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Changes to the digital television and digital radio technical codes

Statement following consultation

STATEMENT

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1. Overview

Ofcom published a consultation on 12 December 2022 which proposed making changes to the existing technical rules that the UK's digital terrestrial television (DTT) and digital radio (DAB) broadcasters are required to comply with as a condition of their licences.

The consultation closed on 20 February 2023, and we received 16 responses to our proposals from industry stakeholders and representative groups. We have carefully considered all the points raised by the respondents, and we have made some minor revisions to our original proposals in light of the comments that we received.

This Statement concludes the consultation process, sets out our analysis of the points raised by respondents, and includes our final decisions on the proposed changes to the technical codes. The new technical code documents are being published alongside this Statement and come into force as of today, 9 May 2023.

What we have decided – in brief

The main changes that we have decided to make are in the following areas:

Network resilience and disaster planning – TV and radio multiplexes

We have decided to proceed with the following changes as proposed in our consultation:

- TV multiplex operators will be required to provide regular updates to Ofcom on their progress towards meeting the recommendations set out in Ofcom's separate report into the fire - and consequent loss of all broadcast radio and TV services - at the Bilsdale TV and radio transmitter mast in North Yorkshire during August 2021. Digital radio (DAB) multiplex operators will also be required to consider the technical resilience of their services and to have proportionate service continuity plans in place.
- Separately, following an incident in September 2021 that resulted in the loss of some subtitling, audio description and signing on a number of broadcast TV services for a prolonged period, we are adding a requirement for the Channel 3, Channel 4 and Channel 5 licensees to ensure that they assign the same priority to the resilience of access services as they do to the vision and sound for those programmes that are scheduled to carry access services.

Radio Multiplexes

We have decided to proceed with the following changes proposed in our consultation:

- To simplify the current process for identifying and mitigating the risks of a new DAB transmitter causing disruption to reception of other services by adopting a system whereby Ofcom will carry out initial assessments of hole punching risk and would generally approve proposals posing negligible risk of disruption. This will reduce the burden on multiplex licensees, particularly new small-scale multiplexes as well as larger established licensees that would otherwise have to consider multiple requests for new transmitters from others. It will also reduce the risk of inconsistent outcomes in managing hole punching, and lead to quicker decision-making. We have noted comments from respondents relating to the thresholds and protection ratios used in our sensitivity analysis and will proceed cautiously.
- As proposed in our consultation, we are maintaining our existing requirements for 'acceptance testing' of new DAB transmitter installations, and we will also provide additional guidance to licensees on the process and specific technical checks which they need to carry out before a new or modified transmitter can enter service. These checks are intended to help ensure that a transmitter meets its licensed technical parameters and does not cause potentially harmful interference to other services.
- We have noted the interest and concerns from respondents about the possible adoption of the non-critical mask. We will carry out some work to review what information exists on areas such as the performance of DAB receivers and identify where there are shortcomings in our knowledge. We intend to discuss our findings with directly impacted stakeholders (broadcast and non-broadcast) in due course.

Other changes

- As proposed in the consultation, we will add references to the digital TV and radio technical codes signposting Ofcom's requirements on exposure to electromagnetic fields that was put in place in 2021. These requirements already apply to all relevant spectrum licensees holding Wireless Telegraphy Act licences, and therefore the references in the technical codes will be informative only.
- We will include HbbTV in our DTT Reference Parameters document as a recommended standard for data services as proposed but with a minor typographical clarification.

This overview is a simplified high-level summary only. Our full decisions and reasoning are set out in the following sections of this document.

2. Introduction

2.1 Our consultation[1], which ran from 12 December 2022 to 20 February 2023, proposed making various changes to Ofcom's TV technical codes and DAB radio technical codes. The consultation itself contains more detailed information on the context and applicability of these codes, but we proposed changes to the following specific documents:

TV technical codes

Television Technical Performance Code ("the DTT Technical Code"); and

Reference Parameters for Digital Terrestrial Television Transmissions in the United Kingdom ("the DTT Reference Parameters").

