



Spectrum Usage Rights

A statement on controlling interference using
Spectrum Usage Rights

Statement

Publication date: 14 December 2007

Contents

Section		Page
1	Executive Summary	1
2	Background	5
3	Introduction to Spectrum Usage Rights (SURs)	8
4	Format of a Spectrum Usage Right	11
5	Defining and making changes to licence terms	17
6	Compliance with an SUR licence	22
Annex		Page
1	Impact Assessment	26
2	Test area size	29
3	Responses to issues raised in the main SUR consultation	30
4	Responses to the consultation on compliance to SUR licences	38
5	Responses to issues raised in the 2.6 GHz consultation	44

Section 1

Executive Summary

Rationale for Spectrum Usage Rights (SURs) in a liberalised environment

- 1.1 As outlined in the Spectrum Framework Review (SFR), Ofcom is moving from a 'command and control' regulatory regime to a market-based approach. A key element of this is spectrum liberalisation where the market is allowed to decide on the optimum use of the spectrum.
- 1.2 Licences are currently stated in many different forms, for example: in terms of a particular technology (e.g. 'GSM'); or in terms of a particular use (e.g. 'mobile'). This approach, coupled with careful control of neighbouring uses, lowers the risk of interference. However, it generally does not provide users with a simple and certain mechanism to subsequently change their usage as circumstances change. The principal reason this apparent lack of flexibility in usage has arisen in licences is a concern that if greater flexibility is allowed it may lead to interference.
- 1.3 There are two key mechanisms whereby the interference caused to neighbouring users can change. The first is the deployment of a different technology, with different in-band and out-of-band emission characteristics. The second is a change in the deployment density or power levels, for example increasing the number of locations where a neighbouring user will be close to a transmitter and hence may suffer interference.
- 1.4 Existing licences control interference indirectly. For example, a licence specified in terms of technology, such as GSM, controls the allowed transmitter power through the specifications developed for GSM, but only influences the transmitter density in so much as the economics of cellular networks lead to an optimal number of base stations. However, in the example case of cellular networks, as subscriber numbers have grown, the number of base stations deployed has also increased. In practice, this increased density has not caused interference problems because neighbouring licences are also specified in the same manner and as one operator has increased the number of base stations so have all the others. Also, operators have tended to coordinate deployments with their neighbours to reduce the impact of interference. This 'symmetry' of use turns out to be inherently resistant to interference because technologies are typically designed to work well when neighbours are using the same technology with similar deployment density.
- 1.5 If an existing user is allowed to change their usage, perhaps to a different technology or a different application then this symmetry may be lost. Neighbouring users may then have different technologies and different deployment densities increasing the probability of interference. This is the principal reason for seeking an alternative approach to controlling interference.
- 1.6 A better way to control interference between licensees is to specify in a licence the interference a licensee is allowed to cause, rather than the signal it is allowed to transmit. The licence then directly controls the interference rather than indirectly as is the case in existing licences. In such a system, the rights of a licensee are defined in terms of the maximum interference that can be caused to neighbours. Most importantly, any change of use or technology is allowed as long as it does not increase these levels of interference, achieving our objectives of allowing flexible spectrum use. This new approach is termed 'spectrum usage rights' or 'SURs'.

- 1.7 This new approach to licensing brings many advantages:
- By directly specifying the parameter which needs to be controlled all unnecessary restrictions are removed from the licence, providing the licensee with maximum levels of flexibility.
 - Specification of interference levels allows neighbours to plan their networks more accurately, with less uncertainty or margin for error, because they have a better idea of the interference levels to expect.
 - Compared to technology specific licences, specifying rights in terms of allowed interference levels caused leads to more flexibility.
 - Clearly setting out the “harm” that one user can cause another simplifies the process of negotiation between users such that they can determine the optimal interference levels that they can cause each other.

Context of this Statement

- 1.8 The SFR, published in November 2004, sets out Ofcom’s long term strategy for managing the radio spectrum. As part of that goal, it addressed the concept of SURs. The SFR outlined at a high level a mechanism by which SURs could be implemented to achieve technology and application neutral access to the spectrum.
- 1.9 Since then, a range of further activity has been undertaken to achieve this, including:
- Further work undertaken by external consultants, the detail of which can be found in their final report, which led to a consultation on SURs published in April 2006.
 - Interaction with stakeholders through workshops on SURs, which led to proposals on its implementation as one option in the spectrum award consultations for the 2.6 GHz and the 1452 -1492 MHz awards.
 - A consultation on compliance issues to an SUR licence published in September 2007.
- 1.10 Responses to the SUR consultations, the consultations on the 2.6 GHz and 1452-1492 MHz spectrum awards and feedback gathered through associated workshops have been taken into account when formulating this Statement.
- 1.11 This Statement forms a conclusion to the development of SURs. It effectively marks the transition from SUR development to implementation. The Statement sets out how in general we will deploy SURs. When we implement an SUR, for example at an auction, we would normally expect more detailed consultation on the specific implementation issues, typically as part of a broader consultation document relating to the award. We do, however, expect to publish additional detailed consultation and discussion documents periodically, for example on modelling methodologies.

Format of an SUR

- 1.12 SURs are intended to control three types of interference namely geographical interference, out-of-band emissions and in-band emissions.
- 1.13 To control emissions into neighbouring geographical areas, the following is used:

- The aggregate PFD (Power Flux Density) at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than Z% of locations at [definition of boundary¹].
- 1.14 To control emissions outside of the licensee's frequency band (that appear as in-band interference for a neighbour), the following is used:
- The aggregate out-of-band PFD at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than Z% of locations in a test area².
- 1.15 To control emissions inside the licensee's frequency band (that may cause interference to neighbouring users in frequency due to imperfect receiver filters), the same measure is used:
- The aggregate in-band PFD at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than Z% of locations in a test area.
- 1.16 An SUR licence is expected to include in-band, out-of-band and where relevant, geographical interference limits. If requested by stakeholders, other forms of restrictions (e.g. EIRP limit, transmitter density limit among others) can be included in an SUR licence to facilitate particular objectives, such as enhancing coordination. The level of these restrictions can be subsequently changed through negotiations with neighbouring licensees.
- 1.17 A consequence of defining out-of-band PFD limits is that an indicative interference level (IIL) in a channel can be inferred. The IIL of a channel represents the anticipated maximum interference levels in that channel caused by licensees in adjacent channels (but does not include interference due to non-licensed sources such as EMC).
- 1.18 IILs are not a guaranteed right that a licensee can rely on. Ofcom will calculate the IIL of each SUR licensee at the time that it is issued where applicable³.

Defining and making changes to licence terms

- 1.19 For new licences, the SUR parameters will be based on an assessment of the most likely uses of that band. Ofcom will make its initial proposals and consult on them. Ofcom will analyse the responses received before finalising the parameter values in the SUR licence.
- 1.20 For existing licences where the terms are to be changed to SURs, licensees will be asked to specify their views on the relevant parameter values for their licence. Ofcom will carefully assess the feedback received and subsequently propose a set of parameters. Ofcom will consult upon these, if needed, with the relevant stakeholders.
- 1.21 Once the parameters are set, licensees are able to make a licence variation request to change them.

¹ The boundary is likely to be the locus of points separating the operational area of one or more co-channel licensees. For compliance purposes, the geographical interference limit may be assessed for only a segment of this boundary.

² An example of a possible test area definition is given in Annex 2.

³ IILs can only be determined where all neighbours contributing to the interference also have SUR-based licences.

- 1.22 An SUR licensee wishing to change its usage will determine whether it can be accommodated within its existing SUR parameters. If it cannot, the licensee needs to ask Ofcom to provide guidance on who may be affected by the change of use and enter into negotiations with the identified licensees to agree the change of use, possibly through compensation for any degradation suffered as a result.
- 1.23 If the agreement of all affected parties can be obtained, required changes to the SUR parameter values will be made by Ofcom. If the agreement of all parties is not obtained, or not sought by the licensee then if requested, Ofcom will still consider the change request as is its duty, but may need to consult as part of this process.
- 1.24 In-band and out-of-band PFD limits are defined throughout a licensee's operational area. Licensees who want differing PFD limits in different parts of their licence area can do so by submitting a licence variation request to Ofcom.

Compliance with an SUR licence

- 1.25 SURs control the PFD radiated by equipment licensed to operate in a permitted frequency band. Such a definition of SURs is compatible with licence terms that can be specified under the Wireless Telegraphy Act 2006. Hence, SUR licences can operate under the existing legal framework.
- 1.26 Ofcom's preferred option is to use modelling to verify compliance to licence terms. The modelling process as well as the inputs used will vary according to the nature of the service being modelled. In addition, Ofcom may decide, where appropriate, to measure the EIRP (Equivalent Isotropically Radiated Power) of the relevant transmitters and compare these to the values provided by the licensee under investigation.
- 1.27 In case of non-compliance, Ofcom will take appropriate action depending on what is proportionate and necessary in the circumstances.
- 1.28 SURs are not defined indoors. Hence, only outdoor transmitters and test points are used to verify compliance to licence terms.

Section 2

Background

Ofcom's approach to managing spectrum

- 2.1 Ofcom has set out its approach to managing the spectrum previously in the Spectrum Framework Review (SFR)⁴. Ofcom's key spectrum vision put forward there, is as follows:
- Spectrum should be free of technology and usage constraints as far as possible. Policy constraints should only be used where they can be justified.
 - It should be simple and transparent for licensees to change the holding and use of spectrum.
 - Rights of spectrum users should be clearly defined and users should feel comfortable that they will not be charged without good cause.
- 2.2 As discussed in the SFR, Ofcom believes that market forces are better than central control in achieving the optimal use of a limited resource such as spectrum. A key change proposed in the SFR is to allow market based mechanisms to prevail wherever this is judged to be in the best interests of citizens and consumers. Such market mechanisms include:
- Trading of spectrum between users so that they can buy, sell, aggregate or unbundle spectrum holdings.
 - Liberalisation of spectrum use, so that users can change technologies or the type of use applied to their spectrum.
- 2.3 Ofcom's proposals for trading are now well advanced. Trading in some licence classes was implemented at the end of 2004, and it is planned to extend it progressively to almost all suitable licence classes.
- 2.4 Spectrum liberalisation is a more complex issue than trading. Spectrum users have been packed in tightly by spectrum managers over the years in several frequency bands, with many users sharing spectrum. Inappropriate liberalisation could cause undue interference or inefficient use of the spectrum unless suitable restrictions are imposed on the use of spectrum in those bands.
- 2.5 Recognising that in the past the selection of licence restrictions has often erred on the side of caution, Ofcom has embarked on a process of liberalisation. This seeks to reduce or remove licence restrictions while preventing damaging increases in interference.

Principles of liberalisation

- 2.6 Liberalisation promises to bring much more efficient and flexible usage of the radio spectrum to the benefit of citizens and consumers. However, changes in spectrum use by a licensee can change the interference experienced by neighbours in both

⁴ <http://www.ofcom.org.uk/consult/condocs/sfr/sfr>

geography and frequency terms. Ofcom has outlined the principles underlying its approach to liberalisation as follows:

- A spectrum user should not suffer an excessive increase in interference as a result of the actions of a neighbour unless:
 - They agree; or
 - The neighbour had not in the past taken up all its existing rights but was now seeking to do so. In this case, the affected user would have been experiencing lower interference than could reasonably have been expected based on the terms of the original licence and the interference levels will now increase towards that level.
- The market is better able to determine optimal outcomes for variables such as boundary conditions than the regulator because of its greater access to relevant information.
- The licence restriction adopted should not place a disproportionate burden on the licensees. It should be as flexible and dynamic as possible consistent with avoiding harmful interference, complying with international obligations or directions from the Secretary of State and avoiding distortions to competition.

