
Technical Policy Guidance for DAB Multiplex Licensees

Published as Annex 2 to Ofcom's Statement on Revisions to Digital Radio Technical Codes.

This is a marked-up version showing:

- a) the proposed changes to the 2014 revision of this document which were published as part of the February 2019 consultation, and
- b) the subsequent revisions to these proposed changes at the conclusion of the consultation process.

A 'clean' version of this document is available at:

<https://www.ofcom.org.uk/tv-radio-and-on-demand/information-for-industry/guidance/DAB-Technical-Policy-Documents>

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1. Introduction

- 1.1 This document is intended to give supplementary guidance to the technical provisions of individual licences awarded to radio multiplex licensees¹. It outlines what Ofcom expects to be its general approach in applying some of the provisions of the Digital Radio Technical Code, and in the approval of transmission proposals. Licensees should note that Ofcom cannot restrict in advance the way in which it will exercise its discretion, so it may be that Ofcom will take a different approach to the one outlined in this guidance in a particular case.
- 1.2 The areas of activity addressed in this document are:
- Multiplex technical management;
 - Approval of transmitter proposals;
 - Planning standards.
- 1.3 The document also provides commentary on other aspects of the Digital Radio Technical Code.

¹ This covers radio multiplex licences awarded under the Broadcasting Act 1996 (as amended), and the associated licences awarded under the Wireless Telegraphy Act 2006 to the radio multiplex licensees.

2. Multiplex technical management

Background

As well as the general duties applicable to all areas of Ofcom's work that are set out in section 3 of the Communications Act 2003, Ofcom also has duties and powers that relate specifically to radio multiplex licensing.

Ofcom has a wide discretion to include in radio multiplex licences such conditions as appear to Ofcom to be appropriate having regard to any duties that Ofcom or the licensee has under the Broadcasting Acts of 1990 and 1996 or the Communications Act 2003 (section 43(1)(a) of the Broadcasting Act 1996). Ofcom also has a specific power to include conditions enabling Ofcom to supervise and enforce technical standards in connection with the provision of the licensed service (section 43(1)(b) Broadcasting Act 1996).

Section 54 of the Broadcasting Act 1996 requires Ofcom to secure particular aims by imposing appropriate conditions in radio multiplex licences. One of the things that Ofcom is required to secure is that the signals carrying the radio multiplex service attain high standards in terms of technical quality and reliability throughout so much of the area or locality for which the service is provided as is for the time being reasonably practicable (section 54(1)(g) of the Broadcasting Act 1996).

Audio characteristics

- 2.1 Ofcom believes that whether a digital sound programme service is broadcast in stereo or mono is an important characteristic of that service, and as such any variations to these characteristics must be considered in accordance with the requirements of section 54(6A) or (6B) of the Broadcasting Act 1996.
- 2.2 We recognise that radio multiplex licensees require flexibility in how they allocate capacity, and do not seek to restrict this. In the vast majority of cases, the broadcaster and/or multiplex operator will be best placed to determine the characteristics of the services they are providing. We do not accept, however, that left to itself, the market will necessarily reflect the interests of consumers.
- 2.3 As a matter of general policy ~~for national and local multiplex licensees~~, Ofcom is likely to refuse a request for a change in audio characteristics only in cases where the capacity freed-up by the change is to be allocated to services which, in Ofcom's view, would not be in the best interests of citizens and consumers. Such an example may be where a multiplex licensee using its full capacity for stereo radio services proposes to reduce these radio services to mono, in order to allocate the permitted 30% data capacity to provide, for example, a closed user group service, and where we judge this would not be in the public interest.
- 2.4 We believe that such a move would generally (in respect of a national radio multiplex licence) unacceptably diminish the capacity of the programme services provided under

that licence to appeal to a variety of tastes and interests, or would generally (in respect of a local radio multiplex licence) unacceptably narrow the range of programmes available by way of digital sound programme services in the area. The policy is therefore designed to ensure that the multiplex as a whole – not an individual service – continues to cater for the overall tastes and interests of listeners.

2.5 ~~For the avoidance of doubt, the preceding Sections 2.1 to 2.4 of this document apply only to national and local radio multiplex licensees. The policy for the audio characteristics of future small scale DAB services is yet to be determined, as the detailed legislation enabling the establishment of a small scale DAB licensing framework has not yet been passed.~~

3. Approval of transmitter proposals

- 3.1 The location and characteristics of individual transmitters of a multiplex need to be agreed by Ofcom before a licence can be issued. The constraints applying to this decision are set out within the licence advertisement. These constraints are generally framed in relation to the avoidance of:
- interference to other users (elsewhere in the UK and abroad) which use the same frequency;
 - coverage beyond the licensed area; and
 - interference to other multiplexes in the same area ([through technical interactions known as 'Adjacent Channel Interference' and 'Blocking'](#))-
- 3.2 Section 4 provides further information on the first two points. This section provides guidance on Ofcom's approach to dealing with the third mechanism.

Adjacent channel interference and blocking

3.3 In considering applications by a licensee for a new transmitter site or the modification of an existing one, Ofcom will consider whether and to what extent this would lead to 'hole punching'² in the coverage of other multiplexes on adjacent-channel frequencies serving the same area. Licensees proposing transmitter sites will need to share their plans with other DAB multiplex licensees and seek their agreement prior to Ofcom considering the proposal.

General Principles

- 3.4 Parties that wish to build a new DAB transmitter must avoid causing undue interference to other multiplexes. The following steps are to be undertaken by all licensees wishing to implement a transmitter, prior to seeking Ofcom consent:
- Develop plans which do not cause undue interference to existing multiplexes
 - Carry out appropriate studies to quantify the risk that the proposed new transmitter presents in relation to any hole punching that might occur and assess the resulting scale of impact on listeners; and
 - Contact and liaise with national, local and small scale multiplex operators that provide coverage in the area to:
 - inform them of the proposal;
 - inform them of a possible source of future interference;
 - specify the likely impact of the proposal on their service;
 - allow them to consider implementing the site; and

² Where a transmitter site is not used by all DAB services available in the area, some receivers near the transmitter site may lose reception of some or all of the services not broadcast from that location. The effect is to punch a hole in the coverage of the victim service(s).

- gain their comments and, ideally, agreement on the use of the site.
- Subject to final Ofcom approval, inform national, local and small scale multiplex operators that provide coverage in the area of the date that the transmitter will be coming on-air.
- Several multiplex operators may submit a joint proposal that will enhance their coverage.

Site Selection Guidance

3.5 To avoid the need for costly mitigation techniques (such as providing a filler transmitter to restore coverage lost through hole punching) and to reduce the risk that other multiplex licensees object to a new transmitter, it is essential¹ important to avoid undue interference at the transmission network design stage.

3.6 The following factors have been identified as useful in avoiding undue interference:

- Use existing DAB transmission sites where possible.
 - Details of on-air DAB sites can be found on the Ofcom website at <https://www.ofcom.org.uk/spectrum/information/radio-tech-parameters>
 - Where a site exists but it is not viable to use it, the risk of interference can be reduced by choosing an alternative location which is as close as possible to, and at the same height, as the existing one.
 - If another service already operates a transmitter in the new service's planned area, that existing site might cause interference to the new service. Co-siting or near-siting will help to reduce any interference to the new service from existing ones.
 - Where reasonably practical, licensees should ensure that any new site they establish can be used by other operators should they wish to do so.
- Sites not located directly by populated areas and/or major roads generally have a lesser impact on other services.
- Low radiated powers have an impact over a smaller radius than higher ones.
- Locating transmitting aerials high above the ground helps to avoid interference at ground level.
- Multiple tier antennas help to reduce signal level close to the site and can therefore reduce the risk of hole punching occurring.