Digital radio technical codes

Digital Radio Technical Code ("the DAB Technical Code"); and

Technical Policy Guidance for DAB Multiplex Licensees ("the DAB Guidance").

2.2 We received a total of 16 responses to the consultation, including one fully confidential response and four partially confidential responses. The non-confidential responses (and part-responses) are available on the Ofcom website[1].

2.3 We have carefully considered the points raised by respondents to the consultation on our proposed changes. We have decided to implement many of the changes as originally proposed in the consultation. However, we have decided to make some minor modifications to our proposed changes in light of the comments that we received.

2.4 Sections 3 to 7 of this document contain brief summaries of the specific proposals we made in our consultation. These sections also contain summaries of the responses received, as well as our analysis of these responses and our final decisions on each of the proposed changes.

2.5 This statement concludes the consultation process, and the four revised technical code documents come into force today, 9 May 2023.

2.6 Versions of the DTT Technical Code and DTT Reference Parameters documents have been marked up to highlight the revisions we have made since our initial consultation proposals. These amended versions are available in Annexes 1 and 2 of this statement, and the final revised documents can be found at the links above.

2.7 We are implementing the revisions to the DAB Technical Code and DAB Guidance documents as proposed in our consultation, and the final revised documents can be found at the links above.

TV technical codes – background

2.8 Digital terrestrial television (DTT) – usually known as Freeview – is broadcast from a network of over 1,100 transmitter masts. Each mast generally transmits three or more 'multiplexes' (with each multiplex containing a number of individual TV channels). Each multiplex is licensed to a specific multiplex operator.

2.9 Three 'public service broadcaster' DTT multiplexes provide near-universal coverage across the UK. Three other 'commercial' multiplexes cover around 9 in 10 households, and a separate local TV multiplex provides more localised coverage in some areas.

2.10 The national DTT multiplexes which are licensed by Ofcom under the Broadcasting Act 1996 are required to observe Ofcom's Television Technical Performance Code ("the DTT Technical Code") and its accompanying Reference Parameters for Digital Terrestrial Television Transmissions in the United Kingdom ("the DTT Reference Parameters"), which set out the high-level technical requirements with which these TV multiplexes must comply[2].

2.11 The DTT Technical Code and Reference Parameters are intended to ensure that the UK's main DTT services achieve at least minimum standards of technical quality, availability and coverage. They also set standards which seek to prevent DTT multiplexes causing undue interference to other licensed services, and to provide for basic technical interoperability between different DTT multiplexes and TV receivers.

2.12 The DTT Technical Code and Reference Parameters were last revised in 2016 and we are now taking the opportunity to amend both documents as set out in this document.

DAB radio technical codes – background

2.13 DAB (Digital Audio Broadcasting) digital radio services are widely available in the UK, and are transmitted from a large network of transmitter masts. As with DTT, a single DAB signal is known as a multiplex, and can contain up to 20 or more individual radio stations. Listeners can usually receive more than one DAB multiplex at a given geographic location.

2.14 The UK's DAB radio networks consist of a number of established multiplex operators providing both local and national DAB services. More recently, 'small-scale' DAB services (which target smaller geographic areas than existing local DAB services) have begun broadcasting, and Ofcom will be advertising further licences for small-scale DAB services across the UK over the next few years.

2.15 DAB multiplex licensees which are licensed by Ofcom under the Broadcasting Act 1996 are required to observe Ofcom's Digital Radio Technical Code ("the DAB Technical Code") and Technical Policy Guidance for DAB Multiplex Licensees ("the DAB Guidance").

[2] The local TV multiplex is also required to observe the requirements in the DTT Reference Parameters document.

2.16 The most recent substantive changes to the DAB Technical Code and Guidance were made in 2019 (with a further minor update in 2020), and we are now taking the opportunity to make further amendments to both documents as set out later in this document.