Changing licence terms

2.7 Currently licensees are able to request that Ofcom make changes to their licence, for example, to remove the restriction to a particular technology. Ofcom will consider each request on its merit. For example, Ofcom may agree to remove licence restrictions that specify a particular technology. Any request for variation to a licence will be considered carefully against Ofcom's statutory duties, including considering whether the variation will cause undue interference to others. This process remains unchanged and valid for all licences, irrespective of type.

2.8 Our aim in determining the most appropriate type of flexible licences is to allow:

- Changes of use to occur without recourse to Ofcom if this can be accommodated within the existing licence terms
- Negotiation between licensees to agree changes⁵ to licence terms which may be required to allow changes of use which could alter the interference caused.

2.9 Given the implication of liberalisation, in the next couple of sections, we describe the rationale and the format for specifying licence terms based on interference caused to neighbours in a more direct way.

Structure of this document

2.10 This Statement is structured as follows:

- Section 1 provides an executive summary of this Statement.
- Section 2 (this section) describes the principles of Ofcom's approach to spectrum liberalisation, setting the background for a new type of licence conditions.

⁵ The changes to the licence terms will need to be implemented by Ofcom through a licence variation.

- Section 3 gives the rationale for specifying licence conditions – Spectrum Usage Rights – in terms of interference levels caused by a licensee.
- Section 4 outlines the types of interference controlled by an SUR and provides a format to express the interference limits.
- Section 5 explains the process of changing licence terms and finally Section 6 describes the process to assess compliance to an SUR licence.
- Annex 1 describes the Impact Assessment as carried out for the SUR Consultation and Annex 2 outlines an example of a test area definition.
- Annexes 3 and 4 summarise the responses to the main SUR consultation and the one on compliance issues respectively. Ofcom's views are also highlighted.
- Other generic SUR comments made in response to the 2.6 GHz award are given in Annex 5. Generic SUR comments on the L-band consultation documents were already discussed in previous consultations and are therefore not included to avoid duplication.

Section 3

Introduction to Spectrum Usage Rights (SURs)

The need for licensing restrictions

- 3.1 A key reason for managing spectrum is to avoid interference between different users – if all users were able to access the spectrum without any planning and yet without interfering with each other, then there would be no need for spectrum management. To do this users are given licences which set out in some form their ‘rights’ – generally in terms of what they are allowed to transmit. It is important that neighbours both in geography and in spectrum are given compatible licences – i.e. that they do not cause excessive interference to each other.
- 3.2 In granting a licence, restrictions are placed on the right to transmit to limit the risk that significant levels of interference may be caused to others. For example, if users have no restriction on the signal levels they are allowed to transmit outside of their designated bands, they may transmit high levels, to the detriment of neighbouring users.
- 3.3 Licences are currently stated in many different forms, for example, in terms of a particular technology (e.g. ‘GSM’) or in terms of a particular use (e.g. ‘mobile’). This approach, coupled with careful control of neighbouring uses, lowers the risk of interference. However, it generally does not provide users with a simple and certain mechanism to subsequently change their usage as circumstances change.
- 3.4 The principal reason this apparent lack of flexibility in usage has arisen in licences is a concern that if greater flexibility is allowed it may lead to interference.

Existing licence restrictions and the control of interference

- 3.5 There are two key mechanisms whereby the interference caused to neighbouring users can change. The first is the deployment of a different technology, with different in-band and out-of-band emission characteristics. The second is a change in the deployment density or power levels, for example increasing the number of locations where a neighbouring user will be close to a transmitter and hence may suffer interference.
- 3.6 Current licences have their restrictions specified in a range of different manners. These include:
 - Through a particular technology.
 - Through a particular use.
 - Through a particular set of emissions characteristics known as a mask.
- 3.7 Existing licences control interference indirectly. For example, a licence specified in terms of technology, such as GSM, controls the allowed transmitter power through the specifications developed for GSM, but only influences the transmitter density in so much as the economics of cellular networks lead to an optimal number of base stations. However, in the example case of cellular networks, as subscriber numbers

have grown, the number of base stations deployed has also increased. In practice, this increased density has not caused interference problems because neighbouring licences are also specified in the same manner and as one operator has increased the number of base stations, so have all the others. Also, operators have tended to coordinate deployments with their neighbours to reduce the impact of interference. This 'symmetry' of use turns out to be inherently resistant to interference because technologies are typically designed to work well when neighbours are using the same technology with similar deployment density.

- 3.8 If an existing user is suddenly allowed to change their usage, perhaps to a different technology or a different application, then this symmetry may be lost. Neighbouring users may then have different technologies and different deployment densities, dramatically increasing the probability of interference.
- 3.9 In summary, existing licences can be characterised as only weakly controlling interference but this is currently not leading to interference problems because they utilise the interference protection assumed when writing technology standards by ensuring neighbours have similar technologies and deployments. If this 'interference protection' is removed by allowing greater flexibility, clearly there is a risk that in some cases interference may result. This is the principal reason for seeking an alternative approach to controlling interference.

Spectrum usage rights and the control of interference

- 3.10 A better way to control interference between licensees is to specify in a licence the interference a licensee is allowed to cause, rather than the signal it is allowed to transmit.
- 3.11 The licence then directly controls the interference rather than indirectly as is the case in existing licences. In such a system, the rights of a licensee are defined in terms of the maximum interference that can be caused to neighbours. Most importantly, any change of use or technology is allowed as long as it does not increase these levels of interference, achieving our objectives of allowing flexible spectrum use. This new approach is termed 'spectrum usage rights' or 'SURs'.
- 3.12 This new approach to licensing brings many advantages:
- By directly specifying the parameter which needs to be controlled all unnecessary restrictions are removed from the licence, providing the licensee with maximum levels of flexibility.
 - Specification of interference levels allows neighbours to plan their networks more accurately, with less uncertainty or margin for error, because they have a better idea of the interference levels to expect.
 - Compared to technology specific licences, specifying rights in terms of allowed interference levels caused, leads to more flexibility in a change of use.
 - Clearly setting out the "harm" that one user can cause another simplifies the process of negotiation between users such that they can determine the optimal interference levels that they can cause each other.

Deployment of SURs

3.13 The approach to SURs for new awards will be decided on a case by case basis and is likely to depend on the feedback received from stakeholders. Regarding existing licences, we would generally only expect to modify these to an SUR format with the consent of the licence holder or for good spectrum management reasons. Given that much of the benefit of SURs arises when all licence holders in a band have licences stated in this way, then following a request from one licence holder, we might embark upon dialogue with their neighbours to assess whether there is sufficient support to changing the entire band to SURs.

Previous consultations and statements related to SURs

3.14 The SFR, published in November 2004, set out Ofcom's long term strategy for managing the radio spectrum. As part of that goal, it addressed the concept of SURs. The SFR outlined at a high level a mechanism by which SURs could be implemented to achieve technology and application neutral access to the spectrum.

3.15 The SFR proposed that the high level proposals of SURs could be developed further once additional study had been undertaken to:

- Add detail to the proposals.
- Examine whether any changes to the legal framework will be needed to enable the proposals.
- Test the proposals using a software model.

3.16 Since then, a range of further activity has been undertaken to achieve this, including:

- Further work undertaken by external consultants, the detail of which can be found in their final report⁶, which led to a consultation on SURs⁷ published in April 2006.
- Interaction with stakeholders through workshops on SURs, which led to proposals on its implementation as one option in the spectrum award consultations for the 2.6 GHz⁸ and the 1452 -1492 MHz^{9,10} awards.
- A consultation¹¹ on compliance issues to an SUR licence published in September 2007.

3.17 Responses to the SUR consultations, the consultations on the 2.6 GHz and 1452-1492 MHz spectrum awards and feedback gathered through associated workshops have been taken into account when formulating this Statement.

⁶ <http://www.ofcom.org.uk/consult/condocs/sur/spectrum>

⁷ <http://www.ofcom.org.uk/consult/condocs/sur>

⁸ <http://www.ofcom.org.uk/consult/condocs/2ghzawards>

⁹ <http://www.ofcom.org.uk/consult/condocs/1452tech>

¹⁰ http://www.ofcom.org.uk/consult/condocs/1452_1492

¹¹ <http://www.ofcom.org.uk/consult/condocs/surfurtherinfo>

Section 4

Format of a Spectrum Usage Right

Introduction

- 4.1 As explained in the previous section, the optimal approach to managing spectrum is one that directly controls the level of interference that a user can generate into spectrum owned by others. Based on a careful and detailed study, we have concluded that SURs are the best way to achieve this objective.
- 4.2 This section describes the format of SURs firstly by introducing the various types of interference that can occur and then detailing the manner in which SURs will control each of these.

The interference problem

- 4.3 In a liberalised regime, ideally the only constraint on spectrum use should be the controls necessary to avoid harmful interference. Therefore the focus in determining the parameters that will be used for new rights is on determining a set of controls that offer flexibility in spectrum use while not increasing the level of harmful interference.
- 4.4 It is well known that the propagation of radio signals cannot be contained within the assigned frequencies and geographic areas and receivers do not perfectly screen out emissions from adjacent bands. In a simplified form, the resulting interference environment can be represented by Figure 4.1 below. In addition to the out-of-band emissions resulting from the modulation process, there are also spurious emissions that can be generated beyond the immediately adjacent bandwidth.

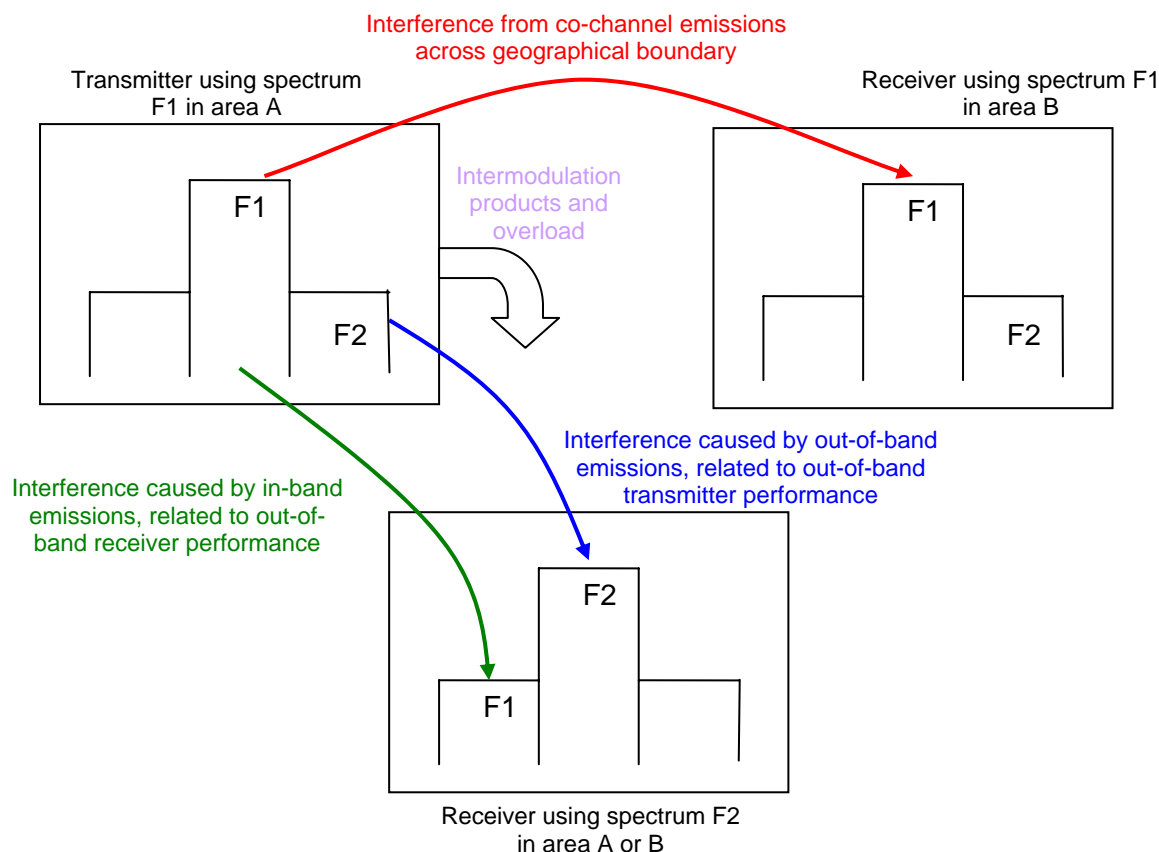


Figure 4.1: Types of interference.

