined to be the final arbiter in interference disputes.

6 Recommendation ITU-R P.1546

If a propagation model were to be used to support arbitration, (and not to become the final arbiter) we believe that Recommendation ITU-R P.1546 would be an inappropriate model to use.

The CD indicates Ofcom's intention to use an *Internet implementation* of Recommendation ITU-R P.1546 (assumed to mean the current version P.1546-1) to evaluate signal levels at the geographical boundaries of licences. Indeed, Ofcom envisage that such an Internet implementation will be the *final arbiter* on boundary interference issues.

BT and the UK Radiocommunications Agency were both highly involved with the development of this Recommendation in the ITU-R. We are therefore fully aware of its strengths, limitations and the purposes for which it was intended. We believe that the proposed new use of this model, as suggested by Ofcom, falls significantly out with its original purpose to the extent where the results as applied here could be unreliable and hence unsatisfactory.

"Rec. 1546" was created to replace the Earlier Recommendation ITU-R P.370-7 dating from October 1995 and now withdrawn by the ITU-R. Its purpose is to provide "broad brush" (i.e. pre-detailed planning) estimates of the interference coverage from (primarily) broadcast and also mobile base station transmitters, so that the general extent of such interference problems can be determined. It is not considered, nor was it intended, to be a model with any real precision. Both broadcast operators and their mobile counterparts use more refined models to determine accurately broadcast/cell coverage and interference levels. The following factors are important: -

- Rec. 1546 is an empirical model, assuredly one based on quite a lot of data, but mainly on measurements below 1GHz with various quality problems arising because of the age of the data and the measurement and analysis techniques available at the time the data was collected.
- It does not properly take account of the mitigation effects of terrain or clutter (both can be important factors in spectrum efficiency) and this is a significant disadvantage in this present context. The model could predict interference into a victim station where, in reality, a major building provides protection.
- It has a claimed upper frequency limit of 3GHz, but, as stated, this is not supported by much data above 1GHz. It should certainly not be considered to be a "general" model for wide application at any frequencies above 3GHz.

- It can predict for 99% of locations and down to 1% of time, but it cannot predict with any certainty what happens at *any location* and *for any period, however small*.
- The standard deviation of error against measurements is about 6-9dB. If an allowance for 1 or 2 standard deviations were to be included (i.e. about 12-18dB) in an attempt to gain a higher level of confidence, it is likely that relatively few systems could be deployed in the UK.
- The method does not generally yield reciprocal predictions, i.e. for a given path geometry a Recommendation 1546 prediction from A→B will not necessarily give the same result as that from B→A, and this is not what one would expect in reality. Whilst this attribute of the model is not a significant problem within its originally intended area of application, its extended use in the manner envisaged would lead to difficulties in the resolution of disputes, as there could be 2 possible answers on each interference path.

Finally, we note that this ITU-R Recommendation is currently undergoing revisions specifically to meet the purposes of the forthcoming ITU *Regional Radiocommunications Conference (RRC-2006)*. As yet we have not seen any information that demonstrates the impact of these changes on the performance of the model over a broader range of applications.

If propagation models were to play a role in the application of spectrum rights, for instance in predictive assessment, then BT would prefer to see something with more fit for purpose capabilities and greater scope for refinement. Recommendation ITU-R P.452-12 would in our view provide a better basis for use in interference resolution. Even so, the implementation would need to be carefully done with specified terrain and clutter databases (which would need to be generally available) and have the broad support of the spectrum user community. BT is very strongly of the opinion that Recommendation ITU-R P.1546 would not provide the right tool for the purposes outlined by Ofcom in the CD.

7 Spectrum for Licence exempt applications

In section 6 of the CD Ofcom sets out its proposals for providing spectrum for licence-exempt applications. Based on some subjective projected trends a modest increase (~250MHz) is proposed in a band or bands yet to be specified. This purports to be enough for 100MBit/s in every home. However, we believe a further assessment of spectrum for licence-exempt applications would be beneficial.