3. Broadcast transmission network resilience (DTT and DAB technical codes)

Our proposals in brief – Consultation Question 1

3.1 We proposed to amend the Television Technical Code to:

a) Require TV multiplex operators to provide regular updates to Ofcom on their progress towards meeting the recommendations set out in Ofcom's separate report[3] into the fire - and consequent loss of all broadcast radio and TV services - at the Bilsdale TV and radio transmitter mast in North Yorkshire during August 2021.

b) Add a requirement for the Channel 3, Channel 4 and Channel 5 licensees to ensure that they assign the same priority to the resilience of access services as they do to the vision and sound for those programmes that are scheduled to carry access services. This proposed new requirement follows Ofcom's separate report[4] into an equipment failure – and consequent prolonged loss of access services provision – at a major UK TV broadcast playout facility during September 2021.

3.2 We proposed to amend the Digital Radio Technical Code to:

a) Require that digital radio multiplex operators should consider the technical resilience of their services and to have proportionate service continuity plans in place.

Consultation Question 1

Do you agree with our proposals for adding requirements to the Television Technical Code and Digital Radio Technical Code relating to resilience of broadcast networks and access services?

Comments received

3.3 Most respondents supported our proposals for network resilience and access services. Two respondents disagreed with our proposals, stating the measures are not needed, while another respondent stated our proposals were inadequate for dealing with reliability of small-scale DAB multiplexes.

Network resilience

3.4 **Arqiva** said that the proposed changes to the Television Technical Code were sensible. It suggested that the proposed amended Code wording for Paragraph 4.4 of the TV Technical Code be modified to include the word 'any' ahead of 'exercises to test those [service

Bilsdale Transmitter Fire Incident Review
Broadcast Centre Incident Review

continuity] plans.', which would remove the potential implication that carrying out service continuity exercises annually is a requirement.

3.5 A confidential respondent also made a comment about the proposed wording of the reporting requirement. That respondent suggested that any review of resilience may conclude that no enhancements to service continuity plans are required, and our wording should include the words 'where appropriate'.

3.6 **Digris** generally agreed that "*all operators should ensure a proportionate service continuity plan* [is] *in place* […] *that meets the reasonable expectations of those contributing financially, in exchange for carriage"*. **Sonova** simply agreed with our proposals.

3.7 **Digital Television Group (DTG)** supported the requirement for licensees to report and feedback on service continuity. It also drew attention to its work looking at a future transition to all content being delivered by IP networks. It urged Ofcom to look forward to the scope and nature of technical codes that might be required in the future to ensure platforms are robust and accessible. A confidential response from another stakeholder also suggested that as audiences increasingly move to consuming TV and radio services via the internet, value for money will be an important consideration when deciding on the level of resilience provided by the DTT platform.

3.8 **Muxnet UK** gave cautious support to our proposal *"on the basis that it requires licensees to consider the options for resilience, but that consideration may legitimately conclude that no practical resilience is viable".* Muxnet expressed concern that our proposal appeared to imply that the extent of resilience incorporated into their service by a licensee may be a consideration in any Ofcom decision whether to revoke a licence. It explained that it is necessary for small-scale DAB operators to deploy cost-effective technical solutions that may feature little or no resilience, to enable their multiplexes to be accessible to small broadcasters.

3.9 **UK Community Radio Network (UKCRN)** welcomed Ofcom's recognition that smaller operators such as small-scale DAB licensees may have more limited resources than larger networks. It deemed that Ofcom's proposed wording *"provides sufficient leeway for Ofcom to adopt reasonable and measured responses to individual cases of breakdown, damage or transmission interruptions".*

3.10 **Folder Media** did not agree that a general condition on licensees to consider resilience is necessary. It stated that it already is in regular dialogue with its transmission providers over matters such as the status of their networks and resilience. Folder Media further explained that its contracts require delivery of services to a high service level agreement, through which it expected its transmission providers to have well prepared disaster recovery plans. It did not see that it was either necessary nor economically viable to replicate their transmission providers' infrastructure.