4.5 This Statement considers only the impact of radiation from a transmitter on a victim receiver, rather than secondary considerations such as the impact of unintentional emissions from a receiver on other receivers¹².

4.6 Figure 4.1 shows four key types of interference:

- Interference caused by co-channel transmissions across geographic boundaries termed here as geographical interference.
- Interference caused by out-of-band emissions falling across frequency boundaries.
- Interference caused by in-band emissions determined by the in-band power of the transmitter and the out-of-band performance of the victim receiver.
- The intermodulation products and overload are to some extent controlled by the out-of-band limits applying to the transmitter. There are, however, situations where intermodulation products arise unexpectedly in a receiver or passively due to non-linear conductivity in metal. Other spurious emissions (e.g. harmonics / frequency conversion products) exist, both for transmitters and receivers.

4.7 Subsequent sub-sections describe how SURs control these four types of interference.

¹² These unintentional emissions are generally covered by EMC regulation.

Geographical interference

- 4.8 In this instance, we wish to protect a licensee's receiver separated geographically from the transmitters of a co-channel licensee.
- 4.9 In principle, the geographical interference restriction is determined so that a licensee can deploy its receivers within its operational area close to the boundaries of adjacent licensees.
- 4.10 The geographical interference limit is defined as:
- The aggregate PFD at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than $Z\%$ of locations at [definition of boundary¹³].

Interference caused by out-of-band emissions

- 4.11 In this instance, the aim is to protect a victim receiver possibly in the same geographical area from out-of-band emissions from another licensee operating in a neighbouring frequency band. Interference received in-band by a licensee, from out-of-band emissions due to its neighbours can be controlled by specifying out-of-band emission limits on the neighbours.
- 4.12 However, even when out-of-band emission limits are defined it is possible to arrive at a situation where the close proximity of a licensee's transmitter interferes with the receiver of another licensee. The areas where this occurs are often referred to as 'dead zones' or holes being 'punched' in the network coverage. To mitigate the effects of this adjacent channel interference, receivers with better adjacent channel selectivity (ACS) or co-location of transmitters may be used.
- 4.13 The out-of-band emission limit is defined as:
- The aggregate out-of-band PFD at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than $Z\%$ of locations in a test area¹⁴.
- 4.14 Defining the PFD limit at a single location is not appropriate, as near a transmitter any PFD limit which results in a reasonable level of interference can be expected to be exceeded. Therefore the PFD limit is defined as a distribution across a range of locations, as shown in Figure 4.2.

¹³ The boundary is likely to be the locus of points separating the operational area of one or more co-channel licensees. For compliance purposes, the geographical interference limit may be assessed for only a segment of this boundary.

¹⁴ An example of a possible test area definition is given in Annex 2.

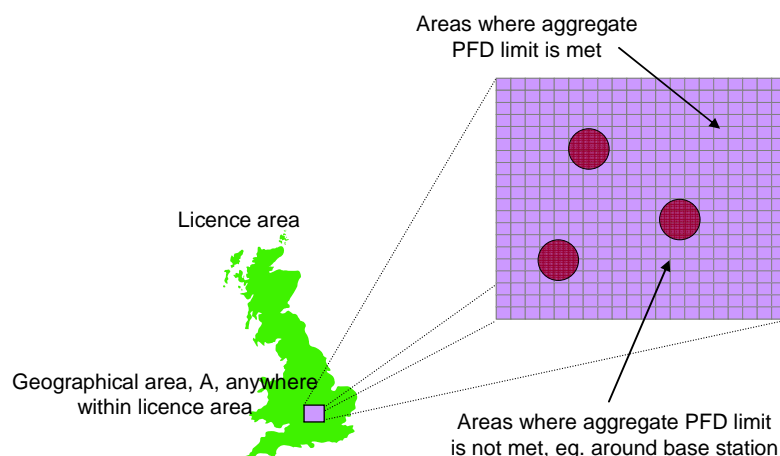


Figure 4.2: Illustration of locations where an out-of-band PFD limit may be exceeded.

4.15 Such a measure has a number of benefits:

- It gives a good idea of the level of interference that licensees in adjacent bands can experience.
- It will not be possible to significantly increase the density of transmitters without reducing the EIRP (without entering into negotiation) as that will result in an increase in the percentage of locations where the PFD limit is exceeded.
- It will not be possible to make a significant change to system operation, such as switching off automatic power control without reducing EIRPs (or without entering negotiation).

4.16 Conversely, because interference levels are specified as probabilities, it gives no information about specifically where interference can be expected. SURs also prevent a licensee from using isolated transmitters operating at relatively high power levels in most practical situations, but if this remains a concern to neighbouring licensees additional forms of restrictions such as an EIRP limit can be included in an SUR licence. Like the SUR licence terms, the EIRP limit specified in the licence can be subsequently changed through negotiation with neighbours.

Interference caused by in-band emissions

4.17 In this instance, we wish to protect a victim receiver from interference received out of its band of operation, caused by in-band emissions from another licensee. To control this type of interference, an in-band emission limit is defined as:

- The aggregate in-band PFD at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than $Z\%$ of locations in a test area¹⁵.

4.18 The arguments for this approach and the benefits offered are the same as for the out-of-band emissions.

¹⁵ An example of a possible test area definition is given in Annex 2.

Intermodulation, overload and other spurious emissions

- 4.19 These aspects of interference generally only become an issue with relatively high power transmitters and/or transmission/reception equipment in relatively close proximity.
- 4.20 Intermodulation products (IPs) are generated from multiple signals by non-linearities in the transmit chain, the receiver, or corroded / unclean metal junctions. While IP emissions from a transmitter will largely be controlled by an out-of-band / spurious emission mask, problems may arise when signals from more than one transmitter interact.
- 4.21 Overload occurs when a strong out-of-band signal, which may otherwise be satisfactorily filtered out by the rest of the receive chain, saturates the low noise amplifier at the front end and drives it non-linear. The degree of degradation due to overload depends on the performance of the receiver front end and the possible implementation of input filtering.
- 4.22 Whereas out-of-band emissions discussed earlier occur immediately outside the necessary bandwidth of the transmission and result from the modulation process, spurious emissions can occur over a much wider range outside the necessary bandwidth. Spurious emissions include harmonics, parasitic emissions, IPs and frequency conversion products. Receivers can also generate spurious emissions although these are typically at very low power levels.

Control of spurious emissions

- 4.23 Intermodulation products and overload are to some extent controlled by the out-of-band emission limits applying to the transmitter as discussed above. In general, they will not cause a problem and hence complex regulatory mechanisms to address them will be disproportionate. Equally, there may be cases where they need to be addressed.
- 4.24 Where intermodulation is found to occur as a result of the interaction of two transmitters, it will be the responsibility of the licensee who deployed its transmitter most recently to resolve this. Ofcom expects it to be clear in most cases from data such as mast rental contracts which transmitter has been deployed most recently.

Indicative interference level

- 4.25 A consequence of defining out-of-band PFD limits is that an indicative interference level (IIL) in a channel can be inferred. The IIL of a channel represents the anticipated maximum interference levels in that channel caused by licensees in adjacent channels (but does not include interference due to non-licensed sources such as electromagnetic compatibility, also known as EMC).
- 4.26 IILs are only indicative because of the vagaries of propagation and the fact that there may be other interference sources, e.g. EMC, which are unaccounted for. Hence, IILs are not a guaranteed right that a licensee can rely on. Ofcom will calculate the IIL of each SUR licensee at the time it is issued where applicable. IILs can only be determined for those licences where all neighbours contributing to the interference also have licences specified in SUR terms.
- 4.27 Ofcom currently provides information on expected spectrum quality for a few licence classes using spectrum quality benchmarks (SQBs). If there are any assignments

where SQBs are currently used but SURs are subsequently implemented, then the IIL will supersede the SQB. However we will expect them to be set at equivalent levels such that the licensee does not suffer any significant change.

Summary

- 4.28 To control emissions into neighbouring geographical areas, the following is used:
- The aggregate PFD at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than $Z\%$ of locations at [definition of boundary].
- 4.29 To control emissions outside of the licensee's frequency band (that appear as in-band interference for a neighbour), the following is used:
- The aggregate out-of-band PFD at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than $Z\%$ of locations in a test area.
- 4.30 To control emissions inside the licensee's frequency band (that may cause interference to neighbouring users in frequency due to imperfect receiver filters), the same measure is used:
- The aggregate in-band PFD at a height H [m] above ground level should not exceed X dBW/m²/MHz at more than $Z\%$ of locations in a test area.
- 4.31 If intermodulation occurs as a result of the interaction of two transmitters, it is the responsibility of the party having most recently deployed a transmitter to resolve the problem.
- 4.32 An SUR licence is expected to include in-band, out-of-band and where relevant, geographical interference limits. If required by stakeholders, other forms of restrictions (e.g. EIRP limit or transmitter density limit) can be included in an SUR licence to meet particular objectives such as facilitating coordination. The level of these restrictions can be subsequently changed through negotiations with neighbouring licensees.
- 4.33 In the next section, we describe the process used to define the SUR parameters in a licence and how these can be changed following a change of use.

Section 5

Defining and making changes to licence terms

Introduction

5.1 As mentioned previously, one of the benefits of SURs is that since the licence is specified in terms of interference levels caused to neighbours, it is easier to determine whether a change of use can be effected. An overview of the change of use process is given along with a treatment on other possible changes that can be made to an SUR licence (e.g. modifying PFD limits for different regions or changing the licence verification method). However, we first describe the procedure to set the initial parameter values in an SUR licence.

Setting initial parameter values in an SUR licence

- 5.2 For existing licences which are to be changed to an SUR format, licensees will be asked to specify their views on the relevant parameter values for their licence. Subsequently, Ofcom will:
- Carefully examine each for appropriateness.
 - Compare those of neighbouring users, where available, and understand the reasons for any differences.
 - Conduct modelling, as appropriate, to resolve any issues.
 - Publish a proposed set of parameters and consult upon these, if needed, with the relevant stakeholders.
- 5.3 For new licences, the SUR parameters are based on an assessment of the most likely uses of that band. Ofcom will make its initial proposals and consult on them. Ofcom will analyse the responses received before finalising the parameter values in the SUR licence.
- 5.4 Once the parameters are set, licensees are able to make a licence variation request to change them as discussed next.