Ofcom's stated desire is to actively encourage innovation, and its prime objective of a *market-driven approach* is not in our view well served by this approach: Just in the telecommunications environment, there are clear pointers to an early greater demand for licence-exempt spectrum, e.g.: -

- *"True" 100+MBit/s WLAN systems using MIMO⁶ technology already on sale in the major computer stores at consumer prices*
- *Gigabit Ethernet is now a consumer product for home networks*
- *Pursuing a "matching" Gbit WLAN offering (IEEE 802.11n is trying to achieve this at the present time (see reference to the WIGWAM project⁷))*
- *10GBit/s Ethernet now available for professional use. This will inevitably lead to a consumer products in a relatively short space of time*

⁶ MIMO – Multiple input, multiple output

⁷ WIGWAM: *Wireless Gigabit with Advanced Multimedia Support*, CEPT WG-FM Document INFO3 Rev 1, Utrecht Meeting, January 2005.

- *The ITU will provide a regulatory framework for “Systems beyond IMT-2000” ~ 2010-2012. Faster (Gbit) WLAN or similar is envisaged as a component*

Furthermore, it is likely that with the development of new low-cost technologies there will be many innovative products beyond the current licence exempt communications applications (e.g. automotive, tagging and tracking, security, sensory etc.) that would benefit from access to such spectrum.

BT believes that the review of spectrum requirements for licence-exempt devices has been too restricted, and that a further review with a wider and imaginative viewpoint (extending beyond just voice and data communications) would better serve Ofcom’s broader goals.

8 Administrative Incentive Pricing

We believe the role of administrative pricing, and its escalating costs and unpredictability, are important factors in the overall spectrum framework. However, it is not clear from the CD how the concept of administrative incentive pricing will be positioned within the new framework and how it will be taken forward in the longer term, i.e. beyond the proposals that form the subject of a separate concurrent consultation. This we believe is an omission from the Review which Ofcom should take the opportunity to address.

Conclusions

BT has read with interest the Ofcom consultation document on the Spectrum Framework Review. We agree that this is a most important discussion document. However, whilst there are some proposals that BT can support, we have found several areas where we remain concerned that this document sends out signals which are at odds not only with past consultations relating to the changing methods of spectrum management but significantly also with consultations running concurrently with it.

Nevertheless, we welcome and strongly support the Ofcom spectrum vision. Furthermore, BT interprets the 3 bullet points in §6.3 of the CD relating to fixed and mobile spectrum as a valuable and essential extension of this vision.

Unfortunately, though innovative and “lateral”, BT does not believe that the material in §3.5 and § Annex H yet represents a workable solution to the management of rights, interference and change of use. We would be concerned that the proposals could lead to a very complex and burdensome spectrum environment, and we question whether they could result in a workable spectrum market on a scale that could create significant economic benefits, especially of the order foreseen by the Analysys, DotEcon study.

Two key factors feature in our concern. Firstly, that of Ofcom choosing to move away from undertaking the evaluation of proposed changes of use. Secondly, the implication that other neighbouring spectrum users, perhaps with competitive interests, should determine the acceptability of such changes, without (at the moment) there being a clearly laid-down process for such discussions, legal and regulatory safeguards, timescales or a route to appeal against unreasonable objections.

In our view much work remains to be done to define *specific rights, use and change of*, as these will govern what will be possible within existing rights, and the extent to which the restrictive rights will

come in to play. Without such detail it is impossible for us to determine whether the concepts and application of *specific rights* and *restrictive rights* are in fact workable or appropriate. We encourage Ofcom to provide, at an early stage, some realistic examples of *specific rights*, as they might be applied to the different licence classes, including in particular the more generic licences that were foreseen as methods of achieving liberalisation. Separately, BT believes that clear guidance would need to be available as to what constitutes neighbours in the context of requiring to be consulted for any prospective change of use.

In BT's view, the setting of boundary conditions on licences, including practical time percentages for which interference should not be exceeded must continue to be governed by pragmatism and the art of the possible, as it has throughout the current spectrum management regime. This will maximise spectrum efficiency and allow advantage to be taken of the statistical benefits of interference mitigation practices and new technologies. The right propagation models could be a powerful aid to discussions on interference resolution, but BT would be very concerned if a propagation model were to be determined to be the final arbiter in interference disputes.

We could not agree that Recommendation ITU-R P.1546 would anyway be the right tool for the purposes outlined by Ofcom in the CD. If propagation models are to play a role in the application of spectrum rights, then BT would prefer to see something with better capabilities and greater scope for refinement, such as Recommendation ITU-R P.452-12, used as the basis for interference discussions. Even then the implementation would need to be carefully done with specified terrain and clutter databases (which would need to be generally available) and have the broad support of the spectrum user community.