3.11 **Maxxwave** believes that Ofcom's proposed requirements to be "*wholly unsuitable",* and expressed *"serious and grave concerns"* about the performance of small-scale DAB networks. Maxxwave is concerned that there are no stipulated targets for the reliability of multiplexes, and recommended that Ofcom carries out a higher level review of reliability to

include (as examples) battery back-up, and programme feeds arrangements. Maxxwave also made a suggestion that multiplex operators employ telemetry capable of logging their service reliability, and suggested some target reliability figures that it feels are achievable.

3.12 **News Broadcasting** responded as both a provider of programme services and a radio multiplex operator. It welcomed proposals that strengthen the resilience of broadcast network, although is concerned that any measures do not result in higher costs. News Broadcasting explained that many aspects of network resilience are determined when networks are designed, and that is difficult and costly to change subsequently. Much of the network is dependent upon Arqiva's shared infrastructure, and News Broadcasting suggested that Ofcom's proposals are incorrectly targeted (at multiplex licensees) and do not provide licensees with any levers to compel Arqiva to invest or undertake work on its infrastructure. It therefore considers Ofcom's proposals to be *"too undefined to have any real effect without potentially adding to the bills of content providers".*

3.13 A number of responses were submitted confidentially, which although generally supportive of our proposals, contained differing views as to how parties should bear any additional costs arising from work that may need to be carried out in following Ofcom's recommendations for resilience and service continuity. Some respondents referred to the contractual arrangements between multiplex licensees and transmission companies, and that introduction of the reporting obligation should not signal an acceptance of one party or another to bear any additional costs. One respondent suggested that Ofcom should be involved in the discussion between the organisations involved *"to lead improvements on resilience and disaster recovery planning and to lead the way on developing post-incident communication and viewer support plans".*

3.14 **Federation of Communication Services (FCS)** made comments on potential interference to business radio systems, which we deal with in Section 4.

Access services

3.15 **National Association of Deafened People (NADP)** said it has been encouraged by the response from the Commercial Public Service Broadcasters and Ofcom to the Broadcast Centre incident in 2021 (that led to the loss of access services on some commercial TV channels), and the subsequent reviews of processes and disaster recovery facilities. It welcomed Ofcom's proposal to include a requirement on the Commercial Public Service Broadcasters to cement the importance of access services alongside vision and sound. NADP said it hoped that the proposal would encourage all involved in the broadcast chain to consider subtitles at every stage, and *"encourage a change in the mindset of all involved in the content production and distribution chain such that accessibility is seen as a necessity rather than an afterthought".* NADP also requested that subtitles should be of the same quality as audio and video, and for these three components to be synchronised as far as is reasonably possible. They made a further request that Ofcom includes requirements that subtitles should not obscure key content on screen, such as scores, or across people's faces.

3.16 **Royal National Institute of Blind People (RNIB)** said that it agreed that resilience of access services is as important as the network that carries them. It stated that "*The needs of access service users must be considered as important as the needs of other viewers and a failure of access services can make content completely unusable".*

3.17 **DTG** supported our proposal to require access services to be given the same priority as the video and audio components of a programme service.

Ofcom's responses

3.18 The intention behind our reporting proposals is for Television Multiplex licensees to report details of any service continuity tests carried out during that year, as well as progress made in addressing lessons learned following the fire at Bilsdale, and in following up on the recommendations made by Ofcom in its review of the incident. The reporting requirement is not intended to place a specific testing obligation on licensees. We also recognise that reviews that licensees carry out over time may conclude that enhancements to service continuity arrangements are not required. For clarity, we will therefore modify the wording added to paragraph 4.4 of the DTT Technical Code as set out in our final position below.

3.19 We note the comments made by Folder Media and News Broadcasting, and their concerns of increased costs that may arise. It is, however, good practice for any business to have in place a service continuity plan to be used in case of serious issues arising, and the aim of including the new paragraph 2.11 in the DAB Technical Code is to ensure that licensees consider the technical resilience of their services, including the consequences of a failure of each part of their broadcast transmission chain.