The change of use process

- 5.5 SURs are stated in the most flexible manner possible, allowing users to change their use of the spectrum without needing to make a change to their licence provided the existing licence terms are not exceeded. However, this may not be possible in some cases and thus, a user may seek to modify its existing licence terms. Alternatively, neighbouring users may conclude that a change in the interference they can cause each other may allow them to optimise their network design and so reduce costs.
- 5.6 Under current licence terms, if neighbouring users wish to make a change in their licence terms which all affected parties agree to, then they are able to present this proposal to Ofcom which will consider changing licences appropriately. Alternatively, the parties may be able to effect the change by spectrum trading. Either of these

mechanisms remains possible with SURs. Licences where the restrictions are stated in terms of SURs can be traded just like any other licence. However, because of their increased flexibility and the more transparent manner in which rights are stated, change of use with SURs is likely to be simpler than with existing licences.

5.7 A high level summary of the change of use process for an SUR licensee is given in Figure 5.1.

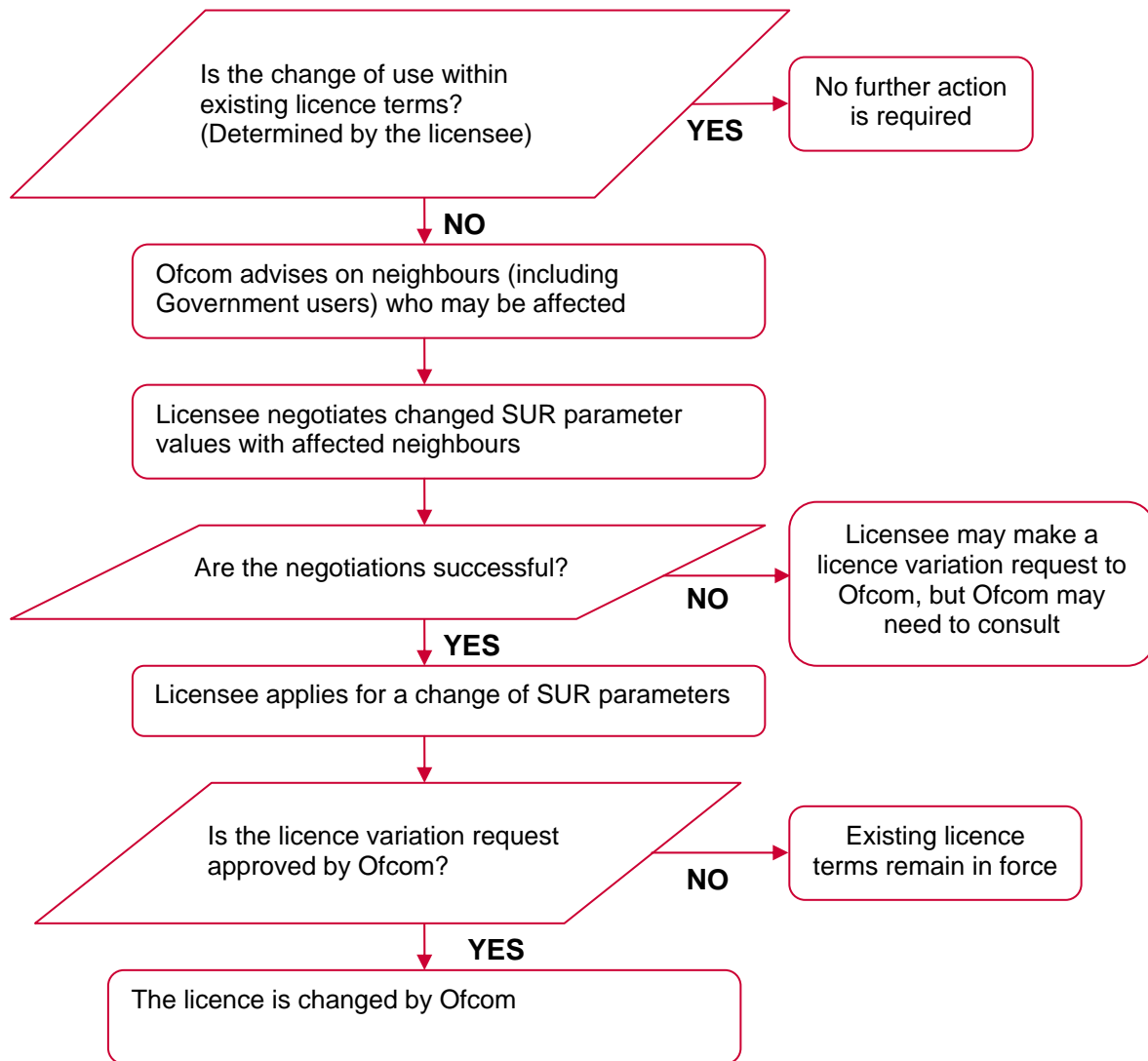


Figure 5.1: Elements of the change of use process based on negotiations with affected neighbours.

5.8 Firstly, the licensee wishing to change its usage should determine whether it can be accommodated within its existing SUR parameters. If it cannot, the licensee needs to ask Ofcom to advise on who may be affected by the change of use and enter into negotiations with the identified licensees to agree necessary changes to SUR parameter values, possibly through compensation for any degradation suffered as a result.

- 5.9 Notifying Ofcom will also trigger where necessary a government process and release of information, for example provision of information on international co-ordination constraints.
- 5.10 If the agreement of all affected parties can be obtained, required changes to the SUR parameter values are made. If the agreement of all parties is not obtained or not sought by the licensee then if requested, Ofcom will still consider the change request, as is its statutory duty but may need to consult as part of this process.
- 5.11 The remaining stages of this process are discussed in further detail in the sub-sections below.

Negotiating change of use

- 5.12 Once the affected neighbours have been determined, then the licensee wishing to change its SURs will need to negotiate appropriate terms with these neighbours. Ofcom will not normally expect to have any involvement in this process.

Issues with particular classes of user

- 5.13 There are particular issues here with specific stakeholder cases – e.g. government users such as the MoD, and licence exempt users. We discuss these circumstances in the sub-sections below.

Receive only users

- 5.14 At the moment, Ofcom gives these users a degree of informal recognition through its assignment policy and enforcement activities but there is no formal entitlement to recognition.
- 5.15 Where RSA (Recognised Spectrum Access) is introduced, these users can obtain a formal right to recognition. At this point any negotiations with such users can proceed on the same basis as with a standard licensee.

Licence exempt users

- 5.16 Licence exempt applications are protected from harmful interference from neighbouring bands, though there is no protection from other users within the band (assuming they are operating legally). When SURs are established for licences neighbouring licence-exempt bands, Ofcom will consider the levels of interference into the licence exempt band that will likely maximise the overall value of all relevant bands, perhaps through a modelling or analysis process.
- 5.17 Since there is no single holder of the right to protection for licence exempt applications operating in a band and there are likely to be many unidentifiable users who in effect jointly possess the right to interference protection, it will generally not be possible to negotiate changes to this protection. Protection given to licence exempt application bands will therefore be non-negotiable with neighbouring licensees.

Vacant spectrum and guard bands

- 5.18 Ofcom believes, in general, that it can best secure optimal use of the radio spectrum by awarding any vacant spectrum in its possession as soon as practicable. However in the short to medium term, issues can arise through neighbouring national

licensees wishing to undertake a change of use which will modify the interference levels in vacant spectrum bands.

- 5.19 If a licensee wishes to make a change of use that can increase the amount of interference experienced in vacant parts of the spectrum that Ofcom administers, Ofcom will consider each case on its merits in the light of all relevant considerations. Ofcom will seek to minimise such occurrences by rapidly awarding vacant spectrum.

Government users

- 5.20 At present, Ofcom manages the interface between government and commercial users, for example by negotiating increased sharing of government spectrum and protection of commercial users' interests in the context of changes in government spectrum use (and vice versa).
- 5.21 There are two issues which will make it more difficult for a licensee to determine whether a change of use has an impact on these users. Firstly, rights to spectrum use are not in general defined at present, and secondly information on spectrum use is not held / known by Ofcom.
- 5.22 This may be a particular issue in relation to certain spectrum bands managed by government users such as the Ministry of Defence. Enhancement of sharing with commercial users is a key theme of the audit of major spectrum holdings by Professor Martin Cave¹⁶, which made a number of recommendations in this area. The response¹⁷ to the audit commits the Government and Ofcom to work together to implement the audit's recommendations. This includes proposals to formalise public sector spectrum holdings and make more information about them available. These measures will facilitate band-sharing generally and negotiation of changes to licences to accommodate new services. These measures may enable neighbouring SUR licensees to negotiate directly with the MoD, for example in bands where Crown RSA has been defined.

International users

- 5.23 In principle, licensees are free to negotiate with other spectrum users across international boundaries. Ofcom will be prepared to consider the possibility of international negotiations. However, this is only likely if and when other administrations choose to adopt similar approaches to liberalisation.

Registration of change of use

- 5.24 If negotiations conclude satisfactorily, then the licensee wishing to change use and all other affected licensees will need to apply for licence variations. It is at this stage that Ofcom will formally approve or reject the proposed change of use. If the changes are accepted a licence variation will be issued.
- 5.25 The only reasons for refusing a licence variation agreed by all affected parties will be the same as those for refusing a trade under the draft trading regulations, namely:
- Interests of national security.
 - Compliance with European Community obligations and international agreements.

¹⁶ <http://www.spectrumbaudit.org.uk/final.htm>

¹⁷ <http://www.spectrumbaudit.org.uk/220306.htm>

- Compliance with a direction from the Secretary of State under Sections 5 or 156 of the Communications Act 2003.
- 5.26 Ofcom will not have a role in approving the technical aspects of the licence variations as such a role would not put sufficient responsibility on the parties concerned to address potential interference problems in negotiations. It may also conflict with Ofcom's responsibilities in enforcing licences and more generally regulating the sector.

Modifying PFD limits for different regions

- 5.27 In-band and out-of-band PFD limits are defined throughout a licensee's operational area. Licensees who want a higher PFD limit in a particular part of their licence area can do so by submitting a licence variation request to Ofcom. The request is expected to include a clear definition of the region where the new PFD limit applies. If the licence variation request is approved following due process, the region for which the new PFD limit applies will be included in the licence.

Changing the approach to verify licence terms

- 5.28 Verification of compliance to an SUR licence can be carried out using a measurement or a modelling approach. Ofcom's preferred approach is to use modelling to verify compliance to licence. This is discussed in more detail in the next section.
- 5.29 A change in verification method of an SUR licence (e.g. from modelling to measurement or vice-versa) follows the same process as for a change of use described earlier.