BT believes that the review of spectrum requirements for licence-exempt devices has been too restricted, and that an early further review with a wider and more imaginative remit (i.e. extending beyond just telecommunications) would be beneficial.

It is not clear from the CD how the concept of administrative incentive pricing will be used within the new framework and how it will be taken forward beyond the current proposals that are the subject of a separate concurrent consultation. This we believe is an omission from the Review which Ofcom should take the opportunity to address.

Appendix 1 – answers to the questions in the consultation document

Q1: Are there any other major medium- to long-term spectrum management issues that this review should be considering? Are there any other significant technological or market developments that this review should be aware of when developing its thinking?

Ofcom may need to consider how and whether it should monitor how well its “change management” system performs against such criteria as ease of use for new entrants and the actual costs and time scales that emerge as the spectrum market develops. We believe there should be regular review against success criteria agreed with the spectrum users, and scope for adjustment if problems are identified.

Q2: Do you believe it is useful to publish a compendium of issues? How frequently should it be published? What information should be included?

BT believes that such a document would probably be useful, provided

- (a) it was published regularly (probably annually),
- (b) it outlined any updated Ofcom spectrum strategy and policy, and
- (c) it indicated Ofcom’s intention vis-à-vis international spectrum developments, including harmonisation and WRCs etc.

Q3: Are there any other issues of sufficient significance to merit mention in this document?

It is not clear from the CD how the concept of administrative incentive pricing will be used within the new framework and how it will be taken forward beyond the current proposals that are the subject of a separate concurrent consultation. As administrative pricing is a significant element of Ofcom’s approach to spectrum management, its positioning within the overall framework will need to be more clearly contextualised in Ofcom’s final positioning.

Q4: Are there important lessons to be learnt from experience in other countries that is not addressed here?

We too have been looking at experiences overseas and in this field more than most it seems clear that “one size does NOT fit all”. The underlying tapestry of geography, utilisation, use, market and technologies available produce a complex interplay. Nevertheless new approaches should continue to be monitored to gauge suitability for introduction in the UK as necessary. We have no further comments to make here.

Q5: Do you agree with Ofcom’s intent to maximise the use of trading and liberalisation?

Yes, BT has consistently support the maximisation of liberalised, tradable spectrum.

Q6: Are there other areas, apart from those identified above, where trading and liberalisation should be restricted? Are there areas identified above where you believe the trading and liberalisation could be fully implemented?

BT has no comments to add here.

Q7: Do you agree with Ofcom’s approach to providing spectrum for licence-exempt use?

We would refer you to §7 of the main text of this response where we indicate that in the telecommunications sphere alone there are already rapid developments, including products already on sale, that already make additional claims on licence exempt spectrum outside of the basis for the assumptions stated in the CD.

Furthermore, it is likely that with the development of new low-cost technologies there will be many innovative products (automotive, tagging and tracking, security, sensory etc.) that will make further calls on such licence exempt spectrum in ways which are likely to be beneficial to society as a whole.

Q8: Is Ofcom's proposed methodology to estimate the amount of spectrum provided for licence-exempt use likely to deliver the right results?

BT believes that the review of spectrum requirements for licence-exempt devices has been too restricted, and that a further review with a wider remit (extending beyond traditional telecommunications) would be beneficial. We do agree with Ofcom however that such prediction with any certainty, especially over time, will be very difficult and as such agree that further periodic reviews will also be necessary.

Q9: What is the appropriate timing and frequency bands for making available any additional spectrum needed for licence-exempt use?

The further review suggested in Q7 might indicate that additional spectrum could be required in a 2-5 year time frame, but in any event a programme of education coupled with market forces should result in appropriate and timely signals which Ofcom would be monitoring.

Q10: Do you agree with Ofcom's longer term proposals for spectrum trading?

BT notes that the Q10 is different in the main text and the Annex. BT fully supports the proposals in relation to trading, but on the wider proposals for market based spectrum management methods we have some concerns on a number of points of detail as set out elsewhere in the main body of this response document.

Q11: Is the approach set out here, and in Annex H, for developing technology-neutral spectrum usage rights appropriate? Are there alternatives?