3.7 Conversely the following increase the likelihood of interference:

- Installing transmitting antennas at a low height.
- Using a high transmitter power.
- Building a transmitter in an area where the other multiplexes have modest signal levels
- Tower block sites where the antenna points toward other tower blocks.
- Using sites located close to housing in urban areas or adjacent to major roads.

3.8 Radio frequency engineering is a specialised activity and licensees that do not possess the necessary skills in-house should engage the services of a competent transmission contractor to assist in the selection, assessment and building of transmitter infrastructure.

Initial site assessment

3.9 In almost all cases a new site can be quickly classed by a ~~n-experienced~~ specialist (a suitably qualified and experienced engineer working with or for the proposing multiplex operator) into one of three categories:

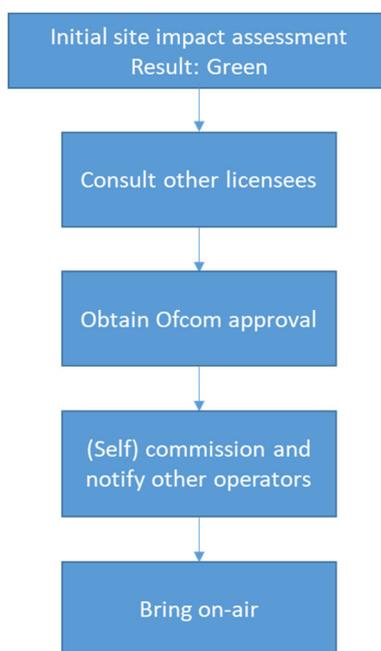
- **Green:** very unlikely to cause interference to other DAB services (e.g. co-sited with other DAB services or in an area unserved by any other DAB multiplex);
- **Amber:** having the potential to cause some interference to some DAB multiplexes (e.g. within the coverage of other DAB services and fairly near to housing or roads); or
- **Red:** expected to cause significant interference to other DAB multiplexes (eg. within the coverage area(s) of other DAB multiplexes and is close to densely populated areas or major roads).

3.10 The licensee will then need to take the steps below depending on the initial site assessment classification.

3.11 For **Green** sites, the licensee should notify other multiplex licensees that have coverage in the area where the transmitter is proposed to be located, providing details listed in Section 3.342 below. Having obtained any relevant agreements, the licensee must seek final approval from Ofcom before commissioning and bringing the transmitter on-air.

3.12 A diagram illustrating the main steps to be carried out for **Green** sites is shown in Figure 1 below

Figure 1: Process for Green sites

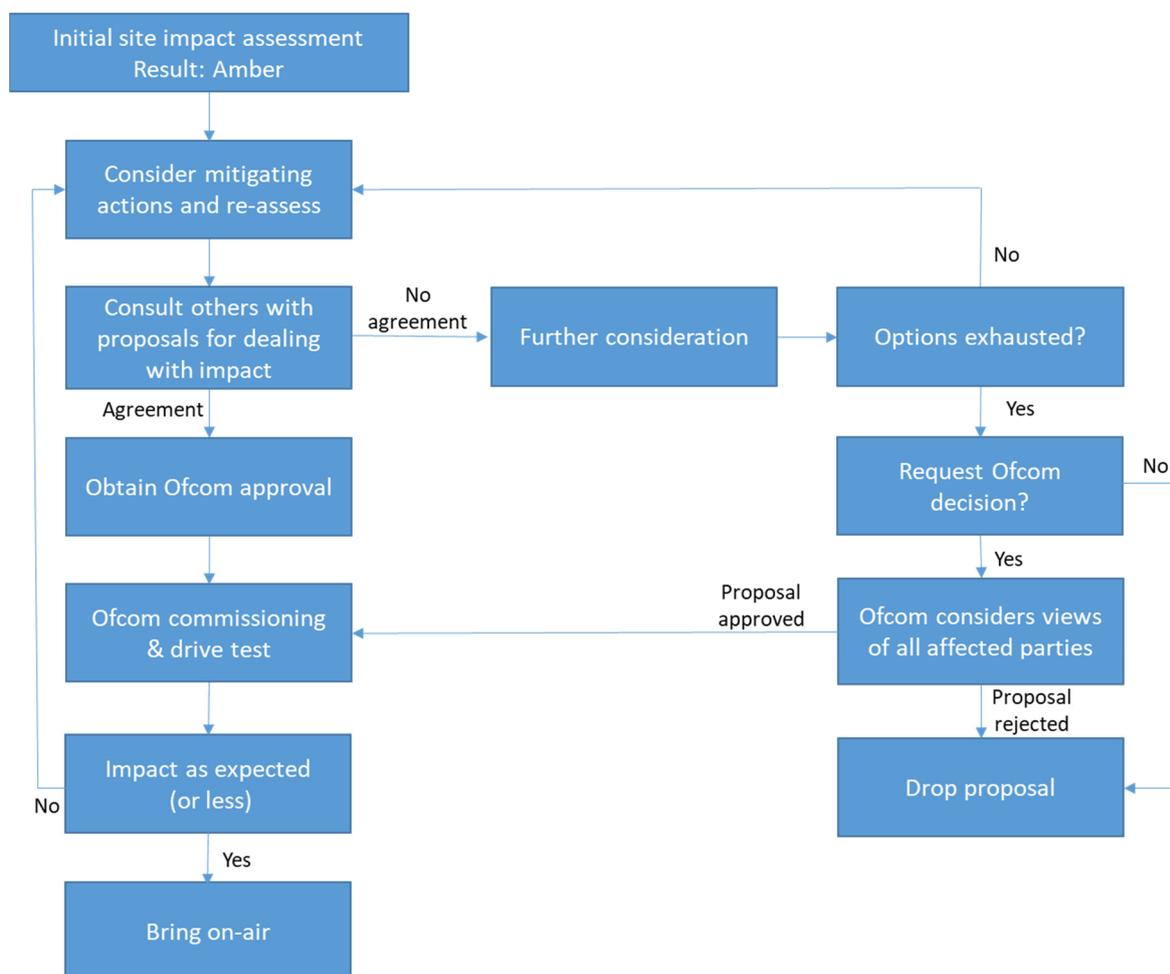


3.13 For **Amber** sites, the licensee should carry out an assessment of the likely impact that the new transmitter might have on the reception of other multiplexes and consider whether there are any mitigating measures that could be adopted to minimise the impact and can allow the site to be reclassified as **Green**.

3.14 The licensee should then notify other multiplex licensees that have coverage in the area where the transmitter is proposed to be located, providing details listed in Section 3.342 below and also the results of their coverage impact assessment. Further guidance on how to carry out the assessment and the types of information that could be provided in support of the assessment is given in Section 3.386 and following. Having obtained agreements from the impacted licensees, the licensee proposing the new transmitter must seek final approval from Ofcom.