Section 6

Compliance with an SUR licence

Legal framework for SUR licences

- 6.1 A licence issued under the Wireless Telegraphy Act 2006 (WT Act 2006) authorises the establishment, installation and use of equipment for wireless telegraphy (i.e. sending and receiving radio signals).
- 6.2 The WT Act legislation does not state how a licence should be specified, but it states that licence terms relate to transmissions from particular equipment. Hence, the specific licence terms used are at Ofcom's discretion.
- 6.3 SURs control the PFD radiated by equipment licensed to operate in a permitted frequency band. Such a definition of SURs is compatible with licence terms that can be specified under the WT Act 2006. Hence, SUR licences can operate under the existing legal framework.
- 6.4 Other than using equipment that does not require a licence (i.e. licence exempt), transmitting without a licence is a criminal offence under the WT Act 2006. Similarly, an individual who holds a licence but transmits in a manner outside of their licence conditions is also committing a criminal offence.
- 6.5 If an SUR licensee transmits outside its licence conditions, Ofcom has powers to investigate and take action (including prosecution or licence variation/revocation) as appropriate. The legislation requires a warning to be first issued to a licensee in breach of its licence before prosecution.

Verifying compliance to SUR licences

- 6.6 Ofcom's preferred option is to use modelling to verify compliance to SUR licence terms. In particular, Ofcom believes that in almost all cases, the only practical method to verify interference across geographical boundaries will be by modelling. This is because (1) it will be very difficult to turn off other interfering signals which may originate in a different country and (2) the time varying nature of long-distance propagation may make the measurement period needed unduly long.
- 6.7 In an interference investigation case¹⁸, after verifying that the interference is not due to an illegal transmitter (i.e. one operating without a licence to do so), Ofcom will investigate the neighbours (including near-adjacent neighbours) of the 'victim' licensee (i.e. licensee claiming to suffer from interference).

Verification by modelling

- 6.8 As mentioned in Section 4, the three interference controls, namely in-band, out-of-band and geographical interference limits are defined in terms of aggregate PFD. By definition, PFD is a vector quantity. However for the purpose of verifying compliance by modelling, only the scalar components of the PFD contributions are considered in determining the aggregate PFD.

¹⁸ This is a scenario where, following an interference complaint, Ofcom has decided to commit resources to investigate the case rather than advising the licensee by running through a list of questions to identify the source of interference.

- 6.9 The modelling process as well as the inputs used will vary according to the nature of the service being modelled. Details of the process to assess compliance to in-band, out-of-band and geographical interference limits will be included in the licence. It is beyond the scope of this Statement to describe them for each licence. However as an illustration, we give below some broad guidelines on a specific case without prejudice to other scenarios not mentioned here.
- 6.10 To verify compliance to an in-band PFD limit due to a broadcasting or mobile downlink¹⁹ type of service (excluding Time Division Duplex), necessary information such as transmitter locations and transmit powers is requested from investigated licensees. A simulation is then run over a test area, in a location chosen by the 'victim' licensee. Only the neighbouring licensee's transmitters²⁰ in the test area will be considered in the modelling. At each of the test points distributed uniformly across the test area, an aggregate PFD value is calculated at the relevant height(s).
- 6.11 To verify compliance to an out-of-band PFD limit, the out-of-band PFD can be derived from the in-band PFD using a range of approaches, one of which will normally be specified in the licence. In some cases, if appropriate, this can be based on the Adjacent Channel Leakage Ratio (ACLR) or the transmitter spectrum mask or other attenuation mask as specified in the relevant standards or, where appropriate, it might be based on actual measurements of a few transmitters.
- 6.12 To verify compliance to a geographical PFD limit, the 'victim' licensee highlights a reference point on the geographical boundary where they believe that interference is occurring. The segment(s) of the geographical boundary that occurs within a radius R ²¹ from the reference point is then used for assessing compliance.
- 6.13 The aggregate PFD is determined at test points which can be distributed, for example, on the terrain data resolution used. The test points are expected to be located along the relevant segment(s) of the boundary.
- 6.14 The actual transmitters of the investigated licensee to be included in the modelling will be specified in the licence terms. In the extreme, all of its transmitters causing signal levels at the boundary higher than the UWB (ultra-wideband) mask (as defined in the European Commission Decision 2007/131/EC) will be considered in the modelling.

Resulting action after verification

- 6.15 Ofcom's approach to interference resolution has been set out in our consultation on liberalisation²². Three cases were outlined there which are summarised below:
- 6.15.1 *If a licensee is in breach of licence conditions*, Ofcom will take appropriate action. This will depend on what is proportionate and necessary in the circumstances. For example, a transmitter fault resulting in spurious emissions, possibly unknown to the user, could be solved by negotiation and agreement on a voluntary basis if the user cooperates. If the breach was not due to transmitter fault and was deliberate, on the other hand, Ofcom would probably consider issuing a Conformity Notice in accordance

¹⁹ A mobile downlink refers to a case where the base station transmits and the mobile terminal is on receiving mode.

²⁰ Indoor transmitters are excluded from the modelling.

²¹ The radius R will be specified in the licence.

²² <http://www.ofcom.org.uk/consult/condocs/liberalisation2/liberalisation/>

with sections 172 to 174 of the Communications Act 2003. This process gives time for remedial action or representations to be made before a criminal prosecution is brought. An immediate interim close-down would be possible, especially if there was a threat to public safety or serious operational or economic problems were caused to other users. The sanction of varying or revoking a licence is separate to the legal enforcement process and in practice would be triggered by the need for strong enforcement action following prosecution or repeated breaches of licence conditions.

- 6.15.2 *If the fault lies in the victim installation*, Ofcom will not generally take any action as remedial action is the user's own responsibility in such a case but may, for a fee charged at commercial rates, advise the operator on remedial action.
- 6.15.3 *If the originator of the interference is operating within the licence terms and conditions and acted in good faith but interference nonetheless results from a discrepancy between the predicted and actual effects of the transmission*, Ofcom will consider the facts of the case, representations by the parties and any other relevant considerations and decide what, if any, action to take. If the victim had previously agreed to the change that caused the interference, Ofcom will generally expect the parties to resolve the situation themselves in line with the terms of their agreement. If they cannot, or if the victim was not party to such an agreement, Ofcom will consider appropriate intervention action.
- 6.16 If the modelling process shows that the investigated licensee is not breaching its licence terms but the 'victim' licensee is still suffering from interference, Ofcom may decide where appropriate to measure²³ the EIRP of the relevant transmitters and compare these to the values provided by the licensee under investigation.
- 6.17 If the EIRP measurements exceed the levels given by the investigated licensee, Ofcom will take appropriate action depending on the nature of the case. Ofcom will use the measured transmitter EIRP as input to further modelling to calculate the PFD levels. If the latter exceed the PFD limits stated in the licence terms, Ofcom will follow guidelines given in paragraph 6.15.1.

Restriction of SURs to outdoor environments

- 6.18 SURs are not defined indoors²⁴. Hence, only outdoor transmitters and test points are used to verify compliance to licence terms.

SURs and harmful interference

- 6.19 Any licensee, including an SUR licensee, can claim to experience harmful interference. SURs effectively set a limit on the interference that a licensee is allowed to cause its neighbours. Therefore, in principle, if this limit is set appropriately, harmful interference should not be caused. Ofcom consults with stakeholders on the

²³ The measurement follows the standard procedure currently used by Ofcom's Field Operations team when enforcing licences with transmitter mask restrictions. The measurement can be carried out at any time of the day and the mean EIRP over a period of a few minutes is expected to be determined. In some cases, e.g. transmitters located on high masts, Ofcom may instead derive the transmitter EIRP based on input power probe readings and verification of the installed antenna type.

²⁴ Indoors mean inside buildings or places in which the shielding will typically provide the necessary attenuation to protect radiocommunication services against harmful interference.

appropriate SUR parameter values to include in licences and strives to set them appropriately.

- 6.20 However if a licensee experiences harmful interference while its neighbours are operating within their licence terms, it is possible that Ofcom did not set the parameter values appropriately. We expect this to be an extremely rare occurrence. In such a scenario, Ofcom will take responsibility for the harmful interference. Ofcom will not deem any licensee operating within its licence terms to be responsible for the harmful interference.
- 6.21 When a licence variation request is made following an agreement from all affected parties, it is assumed that they have agreed on a PFD level that they deem not harmful. In case harmful interference does occur between the negotiating parties, they may choose to re-enter into negotiation in order to correct the problem. In order to clarify this, affected parties may, for example, choose to agree between them that they will not claim harmful interference against one another when undertaking any licence variation. If harmful interference occurs to other parties who were not considered necessary by Ofcom to be involved in the negotiation this will remain the responsibility of Ofcom.
- 6.22 In some cases, individual parties may make a request to Ofcom for a licence variation without the agreement of other affected parties. As is its statutory duty, Ofcom will consider the request and a decision will be made on a case by case basis following a thorough analysis and consultation where appropriate. If Ofcom allows such a licence change and harmful interference subsequently occurs, Ofcom will take responsibility for it.

Annex 1

Impact Assessment

Policy Objective

- A1.1 This impact assessment (IA) estimates the costs and benefits of the proposed introduction of SURs. Overall, the proposed changes will reduce the amount of regulation since licence holders will have increased freedom to change the use of their spectrum with less need to apply to Ofcom.
- A1.2 Ofcom's objectives in liberalising the spectrum are to maximise the value created by use of the radio spectrum while at the same time protecting existing users. Value will be maximised by encouraging innovation, by removing barriers to entry for new companies or technologies and by minimising the time that spectrum sits unused.
- A1.3 The Impact Assessment published here is broadly the same as that published in the SUR Consultation document since no additional evidence emerged during the consultation process that suggested a change was appropriate.

Options

- A1.4 Ofcom has identified that the three main approaches to liberalisation are:
- Not to allow liberalised use of spectrum.
 - To require all change of use requests to be notified to Ofcom for it to decide whether they should be allowed (the current liberalisation approach).
 - SURs, as set out in this document.

Risks

- A1.5 The risk of doing nothing is substantial. In a study for the EC (European Commission) published in May 2004, Analysys estimated that the benefits to Europe of introducing trading and liberalisation are in the region of €9bn per year. Of this €9bn, some €8bn came from liberalisation and €1bn from trading. This study assumes liberalisation broadly in line with our proposals. Some of these benefits will be realised from the existing approach to liberalisation but the full realisation will require SURs as proposed here.
- A1.6 However, the approach proposed is not risk-free. With such wide-ranging and high level proposals there are many potential risks. Here we address the key ones.

Area of risk	Possible effects	Mitigation
SURs incorrectly specified	<p>1) Increased interference to licence holders.</p> <p>2) Flexibility not as great as might be achieved.</p>	<p>Careful introduction of liberalisation to allow the interference risk to be assessed. Use of modelling.</p> <p>Cases where change of use could not be achieved are studied to understand whether a change to SUR format is possible.</p>
SURs contradict each other	Neighbouring licence holders transmit within their rights but suffer interference.	Careful introduction of SURs in conjunction with licence holders and modelling where appropriate.
Market failures	<p>Abuse of market power (e.g. holdouts)</p> <p>Transaction costs</p>	<p>Use competition powers</p> <p>Careful design of SUR parameters and terms to minimise transaction costs.</p>
Disruption to customers	As use is changed some services may be withdrawn with subsequent disruption.	Limited action from Ofcom – this is part of a standard market and would not normally require intervention.