3.20 While the new requirement would oblige a licensee to have in place a service continuity plan, we understand that the scale and scope of the plan should be proportionate to the service the licensee is providing, and our proposed wording allows for that. The requirement to consider technical resilience is also not necessarily driving any additional cost, unless the licensee identifies vulnerabilities with its broadcast network, and the licensee deems it is proportionate to address that shortcoming. Ofcom will not routinely inspect licensees' service continuity plans, although we may request a copy if investigating a potential licence breach (such as may occur if a licensee is unable to provide a full service for a prolonged period following a serious infrastructure failure).

3.21 Other than the network availability targets that have been in place for many years for the television multiplex licensees, Ofcom is not looking to mandate that licensees adopt any particular technical architecture, equipment duplication, or level of resilience. We believe that licensees are best placed to choose what meets the needs of their licence obligations and business imperatives. Similarly, we do not intend intervening in contractual matters relating to resilience between licensees and their transmission companies. Should a service suffer a prolonged outage, Ofcom will take into account the specific circumstances relating to the incident, including the scale of the service, the service continuity plans the licensees had in place and, where relevant, the contractual provisions between affected licensees and their transmission service provider(s).

3.22 We understand the comments made by Maxxwave which is concerned about small-scale DAB networks, and the impact that poor reliability can have, or is having, on programme services seeking carriage on those multiplexes. For historical reasons, only the DTT Technical Code contains availability targets for those licensees' transmitter networks. Radio services are under a general obligation set out in their licences to ensure that their transmissions *"…should be maintained other than for periods of technical failure or maintenance requirements, the duration of which should not be unreasonably protracted"*. It is also worth noting that the legislation that enabled Ofcom to license small-scale DAB services requires the signals carrying those services to achieve 'a reasonable standard of technical quality' which is different to national and local DAB services which are required to achieve high standards of technical quality. We do not therefore believe it is proportionate to require small-scale DAB licensees to achieve a defined availability target when other radio licensees are not subject to any such targets. We consider this point further in Section 6 when addressing Better Media's response to Question 4.

Final position

3.23 We will make the changes to the DTT and DAB Technical Codes as proposed, although we will slightly amend the wording to be added to paragraph 4.4 of the DTT Technical Code as below (underlining is included only to show the amendments to our originally proposed text):

> *The report should also provide a description of the steps licensees have taken during the year to enhance (where appropriate) service continuity plans to be used in case of a major infrastructure failure, as well as details of any exercises undertaken to test those plans. This description should include how licensees have built on the experiences of previous incidents affecting broadcast transmission infrastructure, as well as how they have addressed recommendations set out in any formal reviews of those incidents carried out by Ofcom."*

4. Changes to approval of transmitters process (DAB Guidance)

Our proposals in brief – Consultation Question 2

4.1 We proposed amending the Technical Policy Guidance for DAB multiplex licensees to:

a) Replace the current process through which proposals to launch new DAB transmitters are considered and agreed, with particular focus on the streamlining the assessment of any interference to reception of other DAB radio services through coverage hole punching (receiver blocking or adjacent channel interference).

b) Introduce sensitivity tests into our modelling of potential hole punching effects with the aim of better matching the 'real-world' impact on listeners.

Consultation Question 2

Do you have any comments on our proposed changes to the DAB Technical Policy Guidance relating to the process of transmitter approvals? In particular, do you have any comments on our proposed sensitivity analysis, or on whether we should require or permit applicants to provide both horizontal and vertical antenna pattern information?

Comments received

4.2 The large majority of respondents supported our proposals, with one respondent against the proposal. One respondent raised concerns about potential interference to other (non-broadcast) users of Band III spectrum, while another suggested that consideration should be given to users of assistive listening devices[5].