BT notes the proposals now to base the market led element of the spectrum environment on a concept of dual spectrum rights, i.e. the licence-specific *Specific Rights* defined by virtue of current use, and the generic *Restrictive Rights*, which we understand are a subset of the specific rights and which become the remaining applicable rights immediately upon change of use. We also understand from the proposals that to establish new *specific rights* for a changed use it is necessary for the licensee or prospective licensee to seek agreement of all *neighbouring users* to the proposed new use.

Our detailed views on this issue are set out in sections 4-6 of the main text above. As stated there we believe that there are a number of issues that will need further detailed consideration before Ofcom's radical proposals can be implemented in the market.

We believe there is a generally held view that for trading and liberalisation to be successful, the burdens of the administrative and technical processes, the timescales and the costs involved would all need to be kept to a low minimum. Unfortunately, the proposals as they stand in this review appear to us to be likely to generate a more burdensome approach to dealing with change. We believe that these new ideas would take the UK some way away from the simplicity and flexibility

originally foreseen by Ofcom for the spectrum market, and agreed by many respondents to earlier consultations, as being essential to the establishment of a viable and thriving spectrum market.

We believe it would be helpful if Ofcom were to provide, as soon as possible, some considered representative examples of specific rights, such as might be expected to apply to the different generic licence classes that Ofcom plan to grant more liberal rights of use.

BT believes that a concept involving interference limits that must never be exceeded...*for any period, however small...* is impractical, and would of itself lead to serious inefficiencies in the use of the spectrum. With regard to emission rights we are unaware of any reasons why the current systems that include the setting of specified time percentages for which interference limits should not be exceeded should not continue to play a major role.

BT does not agree that Recommendation ITU-R P.1546 is the right tool for the purpose indicated by Ofcom in the CD. See paragraph 6 of the main body of this response for detailed comments on this issue. In any event we do not believe that a propagation model should of itself become the “final arbiter” in interference disputes.

Q12: Should Ofcom do more to resolve interference?

We refer here to various comments in §§4-6 of the main text of this response as forming the main contribution to this question.

BT Believes that the spectrum management framework that will eventually be put in place by Ofcom should include all possible rational measures to avoid the occurrence of interference, and that interference prevention and the encouragement of interference mitigation techniques are the most productive input that Ofcom can make. The emphasis in the CD on resolving interference rather than preventing it via a sound and practical management framework suggests that further consideration will be necessary in order to achieve the correct balance between prevention and resolution.

Q13: To what extent should Ofcom intervene in promoting innovation?

BT strongly believes that a key ongoing role for Ofcom is in the encouragement of innovation in the use of the spectrum. This can be most actively achieved by continuing to remove unnecessary restrictions on the use of spectrum, by the early recognition of the potential benefits of new technologies, by ensuring the most lightweight “technology neutral” harmonisation feasible in those circumstances where harmonisation of frequency bands is deemed to be necessary, and by making change of use as simple as possible.

Q14: Do you agree with Ofcom’s proposed approach to harmonisation?

Q15: Can you foresee any problems with the proposed approach to harmonisation other than those listed above?

Taking Questions 14 and 15 together, BT broadly supports the proposals as set out in the consultation paper, in particular the move towards a more technology neutral licensing regime for the introduction of new services.

Q16: Do you agree with Ofcom’s proposal to continue with division by frequency as the primary method of dividing the spectrum?

Yes. BT Believes that frequency represents the best regulatory basis for dividing the spectrum. Power, like time, can provide an additional degree of flexibility in spectrum trading and liberalisation agreements.

Q17: Is Ofcom's approach of not Intervening to mandate entitlements in time appropriate?

Yes. BT Believes that provided it is permissible to use time as an element of any spectrum trading and/or liberalisation agreement then there is no need for regulatory action. This will leave open a very wide range of opportunities for innovative time-based solutions for enhancing the use of the radio spectrum.

One observation that BT would like to make is that the CD too strongly links *entitlements in time* with the concept of *cognitive radio*. There are very many ways in which time can be introduced into the sharing of spectrum, and cognitive radio is but one. It is assumed here that Ofcom would give equal weight to all such possibilities.

Q18: Do you agree with the RIA?

BT does not have comments on the RIA.