Table A1.1: Areas of risks with SURs and corresponding mitigation actions

Costs and benefits

- A1.7 This is a difficult area to determine costs and benefits. We are providing increased flexibility but it is up to licence holders to determine how this flexibility is used. The decisions that they make, which we cannot predict, will have a major impact on the costs and benefits. In the Spectrum Framework Review (SFR) Statement, we set out an approach to determining the costs and benefits based on the Analysys study. The responses were mixed. Some acknowledged that estimating benefits in this area was extraordinarily difficult and that we had likely done as much as was possible and sensible. Others felt that a more detailed estimate of the benefits was needed but did not provide any views on how this might be achieved. Our assessment is that given the difficulties in estimating the benefits, but the fact that the benefits are highly likely to massively outweigh the costs, it is not appropriate to expend substantial time and effort attempting more detailed quantification. Hence, what follows is largely the same material as presented in the SFR.
- A1.8 Compliance to an SUR licence will engender some costs, which will generally be negligible compared to the cost of network rollout. If a licence holder wishes to change use and thereby wishes to negotiate with other licensees, the licence holder

may incur additional costs. However it is likely that a licence holder would not incur these costs unless they expected the benefits to be greater.

- A1.9 The benefits are difficult to quantify since they will depend on the uses to which the spectrum is put and subsequent technical developments. Based on the Analysys report and assuming that the benefits of the UK equate to approximately a sixth of the benefits to all of Europe, we estimate that the benefits across all of the economy including licence holders, consumers etc, from the introduction of liberalisation might be in the region of £0.9 bn per year. This estimate is highly speculative.
- A1.10 SURs are an extension of an on-going liberalisation initiative. Some of this £0.9 bn will result from the existing initiatives and some will only be realised with the introduction of SURs. Estimating the split is highly problematic. However, insofar as the introduction of licences incorporating SURs facilitates liberalisation, they can be expected materially to enhance the gains from liberalisation and trading.
- A1.11 The potential costs of making a change of use without SURs in place include:
- Costs to business of going through the Ofcom process;
 - Costs incurred by Ofcom in considering each request;
 - Lost opportunities (or much lower probability) of negotiation between neighbours if they do not have SURs since without these the two parties would have to negotiate a conditional agreement and then both submit change of use requests to Ofcom.
- A1.12 Quantifying these is difficult, but we believe that they are real and will be significant in some cases.
- A1.13 Given that the key value is likely to come from major changes of use, which will likely involve negotiation with neighbours, we conclude that a proportion, which is potentially significant, of this £0.9 bn per year benefit will not be achieved until SURs are introduced.

Summary and recommendations

- A1.14 In summary we are introducing SURs in order to fully liberalise the use of spectrum. There are risks involved in such an approach but in most cases there are mechanisms whereby the impact can be reviewed and our approach modified if problems appear to be emerging.
- A1.15 Because this reduces regulation, there is little cost for users. Benefits are difficult to quantify and necessarily speculative, but could be of the order of hundreds of millions of £s per year.

Annex 2

Test area size

Background

- A2.1 An in-band or out-of-band PFD limit specifies a level not to be exceeded at a height, H, for a percentage of locations within a test area. In principle, the test area associated with an in-band or out-of-band PFD indirectly sets a limit to the power levels radiated by a licensee's transmitters in that area.
- A2.2 If the test area is too large, it is possible for a licensee to deploy a very high power transmitter or a network of transmitters within part of the area and still be within its PFD limits when averaged across the whole area.
- A2.3 Conversely, if the test area is too small, e.g. less than, say, 2 cells²⁵, there is a risk that the area may cover part of a cell such that only areas close to the transmitters are included. This will distort the statistics of the PFD levels.
- A2.4 The exact definition of the test area will be provided in the licence. An example of a possible definition of a test area is given below.

Example test area definition

- A2.5 The test area can be defined as a square area including at least ten transmitters and where the bottom left corner is given by a four figure National Grid Reference (NGR) number. The appropriate test area is the smallest of the following areas, 1 km², 4 km², 25 km², 100 km², 400 km², 2,500 km² or 10,000 km², which includes at least ten transmitters²⁶.
- A2.6 If a test area of 10,000 km² is not likely to include at least ten transmitters, then Ofcom will decide the appropriate area on a case by case basis and will make this information available to the stakeholders when it is consulting on the SUR licence parameters.
- A2.7 Test points over a water feature (e.g. sea, lake or river) or coincident with transmitters are excluded from the compliance assessment.
- A2.8 For mobile uplink services or similar, the test area is the same as that for a mobile downlink channel. This is a simplification in the absence of definite knowledge of the number of terminals active at any point within the area.
- A2.9 For fixed link services, the area should include at least ten transceivers in the case of duplex links or ten transmitters in the case of simplex links.
- A2.10 For satellite services, coverage across the UK is fairly uniform. Hence, the PFD limit may be set at a few specific locations in the UK rather than for a test area.
- A2.11 Radar services are likely to be a special case as a 10,000 km² area may not necessarily include at least ten transmitters. In these circumstances, Ofcom will decide on the appropriate test area on a case by case basis.

²⁵ A cell is here defined as the coverage area of a transmitter.

²⁶ Indoor transmitters are excluded.

Annex 3

Responses to issues raised in the main SUR consultation

Introduction

In April 2006, Ofcom published a consultation document giving an overview of Ofcom's liberalisation programme and outlining the rationale of SURs within a liberalised environment.

The document highlighted the types of interference to be controlled by SURs and proposed a range of approaches to control these types of interference. Ofcom consulted on the suitability of the approaches put forward, the process for negotiating a change of use, the method used for dispute resolution and setting licence parameters among others.

General comments

Most respondents agreed with the concept and definition of SURs. Equally, there were some areas of concern which are set out below and in response to which we have modified some aspects of our original proposals. Note that the respondents' views are in italics.

1. Respondents felt that the proposals are too complex and that it would be difficult to establish and administer SURs. However, only Vodafone offered alternatives.

Ofcom's view:

Our view is that the administration of SURs can be complex if licensees require frequent measurements, but we believe that most licensees will use modelling rather than measurement and that the need to verify PFD levels will be infrequent. While we acknowledge that for a licensee verifying conformance to their licence SURs are more complex than the approach they replace, we believe that the benefits of increased certainty in the aggregate levels of interference outweigh any overhead that this increased complexity might cause.

2. The current approach of spectrum masks is adequate.

Ofcom's view:

We disagree. The current approach does not provide adequate protection to licensees from increased interference that will result if a neighbour increases its deployment density. This is discussed in some detail in Section 3 of this Statement. While the current approach may have worked adequately in a command and control environment, we do not believe that it will allow benefits to be maximised in a regime based on market forces.

3. Changes to the legal and economic framework are needed.

Ofcom's view:

There was little explanation of why, or what is missing, or what changes might be needed. One respondent stated that licensees need to be able to take direct action against those causing interference rather than request Ofcom to intervene – in fact licensees already have

this power²⁷. As explained in the SUR consultation on compliance issues, we remain satisfied that SURs can operate under the current legal framework.

4. Detailed models are needed.

Ofcom's view:

More modelling work has subsequently been performed and, for example, is reported in the 2.6GHz and L-Band consultations.

5. Harmonisation around agreed standards is preferred.

Ofcom's view:

There seems no inherent incompatibility between the introduction of SURs and harmonisation. Market-led harmonisation can be achieved based on standardisation as discussed in the ECC report²⁸ on 'Enhancing Harmonisation and Introducing Flexibility in the Spectrum Regulatory Framework'. We have already discussed our views²⁹ on harmonisation at some length where we have shown that mandatory harmonisation is generally not beneficial.

Ofcom's views to the response received to questions in the consultation document

Question 1: What is the best way to control in-band interference across geographical boundaries?

Most supported our proposal. The following comments were made.

i) Measurements will be difficult to make – modelling would be better.

Ofcom's view:

We accept this. In this Statement, we propose the use of modelling as our preferred option for verifying compliance to licence terms.

ii) Measurement should not be probabilistic as this reduces certainty and makes measurement difficult.

Ofcom's view:

Unfortunately, the nature of propagation is such that signal strength is variable both by time and location. A non-probabilistic limit will need to be set at the maximum received signal, allowing for generally unlikely propagation conditions such as line-of-sight over some distance. Such limits will provide little protection against interference caused by changes such as increased transmitter density.

iii) 'Time' needs further definition. For example, the use of terms such as 'average year' versus 'any year'. Also two time measurements, e.g. 20% or 0.1% may be needed simultaneously in some cases.

²⁷ See Section 108 of the Wireless Telegraphy Act 2006.

²⁸ <http://www.ero.dk/documentation/docs/docfiles.asp?docid=2153&wd=N>

²⁹ http://www.ofcom.org.uk/radiocomms/isu/sip/eu/2_6ghz.pdf

Ofcom's view:

In this Statement, we have modified our definition of the PFD limits so that it does not relate to a specific percentage of time. If a modelling approach is used for verifying compliance in a band and the selected propagation model has a percentage of time as one of the variables, then the appropriate percentage of time will be specified in the licence. If measurements are used, it is expected that the time period over which the measurements are averaged out as well as additional information pertaining to the measurement process will be specified in the licence.

iv) Probabilistic measurement allows neighbours to transmit unlimited powers for some percentage of time.

Ofcom's view:

As mentioned above, our proposed definition of the PFD limits no longer includes a percentage of time factor thus preventing the problem of high transmit powers for short time periods.

Question 2: What is the best way to control interference caused by out-of-band emissions?

Again, most supported our proposals. Some of the comments made in response to Q1 apply here.

i) Aggregate transmitted PSD (Power Spectral Density) should be used instead of the proposed aggregate PFD approach.

Ofcom's view:

Vodafone suggested an alternative approach to the definition of SURs based on aggregate transmitted PSD within a specified area. In this approach, the total transmitted power from all of the transmitters within a given area must not exceed a certain limit. This approach has the advantage of being simpler for the licensee or Ofcom to confirm that the licensee is within its limits since no modelling or measurement campaign is required. However, it has the disadvantage that the aggregate power levels are a relatively inaccurate indication of the interference that can be expected by neighbours. For example, consider two different deployments. In the first case, transmitters are deployed above rooftop level while in the second case they are deployed below rooftop level. Despite them using the same aggregate power, the interference experienced by neighbours could differ significantly in these two situations.

Ofcom performed some modelling work to further assess this proposal and our research suggests that the aggregate transmitted PSD approach allows certain changes of use which have a significant risk of causing dramatic changes in interference for neighbours. For example, it will allow a change from cellular FDD to TDD which is well known to be problematic for neighbours, whereas the aggregate PFD approach we are proposing will effectively prevent this unless agreement can be reached with neighbours.

Further, the main reason for suggesting the aggregate transmitted PSD approach was to reduce the complexity associated predominantly with the use of measurements as a mechanism for enforcing SURs. Since then, as discussed in this Statement, we have modified our proposals to use modelling which simplifies the use of SURs. On balance, we are of the view that aggregate transmit power levels, while an interesting concept, are inappropriate because:

- With a move to modelling, the use of SURs based on aggregate PFD is more practical and there is no significant benefit in further simplification.
- The use of aggregate transmitter power is only a weak guide to the interference levels that a neighbour can experience and may still result in a change of use causing interference problems.

Therefore, while we are very grateful for the proposal of this alternative concept, we do not plan to pursue it further.

ii) PFD limits may need to be specified at more than one height.

Ofcom's view:

We agree. The PFD limits are now defined at a specific height rather than up to a defined height. Hence, it allows for different limits to be specified at different heights as illustrated in the 2.6 GHz consultation document published in December 2006.

i) Applying PFD limits to mobile devices whose location is not known may not be possible.

Ofcom's view:

Although operators cannot control the location of devices, they only allow a certain number in any cell to transmit, up to the cell capacity. Making reasonable assumptions about the distribution of those mobiles actually transmitting is unlikely to cause significant problems.

Question 3: What is the best way to control interference caused by in-band emissions?