4.3 **Arqiva** supported Ofcom's approach in carrying out hole punching analysis, and felt the thresholds we proposed were pragmatic in protecting existing licensees and allowing new licensees. Arqiva believed that the Case 2 sensitivity test (a 4dB relaxation of the interference protection ratio) was a pragmatic suggestion, but expressed concern about the Case 3 sensitivity analysis we proposed (where there is an 8dB relaxation of the protection ratio), and suggested that such cases be permitted on a trial basis only, with drive testing as a requirement. Arqiva stated that it wished to ensure that any relaxation in planning standards is limited only to consideration of hole punching impact close to a new transmitter, and cannot be applied to consideration of co-channel interference over a much wider area. Arqiva said it would like more detail on how the new process would be

[5] Assistive Listening Devices (ALDs) are personal wireless systems comprising a transmitter and a receiver which improve the hearing ability of people with hearing impairment. Correctly prescribed and fitted hearing aids alone can amplify and process sounds to improve the speech to background noise ratio. ALDs are able to enhance the sound quality even further with the addition of a microphone placed near to the wanted audio source or a directly connected audio source (such as a TV streamer or mobile phone interface) attached to the transmitter. Some ALDs operate in the lower part of Band III spectrum in block 5A (approximately 174.1 to 175.7 MHz) which is not used for DAB broadcasting in the UK.

introduced and monitored. It also supported use of vertical as well as horizontal antenna pattern data when modelling hole punching impact, and suggested that Ofcom defines a file format.

4.4 **BBC** broadly agreed with the process we proposed, although highlighted a number of points. It asked that Ofcom uses the most recent set of population data to ensure that new housing is taken into account in our assessment, and asked for clarity on what the process would be if a real-world impact above the thresholds we proposed were found once a new transmitter has launched. The BBC also said that it would be prudent for Ofcom to only use the Case 2 sensitivity analysis (4dB relaxation of protection ratio), and only use Case 3 when evidence shows that an 8dB change to the protection ratio does not adversely affect reception.

4.5 **Digris** noted that small-scale and some local DAB multiplex operators do not have in-house technical capabilities, and welcomed Ofcom carrying out assessments of potential hole punching impact. Digris noted that predictions close to a transmitter are relatively imprecise, although useful to provide an indication of potential impact, and the addition of vertical pattern data may help. Digris suggested that making signal measurements from different transmitting antennas at differing heights could yield a data bank of correction factors that could be applied to future assessments.

4.6 **FCS** set out concerns that DAB transmitters situated close to business radio systems could cause interference to critical and/or safety related operational communications. FCS had provided Ofcom separately with calculations that suggested that a greater degree of filtering than Ofcom currently specifies (the Case 1 or 'critical' filter defined in EN 302 077[6]). FCS suggested that Ofcom specifies the Case 3 or Case 4 filters in EN 302 077, either of which it deems would solve the problem. FCS also suggested that our Technical Policy Guidance should clarify that DAB licensees are obliged to avoid causing harmful interference to other services, irrespective of which spectral mask their service complies with.

4.7 **Folder Media** supported Ofcom's proposals, and sought further information on how Ofcom's sensitivity analysis would be introduced and monitored. It also sought reassurance that any relaxation in planning standards is limited to hole punching assessments.

4.8 **Maxxwave** wished to clarify that Ofcom's question about accepting vertical and horizontal radiation patterns for a transmitting antenna do not relate to permitting mixed polarisation – it supports using vertical polarisation only for DAB. On hole punching, Maxxwave's view is that there are too many variables close to a transmission site that affect signal levels for vertical pattern data to help much with improving predictions. Nevertheless, Maxxwave welcomed Ofcom as an arbiter of hole punching impact.

[6] "Transmitting equipment for the Digital Audio Broadcasting (DAB) service; Harmonised Standard for access to radio spectrum"

4.9 **Muxnet UK** supported Ofcom carrying out hole punching assessments as proposed. It supported licensees being able to provide three-dimensional antenna pattern information as an option.

4.10 **News Broadcasting**, while welcoming Ofcom's work in assessing the impact of small-scale licensees on reception of other services, expressed concerns that our proposals are being introduced to reduce an administrative burden, but at the expense of listeners. News Broadcasting agreed with our proposal for 25 households to be the threshold when considering impact on indoor reception, as households generally have multiple ways of receiving radio services. News Broadcasting was however concerned that any impact to DAB coverage of roads was problematic, as in-car DAB listening is growing, and did not believe our proposed thresholds were acceptable. It suggested Ofcom carries out a more thorough cost/benefit analysis to support our proposals. News Broadcast also did not support our proposal for a Case 3 sensitivity analysis, which it suggested was a way to circumvent well-established principles solely to allow the *"issuance of more DAB multiplex licences irrespective of the structural damage this might inflict longer-term on consumers and the DAB platform as a whole".* News Broadcasting suggested that Ofcom should carry out research to provide evidence supporting our proposed thresholds, and suggests that we carry out a cost benefit analysis as it does not believe the proposals are in the public interest.