3.15 A diagram illustrating the main steps to be carried out for **Amber** sites is shown in Figure 2 below.

Figure 2: Process for Amber sites



3.16 Proposals to build sites initially classified as **Red** do ~~will~~ not have to be considered by ~~either~~ other licensees and will not be considered by ~~or~~ Ofcom unless either:

- an appropriate mitigating measure has been identified to reduce the risk category to **Amber** (e.g. by re-locating the transmitter further away from affected listeners) or **Green** (e.g. by providing a filler transmitter for each of the affected multiplexes to restore lost coverage in the vicinity of the new transmitter); or

- the proposer gathers evidence that the real-world impact on other multiplexes will be **Green** (e.g. by carrying out drive tests or providing other supporting information as set out in Section 3.386 and following)

3.17 Proposals which remain classified as having **Red** impact on any multiplex will not be considered by other licensees or by Ofcom

Identifying the other multiplexes serving an area which need to be contacted

3.18 To identify those local and national DAB services which might be affected by a new service, proposers can find an initial indication of the DAB services available in the vicinity of the proposed site by using the online postcode coverage checker at <http://getdigitalradio.com/?slide=check-your-available-stations>.

3.19 Coverage maps for local DAB services can be found on the Ofcom website at <http://static.ofcom.org.uk/static/radiolicensing/mcamaps/DABmaps.htm>.

3.20 Ofcom will publish coverage maps for small scale DAB services once they come on-air. A link to that webpage will be added to this document in due course.

3.21 When considering the impact on other services only the coverage of on-air services within their licensed areas needs to be taken into consideration.

Liaising with other multiplex operators and sharing site information

3.22 Site proposals and any evidence to support the classification should be sent directly to other licensees. A list of multiplex licensee contact details can be found at <http://static.ofcom.org.uk/static/radiolicensing/html/radio-stations/digital/digital-multiplexes-main.htm>, and relevant contact details for the BBC are available direct from [Ofcom](#).

3.23 Proposers should provide the information set out in Section 3.342 below and any appropriate supplementary evidence set out in Section 3.386 and following.

Consideration of proposals and target response times

3.24 On receipt of a request to use a site classified as **Green**, the receiving multiplex operator should acknowledge the request within **seven** working days and give a full response to the proposal within **twenty** working days ~~must respond within **ten** working days giving agreement or outlining the reason(s) for their objection in their response. If no response is sent agreement will be assumed.~~

3.25 For new sites falling into the **Green** category where there is no service from other DAB multiplexes, there is no need for applicants to liaise with other multiplex operators and proposals may be sent directly to Ofcom.

3.26 On receipt of a request for an entirely new site that falls into the **Amber** category, the receiving multiplex operator should acknowledge the request within **seven** working days and give a full response to the proposal within **twentythree** working days. If the

receiving multiplex operator is unable to respond within ~~twenty~~thirty working days, their acknowledgement of receipt should clearly state the revised period within which they will be able to respond. This should not exceed **thirty-five** working days. ~~If no response is received after either twenty working days or a notified extended period, the receiving multiplex operator will be deemed to have agreed to the proposal. Ofcom should~~may be included as a copy recipient in the circulation of emails.

3.27 Ofcom may permit further extensions to the timescales above at its sole discretion in exceptional cases (e.g. staff illness).

3.28 If the recipient multiplex operator believes that relevant information is missing, the proposer must be informed immediately (by the acknowledgement stage at the latest). Re-submitted requests will be treated as new requests for the purposes of the target response times.

Agreement with multiplex operators and forwarding information to Ofcom

3.29 If the receiving multiplex operators are content with the proposed transmitter, the proposer may forward the details to Ofcom for final approval.

3.30 -If one or more multiplex operators do not agree to the proposed transmitter, the applicant should re-consider the mitigating measures set out in the Site Selection Guidance at Section 3.5 and following to reduce the impact on coverage of the other multiplexes. They should then re-submit their amended proposal to the other multiplex operators following the procedure in the previous section.

3.31 If it is not possible to reach agreement with the other multiplex operators, the parties can send details to Ofcom for a final decision. In considering operators' proposals Ofcom will give due consideration to the interests of consumers, both those that will gain new services and those that might lose access to existing services. In these circumstances, Ofcom will aim to come to a final decision on the proposal within thirty working days of receiving all relevant documentation and notification that the proposal is disputed or deadlocked.

3.32 Ofcom retains ultimate discretion to authorise or reject any proposal for a new transmitter on the grounds of ACI/blocking risk.

3.33 If the transmitter proposal is approved following Ofcom's final decision, details of the approved transmitter proposal will be added to the relevant licences, which has the effect of authorising the transmitter to be brought into programme service.

Approval of transmitter proposals

Information to be provided to other multiplex licensees

3.34 The proposer must inform other multiplex operators of their ~~intention~~plans to implement a transmitter and provide the details listed in Annex A1. This includes cases where the other multiplex operates a transmitter at the same location. In all cases Ofcom will require sight of agreements from other multiplex operators, including (where provided)

agreements for sites categorised as **Green**, before it will allow the site to come into operation.

3.35 Coverage and transmission arrangements often vary between on-air multiplexes. Consequently, a proposed new transmitter site may have a different impact on each of the multiplexes operating in the area. For example, the proposed site may have no impact on national services (**Green** category) but a significant one to a local service (**Amber** or **Red** category).

3.36 To assess the likely impact of a new site, computer predictions can provide a good guide. However, computer modelling is not always completely accurate as localised reception conditions can vary significantly from those assumed by the model. Therefore, in all cases proposers can employ alternative methods to quantify the ‘real world’ impact on listeners. Ofcom and other multiplex licensees will consider such evidence when considering whether to agree to the building of a new transmitter. Further information is provided in Section 3.36 and following.

Table 1 – Site impact classifications

Category	Typical situations and information required
Green (No or very little impact expected)	<p>Examples of this will be:</p> <ul style="list-style-type: none"> • <u>Where the other multiplex operator is using the proposed site or one within 250m of it.</u> • <u>Where other services are using the site at higher powers and / or closer frequencies</u> <p>Information required:</p> <ul style="list-style-type: none"> • <u>Site details</u> <ul style="list-style-type: none"> - <u>The site name</u> - <u>The Ordnance Survey national grid reference (in AB 123 456) format</u> - <u>Site height in metres</u> - <u>Antenna height in metres</u> - <u>Antenna radiation pattern & number of tiers</u> - <u>Photographs showing the antenna location point and the view, in all directions from the antenna mounting point</u> - <u>Effective radiated power</u> - <u>Frequency block</u> - <u>The site address, including postcode where possible</u> - <u>Other multiplex operators that use the site (or adjacent ones)</u>

	<ul style="list-style-type: none"> • Full Brief details of why the site has been categorised as Green. • Details of any other multiplexes already using the site or an adjacent one.
<p>Amber (Some impact expected)</p>	<p>Examples of this will be:</p> <ul style="list-style-type: none"> • Areas at the coverage edge of the other service. • At existing sites where higher powers or closer frequency relationships will be present <p>Information required:</p> <ul style="list-style-type: none"> • Site details <ul style="list-style-type: none"> - The site name - The Ordnance Survey national grid reference (in AB 123 456) format - Site height in metres - Antenna height in metres - Antenna radiation pattern & number of tiers - Photographs showing the antenna location point and the view, in all directions from the antenna mounting point - Effective radiated power - Frequency block - The site address, including postcode where possible - Other multiplex operators that use the site (or adjacent ones) • BriefFull details of why the site has been categorised as Amber. • Assessment of the impact on listeners including supplementary supporting information to support the proposal (see Section 3.38 and following below).
<p>Red (Significant impact expected)</p>	<p>Examples of this will be where:</p> <ul style="list-style-type: none"> • A new site in a town or village is proposed. • A site next to a motorway or 'A' road is proposed. <p>Proposers should not expect to either send or receive a proposal that falls in the Red category. Where there is a significant impact the proposer should either mitigate the impact (for example by changing transmission parameters to reduce the impact) or offer to provide a low power filler transmitter for the victim service(s). Alternatively, the option of seeking a different site could be investigated.</p>

	<p><u>Such a site might be proposed as part of a wider plan with other multiplex operators to improve coverage or where multiple operators propose to share a site. In such cases Ofcom will need to consider the impact on listeners of the overall package of changes.</u></p>
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3.33.37 Failure to provide all relevant information about the proposed site is likely to extend the time taken to reach agreement, as existing multiplex operators may reject incomplete requests at the acknowledgement stage. To ensure that all the required information is provided Ofcom has produced a separate check sheet which can be found in Annex A1 of this document.