As above, most were supportive. Comments made were identical to responses to Question 2.

Question 4: Which would be your preferred option for control of spurious emissions? If not one of the above options, what would you propose?

A very mixed set of responses was received. First in time registration was preferred by some although one respondent noted that registration might not actually be required as it would normally be clear which transmitter was first deployed. Further investigation was proposed by one respondent while another suggested that it would be possible to rely on site engineering.

Ofcom's view:

Our view is that the best compromise is to use first in time principles, but without actual registration, on the basis that understanding who deployed a transmitter first is normally straightforward so it will be disproportionate to impose a registration requirement. This Statement addresses this.

Question 5: Do you agree to the proposed approach described here for Indicative Interference Levels?

i) ILLs do not go far enough and that some guarantee should be offered.

Ofcom's view:

However, no respondent suggested what sort of guarantee will be appropriate, how it will work and who will pay any damages. Our current view is that IILs remain indicative in nature.

ii) Ofcom should calculate IILs rather than licensees.

Ofcom's view:

Ofcom accepts that there is less room for error or misinterpretation if it calculates the IILs for each licence. Ofcom will provide a licensee's IIL at the time the licence is issued as discussed in the Statement.

However, using IILs requires a little care. The IIL of a licence is the sum of the out-of-band PFD distributions of the relevant neighbours. Adding together such distributions requires appropriate statistical tools. Ofcom will undertake this addition if required, making necessary assumptions such as assuming that the location of the highest levels of interference are uncoordinated across the different sources of interference. Assuming that licence holders have a single set of SURs across the entire licence area then there will also be a single IIL across the licence area.

If the licence holder wishes to verify that their IIL is not being exceeded, likely using a modelling process, they will also need to know the size of the area over which the modelling must be performed. As we have noted before, if modelling is conducted over too small an area erroneous results are possible due to, perhaps, the test area only covering a location close to a base station. The size of this area is the largest of the test areas for each of the neighbours making a material contribution to the IIL in the geographical area of interest. As discussed in Annex 2, the test area is determined based on the local density of neighbours' transmitters which is information available to Ofcom but not to the licence holder wishing to determine whether it is suffering interference. Hence, in principle, the licence holder would need to request from Ofcom the size of the test area they should use in any given location. However, because of the burden this will place on Ofcom and neighbouring licence holders, a licence holder in the first instance should assume that the test area is the same as for their own network. If, within this test area, they believe that they are suffering interference then Ofcom will investigate and provide information about the appropriate test area as needed.

iii) A formal process of consultation with neighbours is needed before setting IILs.

Ofcom's view:

Ofcom will consult where necessary when setting SUR parameters. IILs are implicitly considered as they are derived from the out-of-band emissions.

Question 6: How should a licence holder determine which frequency and geographical neighbours should be involved in a change of use negotiation?

i) Ofcom should determine who is affected by any proposed change and publish this. This allows everyone to assess whether they may be affected.

Ofcom's view:

Ofcom will advise the licensee requesting the change of use as to the affected parties. The onus is on the licensee requesting the change of use to inform the affected parties.

ii) Any proposed change should be published for a set time period allowing those who might be affected to object.

Ofcom's view:

Publication of such information is likely not needed, given the relatively small number of licence holders who typically might be affected. It might also be seen by the licence holder wishing to change their limits as publicly revealing commercially sensitive information. Therefore, in general, Ofcom will not publish. However, where there is some doubt as to who might be affected we may notify those licence holders where the effect is in doubt to allow them to make their own assessment, if they wish.

Question 7: Would it be useful for Ofcom to make its change of use modelling tool publicly available?

i) Respondents were in favour for Ofcom to make the modelling tool publicly available.

Ofcom's view:

This suggestion was made at a point when we were proposing the use of measurement to verify SURs. In this case, the modelling tool would only be an indicative means to provide some initial assessment of any proposed changes. However, we are now proposing modelling to verify SURs. With this new approach, the modelling tool used becomes a key component of licence verification. Because of its critical role in this revised approach, Ofcom recommends that commercially available tools are used to assess a change of use or for compliance purposes carried out internally by a licensee. Hence, we do not expect there to be a role for our modelling tool and no longer intend to make it available for this purpose.

Question 8: Are the proposals for negotiating a change of use with non-commercial and other similar users appropriate?

i) Ofcom has obligations with respect to international coordination and Ofcom should engage with other administrations when requested to do so.

Ofcom's view:

Ofcom will be prepared to consider the possibility of international negotiations.

ii) Ofcom should help in the interaction between non-commercial and commercial users.

Ofcom's view:

In its response to the Cave Audit, the Government has committed to provide more information on public sector spectrum holdings. As more information becomes available, Ofcom expects commercial users to directly negotiate with public sector licensees.

iii) Ofcom should act on behalf of licence-exempt users seeking to facilitate a change of use. A hard constraint could place undue restrictions on users adjacent to a licence-exempt band.

Ofcom's view:

When SURs are established for licences neighbouring licence-exempt bands, Ofcom will consider the levels of interference into the licence exempt band that will likely maximise the overall value of the spectrum, perhaps through a modelling or analysis process.

iv) There may be an unusual situation where a licence-exempt band is offered more protection than a licensed band as the interference limit in the latter has been raised following negotiations.

Ofcom's view:

If a licensee fears this may happen and that it would have problematic consequences for them, it should not agree to a higher interference limit during negotiations. A licensee is under no obligations to negotiate.

v) Mobile and broadcasting uplink should be considered as individually licensed rather than as licence-exempt or receive-only users.

Ofcom's view:

Uplinks associated with licensed downlinks are treated as licensed downlinks in terms of the ability to negotiate.

Question 9: What is the best approach towards enforcement and dispute resolution?

i) Ofcom should not try to abdicate any responsibility through the introduction of SURs.

Ofcom's view:

This is not Ofcom's intention. We still retain all the duties to assess compliance to licence terms relevant under the current regime and have no plans to change these. Moreover, as detailed above, we have modified our original proposals to increase Ofcom's involvement in the process of negotiating changes to SURs.

Question 10: What is the right approach to setting licence parameters for an SUR?

i) Most respondents agreed that the licensees should be consulted and most thought that it was appropriate for existing licensees to come up with the initial set of values themselves. A couple of respondents felt that the right approach to set initial SUR licence parameters depended on which SUR format is selected.

Ofcom's view:

This Statement contains the same approach for existing licences as outlined in the consultation document. In essence, Ofcom will ask existing licensees for their views on the appropriate SUR parameters which Ofcom will analyse. Subsequently, Ofcom will publish a set of parameters and may consult upon these if needed.

ii) A respondent viewed that setting SURs for new licences based on the most likely use conflicts with Ofcom's service and technology neutrality objectives. However, the respondent was unable to propose a better solution. Another respondent agreed that initial SUR parameters should not necessarily be based on complete technology neutrality.

Ofcom's view:

As mentioned in the SFR, Ofcom aims to be technology and service neutral where feasible. Setting initial SUR parameters based on most likely use does not necessarily preclude the band being used for other uses. A change of use is allowed as discussed in more detail in Section 5 of this Statement.

Question 11: What is the best approach to the measurement of interference?

i) The proposed approach is too expensive.

Ofcom's view:

We accept that measurements can be expensive. In this Statement, we have put forward modelling as our preferred option for verification of compliance.

ii) The methodology needs to vary according to licence parameters / service deployed.

Ofcom's view:

While modelling is our preferred option, SUR licensees can request a change of the licence verification method to measurements. However, regardless of whether modelling or measurement is used, we would expect different terms and in some cases different approaches (e.g. determining the size of the test area) depending on the particular service or licence.

iii) It might be valuable to set out a proposed measurement process in more detail.

Ofcom's view:

Modelling is our preferred option for verification of compliance. The proposed modelling approach is set out in Section 6.

iv) Indoor measurements are also needed.

Ofcom's view:

Ofcom is minded not to apply SURs to indoor situations for practical reasons. Defining an appropriate indoor test area is likely to be difficult given that floor area sizes vary significantly across buildings. In addition, using measurements to verify compliance can potentially result in significant disruption to the occupiers of the buildings, while the use of modelling is challenging as indoor environments are complex. No additional indoor protection is offered with current licences.

Question 12: Should SURs be initially introduced at national and wide-area level?

i) Small areas such as airports will benefit from SURs and they can readily be introduced.

Ofcom's view:

We accept this. All new awards, for both small and large area licences will be considered for SURs and any request from licensees for a change to SURs regardless of the size of their coverage area will be given serious consideration.

Annex 4

Responses to the consultation on compliance to SUR licences

Introduction

In September 2007, Ofcom consulted on the compliance to SUR licences and outlined a modelling and a measurement approach for this purpose. In addition, the consultation highlighted that SURs could be introduced within existing legislation, namely the Wireless Telegraphy Act 2006.

Nine responses were received for this consultation. The responses are grouped according to common themes and Ofcom's views on the feedback received are given in the next subsection. Respondents' feedback is shown in italics.

Ofcom's views to the response received to the questions in the consultation document

Question 1: Do stakeholders have any comments on the methodology for verifying compliance to licence terms or have any other comments on the contents of this document?

Using modelling to assess compliance

Most respondents expressed the preference to use modelling to assess compliance rather than a measurement approach. More detailed comments from stakeholders are given below:

i) If modelling is chosen to assess compliance, reliable models should be used and appropriate terrain and clutter databases should be available. Ofcom should make the model and databases available through an online tool. The implementation of the model should be clear so that results are repeatable.

Ofcom's view:

Ofcom broadly agrees with these comments. Where appropriate, stakeholder feedback will be sought on the appropriate model and databases. Selected models used to assess compliance are likely to be approved by ITU or widely accepted by the radiocommunications community and widely available databases are expected to be used.

An online tool will not be made available by Ofcom. If modelling is used for compliance assessment, we recommend the use of commercially available tools as they would have been rigorously tested. These tools should allow the use of a range of models and databases. However, where appropriate, we may publish a "test network" along with the resultant modelled signal levels so that stakeholders can verify that the implementation that they are using provides the same results.

ii) The selected model should be accurate. Tuning of the model should be considered.

Ofcom's view:

It is helpful if the predicted PFD levels are not far off from reality and all efforts will be made in selecting an appropriate model. However, in principle, as long as the same model is used

to assess compliance and to set the PFD limit in the licence, then the accuracy of the model is less significant. This can be understood by imagining that the model generates PFD values that are, say, 5dB, higher than reality. When Ofcom sets the PFD limits for the licence it will generally take a typical deployment and use the model to generate PFD levels. These levels will then be 5dB higher than might be measured in reality. However, when an operator defines their network and checks the PFD levels they will do so using the same model, leading to results that are also 5dB higher than reality. The two 5dB errors will cancel out.

iii) It is impossible to identify all unknown interfering sources, in particular illegal emissions and spurious emissions.

Ofcom's view:

As mentioned in the consultation on compliance issues and in this Statement, identifying illegal broadcasters may be an element of investigation of any interference complaints. Ofcom will make every effort to identify interfering sources. In the past, our track record at doing so has been extremely high.

Our position on the control of spurious emissions is given in Section 4 of this Statement.

iv) Models fail or are undefined at short distances from the transmitter, which is where most problems are likely to be felt.

Ofcom's view:

At these short distances, free space propagation is likely to be the dominant factor where line of sight occurs. There are ITU models that reflect this in their short range predictions.

v) Deriving an out-of-band PFD from an in-band PFD using ACLR or spectrum masks as given in standards may not be appropriate for a number of cases, including where an equipment manufacturer's specifications are better than the standards or the equipment is operated at a lower power than the rated maximum.