Information to be provided to Ofcom

3.43.38 Following consultation with other multiplex licensees, the proposer should forward the information above together with copies of agreements (or otherwise) obtained through the liaison process to Ofcom for consideration. Final approval of all site proposals must be given by Ofcom before new sites can be brought into service.

Assessing listener impact and providing supplementary information

3.39 There are several measures that proposers can adopt to assess the likely impact of their proposal in order to avoid causing undue interference to other multiplexes. These are described in the sections below.

Computer modelled predicted impact

3.40 Predictions of the impact that a transmitter may have on reception of other multiplexes in the vicinity can be produced by using a suitable prediction tool. The tool will need to take account of the transmission parameters of each of the multiplexes providing a service in the area, as well as the proposed new transmitter and likely characteristics of in-home and car receivers.

3.41 As mentioned previously, proposers should note that, due to the numerous factors involved, computer modelling does not always give an accurate assessment of the real impact of a new site. They should therefore be used as a guide rather than definitive evidence.

3.42 Proposers are advised to take the following into account when carrying out impact modelling to ensure the predictions are as accurate:

- a) Choose a model that uses appropriate propagation algorithms³ for calculating field strengths from both existing and proposed sites;
- b) Use terrain and clutter data with a resolution of 100 metres or less;
- c) Take transmitter parameters for existing services from Ofcom's database here <https://www.ofcom.org.uk/spectrum/information/radio-tech-parameters>;
- d) Include the antenna patterns for existing and proposed transmitters in predictions;
- e) Where relevant, take account of SFN gains arising where transmitters operate as part of a Single Frequency Network;
- f) The figures in Table 2 below can be assumed for the protection margins for receivers in different environments; and
- g) The population affected by the proposed new site should be derived from 2011 census data. A data set ~~is available~~ for this assessment will be available at <https://www.ofcom.org.uk/tv-radio-and-on-demand/information-for-industry/guidance/DAB-Technical-Policy-Documents> here: ~~[link to be provided]~~

³ A free space field strength calculation may be sufficient for signals travelling short distances of a few hundred metres. For longer paths, a propagation model appropriate to VHF frequencies and the UK environment including terrain height and surface clutter is preferable.

Table 2 - Protection Margins for different Adjacent Channel Interference conditions

<u>Outdoor percentage locations, %</u>	<u>Indoor percentage locations, %</u>	<u>Protection margin, dB</u>		
		<u>1st adjacent</u>	<u>2nd adjacent</u>	<u>≥3rd adjacent</u>
<u>99</u>	<u>96.0</u>	<u>-22</u>	<u>-27</u>	<u>-32</u>
<u>95</u>	<u>89.2</u>	<u>-26</u>	<u>-31</u>	<u>-36</u>
<u>90</u>	<u>83.2</u>	<u>-28</u>	<u>-33</u>	<u>-38</u>

Measurements and drive tests

3.43 Drive tests of the area surrounding a proposed transmitter site with a logging receiver and suitable aerial will enable the proposer to gather data on the signal levels of the other multiplexes in the area. These can be used in combination with predictions of the likely signal level from the proposed new transmitter to assess whether there will be an impact on listeners in-home or in cars in the area. Alternatively, drive tests can be carried out during test transmissions from the proposed new transmitter location to measure the actual impact on reception in the area (see section 3.4936 and following on Listener impact tests).

3.44 To be of most use, a test receiver capable of continuous signal logging should be used that records the following for each multiplex providing a service in the area:

- Location (from a GPS reference) at which each measurement is made
- Field strength at that location
- Bit error rate at that location

3.45 Data from these measurements can be used to produce ‘coloured trail’ maps of the signals from existing services. Examples of such maps are available in Annex I of the EBU document ‘Guidelines for DAB Network Planning’⁴.

3.46 If a test transmitter is used (or the measurements are being undertaken to confirm the impact following installation and commissioning of a transmitter), then measurements of each multiplex should be carried out with and without the test or new transmitter on air. Coloured trail maps can then be produced to illustrate clearly where reception has been degraded by the new transmitter and to confirm where it has not. Assessment of degradation can be through logging bit error ratio, locations where receiver loses reception, or by comparing signal levels.

3.47 Any drive test measurements should be recorded electronically and made available to other multiplex operators as part of the liaison process. The results should be accompanied by a brief narrative report which clearly explains the findings of the tests.

⁴ EBU Tech 3391, <https://tech.ebu.ch/docs/tech/tech3391.pdf>

3.48 Further information on the prediction and measurement of the impact of a new transmitter is available in a report published by the European Broadcasting Union⁵, at <https://tech.ebu.ch/publications/tech3391> (see particularly section 5.2.1.2 and Annex I).

Listener impact tests

3.49 Any licensee may carry out a site test or fully implement a site on a trial basis to assess the impact it might have on other services. This option can be used to gather the information described in Section 3.36 on real world impact required to be provided to other licensees and Ofcom for **Amber** or re-classified **Red** sites. Building the transmitter would be at the sole risk and expense of the licensee and the implementation of a site does not mean that Ofcom will allow it to continue operating after testing. If the proposer wishes to proceed with carrying out a trial transmission, the following procedure must be followed.

- The trial transmitter must be correctly licensed, and Ofcom must agree to the trial before it goes ahead.
- The installation must be commissioned and use equipment that is compliant with the Ofcom Digital Radio Technical Code.
- Any licensee that might be affected must be informed at least two weeks before the test transmissions commence. [The potentially-affected licensee\(s\) may require that tests are scheduled to avoid certain programming periods or special events.](https://tech.ebu.ch/publications/tech3391)
- Any other relevant licensee that wishes to carry out their own reception tests during the test transmission period must be allowed to do so.
- Tests should last no longer than six hours.
- If there is a significant impact on listeners in the area, Ofcom may require the test transmission to cease immediately.
- Following the test transmissions, feedback from other multiplex operators in the area should be sought and a test report should be produced and circulated to these other multiplex operators and to Ofcom.

3.50 In the event of significant impact, the licensee of the new site may be required to put in place measures to restore some, or all, of the lost reception. The transmitter must be turned off while the required remedies are implemented. Some options to achieve this might include one or more of:

- Reduce the power of the transmitter.
- Modify the antenna system.
- Move the site.
- Provide filler transmitters for the victim services.

⁵ EBU Tech 3391, <https://tech.ebu.ch/publications/tech3391>

- 3.5 — Ofcom organises and chairs a group, the Joint Planning for Radio Group (JPRG) representing all its digital radio multiplex licensees⁶, which it uses to develop its policies on digital radio spectrum management.
- 3.6 — Management of Adjacent Channel Interference (ACI) has in the past been achieved through two measures:
- a memorandum of understanding between Ofcom and industry that sets out the basis upon which ACI impacts were assessed; and
 - a list of transmitter sites and associated characteristics⁷ (known as the Reserved Assignments List or RAL) which and within which any licensee may expect to be able to secure Ofcom's agreement to develop, subject to compliance with all other requirements of the licence.
- 3.7 — Ofcom has discussed roll-out plans with the commercial DAB multiplex operators and the BBC through the Ofcom chaired Joint Planning for Radio Group (JPRG). All of the participants have indicated a desire to move to a more streamlined approach to dealing with ACI. The fundamental principle agreed by the JPRG members is that the multiplex operators be given freedom to coordinate their roll-out plans and manage the impact of ACI that might arise from new transmitter sites through liaison amongst themselves.
- 3.8 — Ofcom will consider proposals, taking into account the potential impact upon listeners where ACI is predicted to occur. If the DAB multiplex operators are unable to come to agreement on a proposed site, the final decision will be made by Ofcom.
- 3.9 — We have therefore agreed with industry that the previous Memorandum of Understanding be dissolved and to adopt the processes detailed below for dealing with the potential impact of ACI. The DAB transmitters currently in use form the basis of a new list of Reference Sites that contains details of the transmitters already in service and a list of those anticipated to be built to expand coverage of the national and local multiplexes. The list of Reference Transmitters will be available on Ofcom's website.

General Principles

- 3.10 — The following steps are to be undertaken by all operators wishing to implement a transmitter, prior to seeking Ofcom consent.
- 3.11 — All operators should endeavour to:
- share existing sites wherever practicable;
 - minimise any additional interference to other multiplexes;
 - where reasonably possible ensure that sites can be used by other operators should they wish to do so;

⁶ a representative of each of the companies which have a majority shareholding, and their transmission contractors, and the BBC.

⁷ except that a unique frequency is in many cases not specified

- engage in studies in order to investigate and resolve differences between the proposed an actual impact of transmitter implementations; and
- contact and liaise with national and local multiplex operators in order to:
 - inform them of the likely impact of the proposal;
 - to inform them of a possible source of future interference;
 - enable them to implement the site in order to minimise ACI; and
 - gain their agreement to use of the site.

Approval of transmitter proposals

3.12 — Copies of agreements (or otherwise) obtained under 3.10.5 should be forwarded to Ofcom.

3.13 — Ofcom will have final approval of all site proposals before they can be brought into service. In considering operators' proposals Ofcom will also take into account the interests of consumers.

Procedure for assessing the impact of adding a DAB multiplex to an existing transmission site

3.14 — Figure 1 below illustrates the process for giving consideration to a proposal to add a multiplex to an existing DAB transmission site. The process is also described below. In all cases the impact on both household and road coverage will be calculated.

The 'A' calculation: The interference from the proposed transmitter

3.15 — The potential interference caused to the coverage of all national multiplexes should be calculated.

3.16 — The potential interference caused to the coverage of all local multiplexes in the vicinity of the site should be calculated. Only the household and road coverage within the licensed area of the victim service(s) will be taken into account.

The 'B' calculation: The interference from the existing transmitter(s)

3.17 — The existing interference caused to the coverage of all national multiplexes should be calculated using the method agreed by the JPRG.

3.18 — The existing interference caused to the coverage of all local multiplexes in the vicinity of the site should be calculated. Only the household and road coverage within the licensed area of the victim service(s) will be taken into account.

3.19 — If the impact of the existing site on each of the existing multiplexes is greater than the impact from the proposed one, site implementation will normally be allowed.

The 'C' calculation: The reduced impact on the proposing service

3.20 — The proposed transmitter will normally reduce the impact of the existing one on the proposing multiplex. Calculate the number of households and roads that will no longer

suffer from adjacent channel interference. In many cases this value will be similar to that calculated for 'B' above.

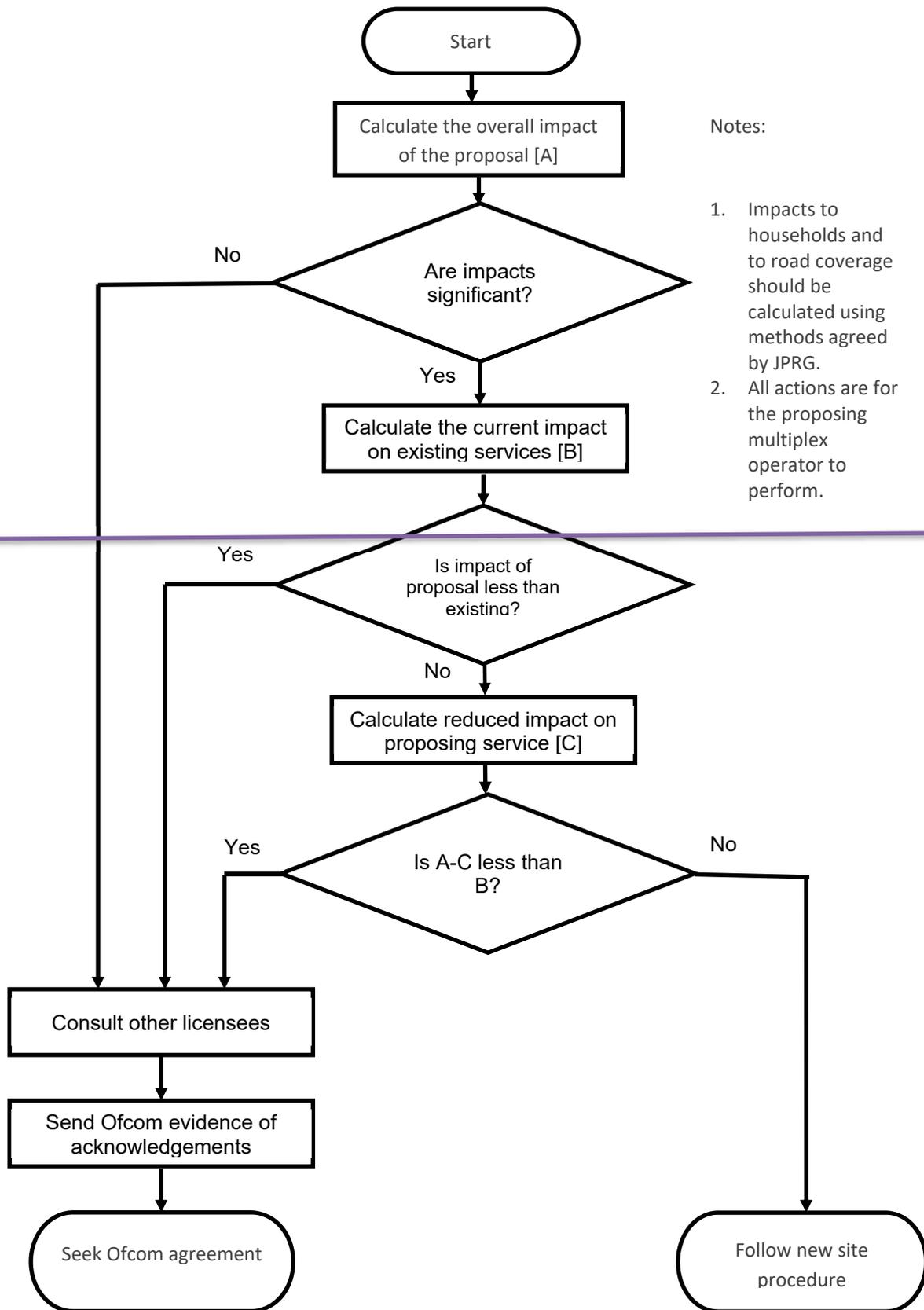
3.21 — If the proposed site rectifies the existing adjacent channel hole and does not cause a significant increase in ACI to the remaining multiplex(es) that are not co-sited it will normally be allowed.