Ofcom's view:

Ofcom recognises this and during the consultation on any auction or discussion with licence holders wishing to change to SURs Ofcom will welcome input as to the best way to derive the out of band PFD levels.

vi) It is unclear how modelling will be performed for mobile uplink channels.

Ofcom's view:

This Statement outlines the modelling process for a mobile downlink type of service but does not give details on other cases. However, Ofcom intends to consult shortly on the details of the modelling for other cases including mobile uplink channels.

vii) Unclear whether a modelling or a measurement approach will be used to assess compliance.

Ofcom's view:

Ofcom's preferred option is to use modelling for compliance assessment. However, stakeholders can express their preference for a measurement approach. The same applies to a licensee wishing to change its existing licence to an SUR licence.

Using measurement to assess compliance

i) Some respondents thought that the proposed measurement methodology was interesting but most felt that using measurement to assess compliance will be expensive and that it is not clear in some cases how to determine which licensee is responsible for interference. In addition, concern was raised regarding practical issues related to the measurements.

Ofcom's view:

Given the feedback received, Ofcom's preferred option to assess compliance is modelling.

Licence variation

i) What criteria will be used to accept unilateral proposals for variation?

Ofcom's view:

Each case will be assessed on its merits before making any decision in just the same way that licence variation requests are considered at present. Since cases are likely to differ, it is not possible for Ofcom to publish a definitive list of criteria used in its decision process. Ofcom may also consult and stakeholders' feedback will be taken into account when arriving at a decision.

ii) Rules to allow variations to licence conditions need to be clear and transparent.

Ofcom's view:

As stated in this Statement, if all the affected parties have agreed to new PFD limits, then Ofcom is likely to approve the change requested. However, Ofcom will not have a role in approving the technical aspects of the licence variation.

In case of the criteria for deciding on a unilateral request, the answer to the previous point is relevant.

iii) Agreements will be less attractive if Ofcom will not be involved in resolving interference problems in cases where SURs have been modified by agreement between parties.

Ofcom's view:

This is a mis-interpretation. Ofcom will continue to be involved, where appropriate, in resolving interference problems regardless of whether licences have been modified by negotiation. The only difference is that Ofcom will no longer be responsible for resolving claims of harmful interference where these occur between licence holders that have been part of the negotiation. Although stakeholders will clearly form their own views as to the attractiveness of certain options, Ofcom does not believe that this makes licence variation necessarily unattractive since such licence holders can form an agreement between themselves that they will not claim harmful interference between each other if within the modified licence terms.

iv) There is a lack of clarity on who are the affected parties

Ofcom's view:

Ofcom is responsible for advising as to the affected parties. Cases are likely to differ and it is not possible in this Statement to give more detailed guidance on how the affected parties are determined.

Legal issues

i) Changes to primary legislation are required for the introduction of SURs.

Ofcom's view:

Ofcom disagrees. Within the context of Wireless Telegraphy licences, licensees have the right to transmit subject to certain restrictions. If the technical licence conditions are expressed in terms of SURs, the restrictions will be given by an aggregate PFD limit over a test area and at a boundary, if appropriate. Ofcom views that it is possible to impose technical conditions given by SURs within the existing legal framework.

ii) What is the basis of the change to an SUR regime? It is incumbent on Ofcom to demonstrate that a change to SURs is necessary and proportionate.

Ofcom's view:

We anticipate that we will only change existing licences to SURs with the consent of the licence holder or for strong spectrum management reasons. If a licensee consents to a change then, it will have deemed SURs to be necessary and proportionate.

iii) ETSI will be developing harmonised specifications based on block edge masks. If SURs are implemented in the UK, then UK operators will have to comply with two regimes. The introduction of SURs is only lawful if such a dual approach is appropriate and proportionate.

Ofcom's view:

As above, it will generally be up to the licence holders to determine whether they wish to change their licences to SURs, or whether they would prefer to await the possible introduction of pan-European measures. Hence, the licence holder will decide whether they believe SURs to be appropriate and proportionate.

iv) It is unclear what proof is required to show harmful interference is being experienced.

Ofcom's view:

Currently there are no strict guidelines that have to be followed to show harmful interference and this will not change as the result of the introduction of SURs.

v) It is unclear what Ofcom means by taking responsibility for harmful interference

Ofcom's view:

It is not possible to give more detailed guidance in this Statement. Ofcom will assess each case on its merits.

vi) The rights of existing licensees must be given due consideration. 3G spectrum holders expect spectrum rights clear of interference (see 3G auction Information Memorandum) while SURs are meant to effectively set a limit on the interference a licence holder is allowed to cause its neighbours.

Ofcom's view:

As discussed above, we would only generally expect to change the licences of existing licence holders to SURs with the consent of the licence holder at which point appropriate SUR parameter levels can be discussed.

vii) SUR licensees are discriminated from other WT Act licensees. The consultation states that if modelled PFD values are significantly different from reality but within a neighbour's licence terms, the victim licensee will have no recourse to an interference complaint.

Ofcom's view:

If a licence includes modelling as the approach to assess compliance, then if this licensee raised an interference complaint due to its neighbour's modelled PFD being significantly different from reality but within its licence terms, it is unlikely that the complaint will be upheld. This is because by agreeing to use modelling for compliance assessment, the licensee accepts that predicted values do not necessarily match reality.

viii) No outline or details of compensation have been provided

Ofcom's view:

It is not possible in this Statement to give more detailed guidance on compensation. Each case will be considered on its merits.

ix) A draft licence for SUR based on modelling contains many obligations and restrictions but almost no rights for the use of spectrum. It does not even include any right to freedom from interference from other users exceeding their limits in their SURs

Ofcom's view:

An SUR licence gives a licensee the right to transmit within the specified band provided that the in-band, out-of-band and geographical (if appropriate) interference limits are not exceeded. If other users exceed their SUR limits then as discussed in the Statement, appropriate action will be taken.

x) Some stakeholders have concerns in using modelling as the basis of a contract when modelling is not an accurate reflection of reality

Ofcom's view:

Using modelling for compliance assessment is an option available to the licensee. Licensees who choose this approach for compliance assessment implicitly accept the inherent trade-offs that exist with a modelling approach – namely a simpler and faster verification process at the expense of reduced accuracy. Licence holders who are concerned about this can either express a preference for measurement, or can request different type of licence terms such as “block edge masks” which do not seek to control interference directly.

General

i) SURs are not suited for highly directional antennas

Ofcom's view:

Ofcom is in the process of investigating the suitability of SURs to adaptive antennas and traditional directional antennas used for example in fixed links services. Ofcom will report on its findings once they are available but does not foresee any difficulties.

ii) One of the respondents recommended that an EIRP mask is included in an SUR licence until the uncertainty with SURs is resolved.

Ofcom's view:

The inclusion of an EIRP mask in an SUR licence is a possible option that can be considered. Stakeholders and existing licensees applying for a change to an SUR licence can express a preference for this if they wish.

iii) Ofcom should provide a practical example by taking an existing network and show how it is compliant with an SUR regime.

Ofcom's view:

Ofcom intends to provide this for a possible network operating in the L-band.

iv) Ofcom should provide clear expected timelines for interference resolution.

Ofcom's view:

Given the complexity of each interference complaint case, it is not possible for Ofcom to provide definitive timelines for interference resolution. However, in all cases, Ofcom endeavours to resolve the complaint in an effective and timely fashion.

v) There is no evidence that Ofcom has seriously considered other approaches than the aggregate PFD.

Ofcom's view:

Prior to the publication of the SUR consultation, Ofcom has commissioned external consultants to look into a range of possible approaches to SURs. These were described in our SUR consultation document and the consultants' report is on our website. In addition, one resopdee suggested an alternative approach that we carefully evaluated and modelled and have discussed in Annex 3, Question 2.

vi) Procedures adopted by Ofcom need to address a third potential cause of interference, namely users that are not neighbours. They can cause interference due to spurious emissions at close proximity.

Ofcom's view:

Our position on the control of spurious emissions is given in Section 4 of this Statement.

Annex 5

Responses to issues raised in the 2.6 GHz consultation

Introduction

In December 2006, Ofcom consulted on the auction design and technical details of the 2.6 GHz (2500-2690 MHz, 2010-2025 MHz and 2290-2300 MHz³⁰) spectrum award. Ofcom proposed technical licence conditions based on the use of spectrum masks and SURs.

The consultation document included appropriate SUR parameters for the bands under consideration, a description of the methodology and assumptions used to derive the SUR parameters. Stakeholders were requested for their views on all of the above.

In this Annex, we focus on generic SUR responses rather than those related specifically to the 2.6 GHz award. Also, we avoid duplicating issues that have been raised in the responses to the SUR consultation documents. Note that the respondents' views are in italics

Ofcom's views on specific areas raised in the responses

1. A single set of SUR parameters is not sufficient to cover all of the UK. A range of SURs should be specified for different geo-types (e.g. urban, sub-urban, rural etc).

Ofcom's view:

Ofcom is minded not to define SURs for different geo-types, but rather have a single set of SUR parameters valid across a licensee's operational area. However, if licensees wish to have different PFD limits for each geo-type or different regions for that matter, they can submit a licence variation request to Ofcom which will assess the implications and decide on the appropriate course of action.

2. SURs abandon the principle of coordination. A respondent raised the issue that SURs appear to rely solely on the management of bands by modelling and measuring PFD levels and abandoning base station coordination.

Ofcom's view:

This is not the case as SURs do not preclude coordination among licensees.

3. SURs do not translate readily into emission mask requirements needed for the design and manufacture of transmitters.

Ofcom's view:

Under SURs, equipment manufacturers are still able to produce equipment according to prevailing standards. The onus is on the licensee to ensure that it meets its SUR parameters. This requires network planning including appropriate filtering and settings of certain system parameters, e.g. transmitter power, transmitter deployment etc.

³⁰ At present, only the 2500-2690 MHz and 2010-2025 MHz bands are under consideration in this award.

4. A number of stakeholders expressed concern that the probabilistic emission restrictions of SURs will allow neighbouring SUR licensees to deploy much higher power transmitters in a few locations and cause a greater risk of interference in certain parts of the licence area. An EIRP limit was proposed in conjunction with SURs to limit interference issues.

Ofcom's view:

The aggregate PFD approach proposed provides limits on the aggregate interference in a test area. In principle, this allows network density to vary by commensurately adjusting transmitter powers within an area. This does indeed allow the possibility of higher power transmitters to be deployed with a lower density network. This can lead to interference to receivers operating in an adjacent channel over larger areas around the transmitters, but there will be fewer of these areas than for a lower power network. Whether this is an issue will depend on the receiving equipment and the nature of the deployment. Our research suggests that while the area over which receivers may be blocked around a higher power transmitter is larger, the overall area blocked within a test area remains about the same, due to the reduced network density.

While we consider the risk of increased interference is small for the reasons outlined above, in some cases an EIRP limit may also be implemented. It will give greater certainty to prospective licensees in terms of the limits to interference that they may expect from any given transmitter and in terms of the likely measures required for coordination with neighbours in the network deployment process. This is achieved with a relatively small additional overhead. Hence our current SUR proposals allow for an EIRP limit to be specified in an SUR licence. The EIRP limit can be modified or removed at a later stage through negotiation between neighbours.