3.22 — Otherwise the proposing multiplex operator should consider ameliorating actions including the provision of a hole filling relay.

Liaison with other multiplex operators

3.23 — Even where the impact on other multiplexes is low, the proposing multiplex operator should inform other multiplexes of the intention to bring a new transmitter site into operation prior to seeking Ofcom consent. The proposing multiplex operator should provide Ofcom with evidence that appropriate consultation has taken place when submitting an application for consent.

Figure 1—Existing site procedure



Procedure for assessing the impact of adding a DAB multiplex to a new transmission site

General requirements

3.24 — Operators who wish to implement new sites should endeavour to adopt the following principles:

- to minimise the interference to other multiplexes;
- where reasonably possible, to ensure that the site can be used by other operators should they wish to do so; and
- to contact all national and any local multiplex operators in order to gain their agreement to the use of the site and to inform them of a possible source of future interference.

3.25 — Copies of agreements reached with the other multiplex operators under 3.22.3 should be forwarded to Ofcom.

3.26 — Figure 2 illustrates the process for giving consideration to a proposal to add a multiplex to a transmission site not used for DAB. The process is also described below. In all cases the impact on both household and road coverage will be calculated.

ACI calculation: the interference from the proposed transmitter

3.27 — The interference caused to the coverage of all national multiplexes should be calculated using the method agreed by the JPRG.

3.28 — The interference caused to the coverage of all local multiplexes in the vicinity of the site should be calculated. Only the household and road coverage within the licensed area of the victim service(s) will be taken into account.

Assessment of impact

3.29 — If the interference to victim services is not significant the proposer should seek Ofcom agreement.

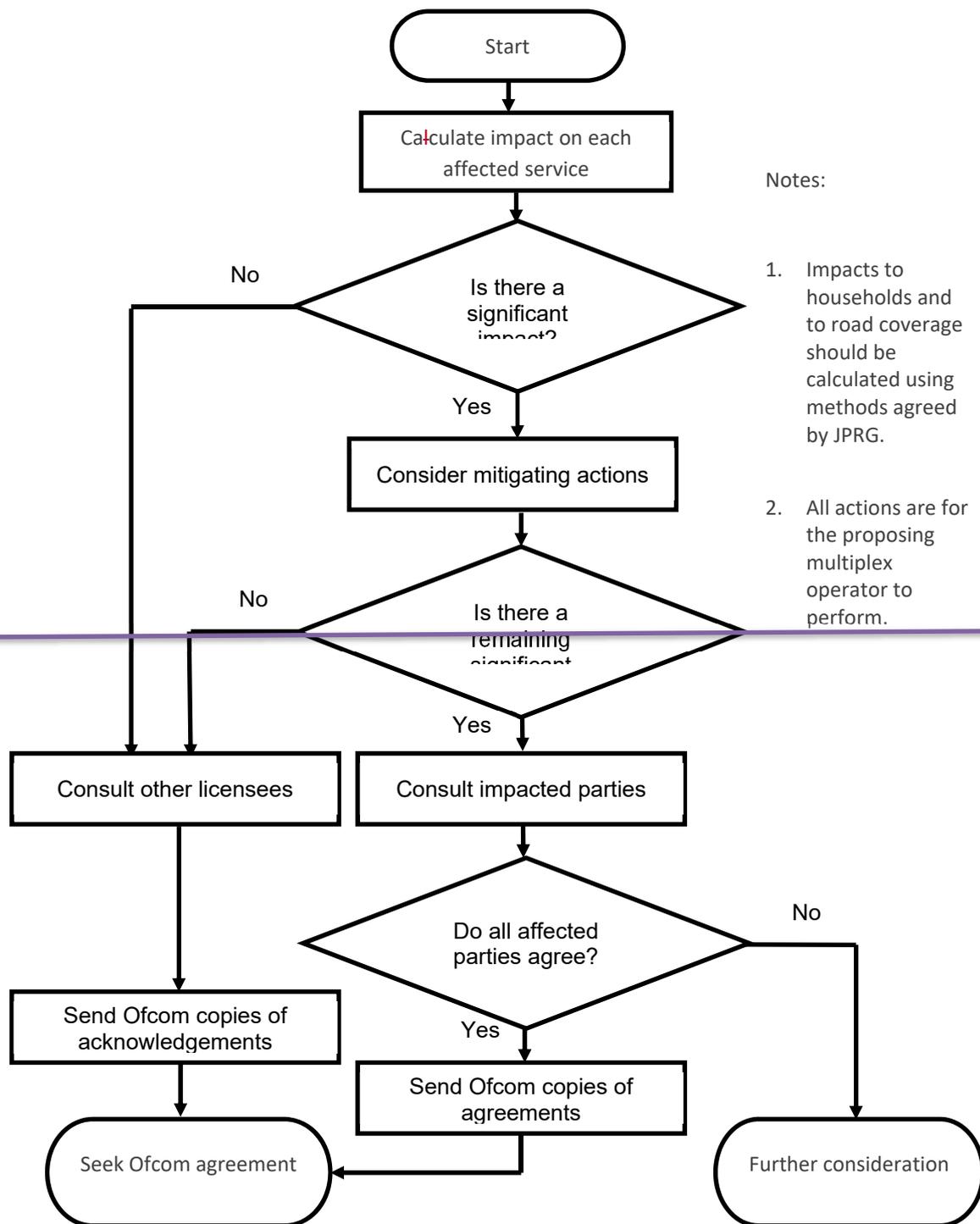
3.30 — If the interference is significant the proposer should:

- reconsider the application; and
- propose ameliorating actions which may include the provision of a ‘hole filling’ relay.

Liaison with other multiplex operators

3.31 — Even where the impact on other multiplexes is low, the proposing multiplex operator should inform other multiplexes of the intention to bring a new transmitter site into operation prior to seeking Ofcom consent. The proposing multiplex operator should provide Ofcom with evidence that appropriate consultation has taken place when submitting an application for consent.

Figure 2—New site procedure



4. Planning Standards: wanted coverage and interference protection

- 4.1 In assessing licence applications, Ofcom has to take a number of statutory criteria into account in deciding whether and to whom to award a multiplex licence. One of these is the extent of coverage provided.
- 4.2 Ofcom assesses the extent of coverage delivered in terms of two modes of reception; ‘mobile’ and ‘portable indoor’, at each 100m x 100m square of territory within the licence area. All coverage assessment will be carried out on the basis of level 3 error protection being used, specifically unequal error protection level 3 or UEP-3 for DAB services and equal error protection level 3A or EEP-3A for DAB+ services.
- 4.3 The methods and thresholds used to produce the coverage predictions were developed as part of the work carried as part of the Government’s Digital Radio Action Plan⁸, the purpose of which was ‘to provide the information to allow for a well-informed decision by Government on whether to proceed with a radio switchover’.
- 4.4 Ofcom was asked to chair a DAB coverage and spectrum planning group to determine the current level of FM coverage and develop a range of options to increase DAB coverage to match FM. The assumptions and thresholds were published in our May 2012 Report to Government on DAB Coverage Planning⁹.
- 4.5 The assumptions are also summarised as below:

Mobile Coverage

- 4.6 Coverage in a mobile environment will be assessed in terms of the number of kilometres and percentage of ‘A’ roads and motorways within the licence area that receive a field strength of at least 54 dB(µV/m) at 10m above ground level. The derivation of this field strength is given in Table 31 below.

Table 31: Derivation of Minimum Median Field Strength for In-Car Reception

UEP		3
Noise bandwidth	(MHz)	1.5
Thermal noise	(dBm)	-112.22
Required C/N	(dB)	8.4

⁸ Government’s Digital Radio Action Plan:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/270375/Digital_Radio_Action_Plan_v10_5_.pdf

⁹ DAB Coverage Planning – Report to Government 2 May 2012 :

http://stakeholders.ofcom.org.uk/binaries/broadcast/radio-ops/coverage/DAB_Statement.pdf

Receiver noise figure	(dB)	7
Rayleigh implementation margin	(dB)	4.6
Minimum receiver signal level	(dBm)	-92.2
Frequency	(MHz)	220
Wavelength	(m)	1.36
Receiving antenna gain	(dBi)	-2.9
Required field strength	($\mu\text{mV/m}$)	54.6
Required field strength	(dB $\mu\text{V/m}$)	34.7
Height Gain	(dB)	10
Required percentage of locations	(%)	99
Inverse Normal function	For 99% locations	2.33
Outdoor Location Variation	(dB)	4.0
Additional field strength required	(dB)	19.3
Minimum Median Field Strength	(dB $\mu\text{V/m}$)	54.0

Indoor coverage

4.7 To define coverage to portable receivers within an indoor environment account will be taken of the penetration loss of the building type around the reception point. This will be considered to be either suburban or dense urban and the losses for each category are given in Table 42 below.

Table 42: Building Penetration Loss

Building Type	Median Penetration Loss (dB)	Standard Deviation of Penetration Loss (dB)
Suburban	8	4.4
Dense Urban	15	5

4.8 Indoor coverage will be assessed in terms of the number of households within the licence area that receive a field strength of at least between 63 and 68 dB $\mu\text{V/m}$ in suburban areas and 70 and 75 dB($\mu\text{V/m}$) in a dense urban area. The lower of these pairs indicate a useful service and the latter a robust one. These signals are being received at 10m above ground level. The derivation of these field strengths is given in Table 53 below.

Table 53: Derivation of Minimum Median Field Strength for Indoor Reception

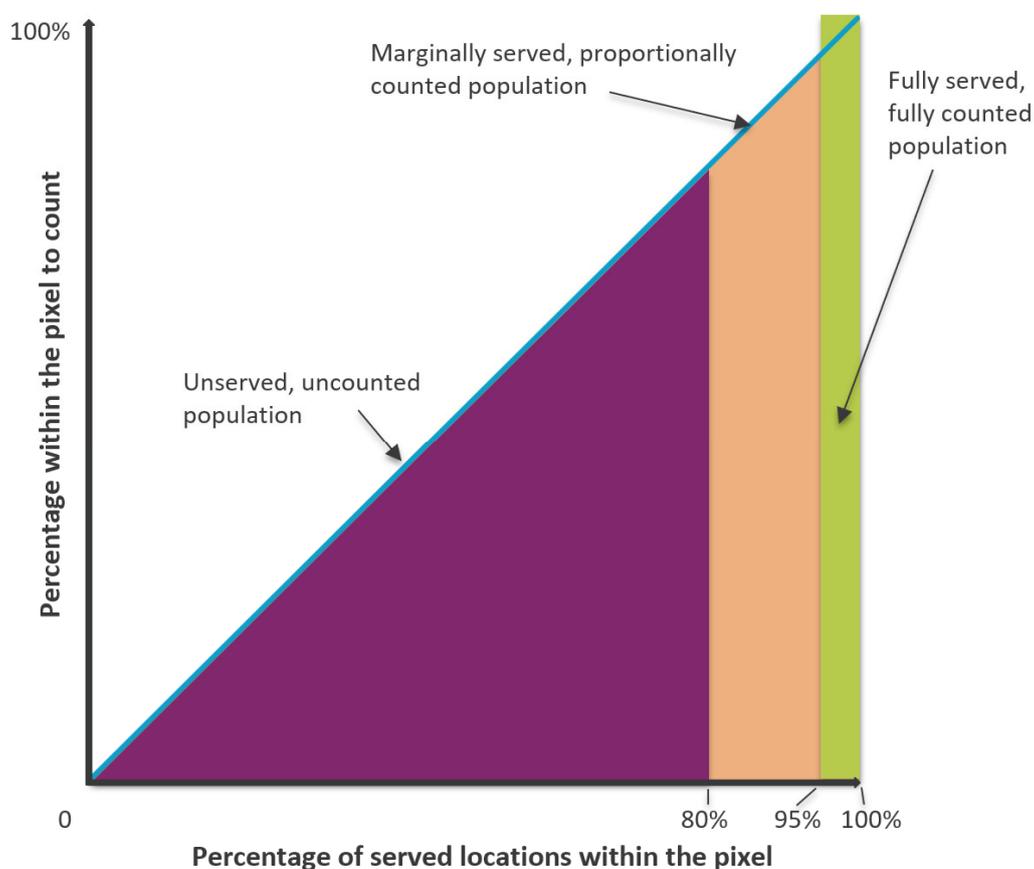
UEP		3			
Reception environment		Suburban		Dense Urban	
Reception quality		Useful	Robust	Useful	Robust
Noise bandwidth	(MHz)	1.5	1.5	1.5	1.5
Thermal noise	(dBm)	-112.22	-112.22	-112.22	-112.22
Required C/N	(dB)	8.4	8.4	8.4	8.4
Receiver noise figure	(dB)	7	7	7	7
Rayleigh implementation margin	(dB)	4.6	4.6	4.6	4.6
Minimum receiver signal level	(dBm)	-92.2	-92.2	-92.2	-92.2
Frequency	(MHz)	220	220	220	220
Wavelength	(m)	1.36	1.36	1.36	1.36
Receiving antenna gain	(dBi)	-8.1	-8.1	-8.1	-8.1
Linear Gain		0.155	0.155	0.155	0.155
Required field strength	($\mu\text{mV/m}$)	99.4	99.4	99.4	99.4
Required field strength	(dB $\mu\text{V/m}$)	39.9	39.9	39.9	39.9
Building Penetration Loss	(dB)	8	8	15	15
Height Gain	(dB)	10	10	10	10
Required percentage of locations	(%)	80	95	80	95
Inverse Normal function		0.84	1.64	0.84	1.64
Outdoor Location Variation	(dB)	4.0	4.0	4.0	4.0
Building Penetration Loss SD	(dB)	4.4	4.4	5.0	5.0
Composite Location variation	(dB)	5.95	5.95	6.4	6.4
Additional field strength required	(dB)	23.0	27.8	30.4	35.5
Minimum Median Field Strength	(dB $\mu\text{V/m}$)	62.9	67.7	70.3	75.4

4.9 In addition a cut-off and proportional method of coverage counting will be used to calculate the total population that receives a DAB service. This will be assessed using the predicted percentage of locations for each pixel as detailed in Table 64 and Figure 3 below

Table 64: Proportional counting thresholds

Percentage of pixel locations served	Percentage of pixels population considered served
95% or greater	100%
80% to 94% inclusive	Between 80% and 94% in proportion to locations served ¹⁰
79% or fewer	0

Figure 3: Diagrammatic representation of the proportional counting thresholds



4.10 In all cases the 100m x 100m square must also be (calculated to be) adequately free from interference. These assumed values for wanted coverage are taken as the basis of Ofcom’s interference protection practice (see section below).

¹⁰ For example if the pixel is predicted to have 85% of its locations served then 85% of the population in the pixel will be considered to be served.

Licensed areas

- 4.11 Another statutory requirement placed on Ofcom is to define for each radio multiplex an area for which a service is licensed, i.e. a 'licensed area'. Ofcom believes it is most appropriate for licensees to be responsible for network planning and delivering coverage within the minimum of constraints necessary in order to properly address statutory requirements, and the integrity of the licence award process. At the technical level Ofcom gives effect to the principle of the 'licensed area' by defining a geographical area, known as the 'licensed area', within which Ofcom will take steps to control the extent of interference to the licensed service.
- 4.12 The concept of a 'licensed area' is set out in the 1996 Broadcasting Act, in establishing the statutory criteria which Ofcom applies in its licensing of digital radio multiplex licences. In respect of local radio multiplexes, the 'licensed area' is described by Ofcom to reflect its views of what constitutes a coherent local area, consistent with the intentions of legislation, and consistent with Ofcom's statutory duties as specified in the Communications Act of 2003.
- 4.13 The relevance of the licensed area includes that it defines the area within which Ofcom will apply measures to protect the relevant service from interference to the extent practicable.

Co-channel interference

- 4.14 In calculating freedom from co-channel interference, the assumptions include that the interfering signals propagate in conditions corresponding to those believed to apply in the least favourable circumstances and which occur only over 1% of the time. A protection margin of 25 dB is applied between wanted and unwanted signals.
- 4.15 It is assumed that an area of analysis is still served if the median interfering field strength is 25 dB lower than the median of the wanted signals. This margin is derived as follows:
- Receiver protection ratio: 10 dB
 - Planning margin for 99% location availability: 15 dB
- 4.16 The planning margin is derived theoretically as $(4.0 \times 2.33 \times \sqrt{2}) = 13.2$ dB, assuming both wanted and unwanted signals are Gaussian distributed with standard deviations of 4.0 dB, and have a correlation coefficient of 0. However, field tests have indicated that a margin of 15 dB provides a practical achievement of 99% availability in a number of different measurement scenarios, in other words, taking account of the fact that the standard deviation or correlation coefficients may depart from the assumed figure.
- 4.17 In applying what are general limits to the maximum allowable field strength from one area's network into the protected area of another co-channel service, some account is taken of the fact that most of the wanted service area receives a wanted signal at a significantly higher level than the lowest workable value. In general, there is a positive correlation; where unwanted signals are higher, then so are the wanted signals. Therefore, a 10 dB margin is added to the threshold of allowable interference. If maximum

interference into the area is kept to this higher threshold, which tends to 'bite' first on higher, more exposed ground, then the levels in the generality of the area will be lower.

Adjacent channel interference

- 4.18 Measures to protect reception from adjacent channel interference are only applied within the licensed areas of the services concerned (see Section 3 above).

Note on Unequal Error Protection (UEP)

- 4.19 In order to ensure consistency when making coverage predictions, we propose that all DAB coverage assessment will be carried out on the basis of Unequal Error Protection level 3 (UEP-3) being used. ~~We therefore propose to amend Section 3.14 of~~ the Digital Radio Technical Code ~~to require~~s that unless otherwise agreed with Ofcom, all transmissions will use UEP-3 for audio and UEP- 3A for data services. The DAB+ standard does not support unequal error protection and all services are transmitted with equal error protection (EEP). Consequently ~~Section 3.15 of the Digital Radio Technical Code Ofcom proposes requires~~ ~~that~~ all DAB+ transmissions ~~must to~~ use EEP-3A.
- 4.20 Where licensees apply to use UEP-1 or UEP-2, this may be agreed by Ofcom on a case by case basis. However, licensees should be aware that if at a later date the licensee wishes to reduce the level of error protection Ofcom may require that any resulting loss of coverage (and therefore listener disenfranchisement) to be mitigated.
- 4.21 As UEP-3 forms the basis of our coverage planning and interference assessment criteria unless already agreed with Ofcom, we will not allow services to reduce the UEP used below this level (i.e. to UEP-4 ~~or UEP-5~~). This is to ensure a consistent user experience and stability for the receiver market.

A1. Example site details check sheet

Proposal to implement a new DAB site at: *[Enter Site name]*

	<u>Information</u>	<u>Details / confirmation</u>
<u>Proposer details:</u>	<u>Licensee name</u>	
	<u>Contact name:</u>	
	<u>Contact address:</u>	
	<u>Contact phone number(s):</u>	
	<u>Contact email:</u>	
<u>Recipient multiplex operator:</u>	<u>Name:</u>	
	<u>Licence area:</u>	
	<u>Frequency block:</u>	
<u>ACI site Red / Amber / Green categorisation:</u>	<u>Green / Amber / Red</u>	
	<u>Provide a full assessment detailing why this site has been categorised as 'Green' or 'Amber'. Why has this category been given?</u>	
<u>Site details:</u>	<u>Site address & postcode:</u>	
	<u>Grid reference (in AB 123 456 format):</u>	
	<u>Site height in metres:</u>	
	<u>Aerial Height in metres:</u>	
	<u>Antenna type:</u>	
	<u>Number of antenna tiers:</u>	
	<u>Is antenna?</u>	<u>Directional / Non-directional</u>
	<u>If antenna is directional supply pattern</u>	
	<u>Effective radiated power in Watts:</u>	

	<u>Frequency block:</u>	
	<u>Photographs required:</u>	<u>Site location:</u>
		<u>Antenna location:</u>
		<u>360 view:</u>
<u>Other users:</u>	<u>Is this site or one within 250m already used by another multiplex(es)?</u>	<u>Yes / No</u>
	<u>If Yes:</u>	
	<u>Which one(s)? Give name & frequency block of each:</u>	
	<u>Are you sharing an existing antenna? If so which one:</u>	
	<u>Is your effective radiated power higher than the multiplex on the closest frequency block? If so what is the difference:</u>	<u>Yes / No</u> <u>X.X dB higher</u>
<u>Additional information for Amber category sites regarding the predicted site impact:</u>	<u>Prediction map indicating area likely to be affected:</u>	
	<u>Results of computer planning tool impact prediction (if available)</u>	
	<u>Details of the population and / or roads likely to be affected:</u>	
	<u>File of receiver measurements taken:</u>	
	<u>'Coloured trail' map generated from receiver measurements indicating predicted area of impact:</u>	

Proposers should note that failure to supply full details ~~will~~ may result in the recipient refusing to consider your proposal. The response timescales below will only commence when the recipient multiplex operator(s) are in receipt of full details

Guidance for recipients

On receipt of a request to use a site classified as **green**, the receiving multiplex operator must acknowledge the request within **seven** working days and respond within ~~twenty~~**ten** working days giving agreement or outlining the reason(s) for their objection in their response. If no response is sent agreement will be assumed.

On receipt of a request for an entirely new site that falls into the **amber** category, the receiving multiplex operator should acknowledge the request within **seven**~~five~~ working days and give a full response to the proposal within ~~twenty~~**thirty** working days. If the receiving multiplex operator is unable to respond within ~~twenty~~**thirty** working days, their acknowledgement of receipt should clearly state the revised period within which they will be able to respond. This should not exceed **thirty-five** working days. If no response is received after either ~~twenty~~**thirty** working days or a notified extended period, the receiving multiplex operator will be deemed to have agreed to the proposal. Ofcom may be included as a copy recipient in the circulation of emails.

If the recipient multiplex operator believes that relevant information is missing the proposer ~~should~~**must** be informed immediately and in any case no later than the acknowledgement deadline.