4.11 **Sonova UK** asked that *"Concern should be given to the potential interference with assistive devices for* [the] *hearing impaired"*

4.12 **UK Community Radio Network (UKCRN)** stated that it was largely happy with the changes that Ofcom is proposing. It felt that it was helpful for Ofcom to carry out the assessment of hole punching impact, and was content with the thresholds and sensitivity analysis as proposed. It saw no issues with permitting submission of horizontal and vertical antenna patterns, so long as providing the latter remained optional.

Ofcom's responses

Introduction of new process and sensitivity analysis

4.13 We are grateful to respondents for their comments on our proposals for amending the process for assessing and approving new DAB transmitters. We recognise that loss of reception of any existing service is undesirable, and our aim is to minimise inconvenience to listeners who might lose reception when a transmitter carrying another digital radio multiplex launches near to where they live or drive. We have to balance that potential loss against the benefit to be gained though the launch of new services. It would be very restrictive to completely eliminate the risk of interference, also noting that in most cases, the impact on listeners is usually less than is predicted.

4.14 We are therefore pleased that most respondents agree that the thresholds we have proposed when assessing plans for new DAB transmitters are pragmatic, and also agree with our proposal for using sensitivity analysis. We note News Broadcasting's concerns

regarding the potential negative effect that reception holes, particularly in roads coverage, may have on listeners and on the DAB platform more generally. We do not however agree with News Broadcasting's characterisation that the new process is seeking to circumvent planning standards simply for administrative reasons. Our aim remains to protect listeners of DAB services as it is in no-one's interest for people to lose access to services that they value. The new method has two main aims: to reduce the burden on all licensees of considering proposals for new transmitters by other parties (the majority of which are uncontentious), and using sensitivity analysis to more closely match the impact on listeners experience in the real-world.

4.15 As most respondents are content with our proposals, we do not intend carrying out further research to validate the thresholds we have chosen. The road impact thresholds were chosen on the basis that a vehicle travelling through a reception hole of either 150m in a built-up area, or 400m for a faster road would experience a break of between 15-20 seconds which we believe would not cause listeners to retune. All forms of radio service (e.g. broadcast, mobile phones or business radio) experience some areas where reception 'drops-out', and regular travellers along a route become accustomed to where these occur. We do not therefore believe that occasional short breaks in reception are likely to drive listeners away or to damage listener perception of the DAB platform. We will nevertheless work with licensees wishing to launch a new transmitter with a view to minimising the impact on reception of other services.

4.16 The new process will be used from the date of this statement alongside which we are publishing the revised versions of our Digital Radio Technical Code and Technical Guidance. Licensees wishing to launch a new transmitter now no longer need to liaise with other multiplex licensees if Ofcom's analysis shows that the predicted impact falls below the thresholds set out in the Guidance using the standard planning criteria, or under a Case 2 sensitivity analysis (with a 4dB relaxation applied to the adjacent channel protection ratio).

4.17 We intend being cautious in the introduction of the sensitivity analysis. If the impact exceeds the thresholds under Case 2 sensitivity analysis, we may permit a transmitter to be built and tested if it meets the thresholds under a Case 3 sensitivity analysis. Licensees will however be required to carry out a drive test of the multiplexes predicted to suffer an impact on their reception, and the new transmitter will only be permitted to continue operation if the measured impact falls below the thresholds. The licensee will also be required to notify the potentially affected other multiplex licensees and Ofcom in advance of the transmitter being tested. Ofcom may visit the location while the transmitter test is being carried out to verify the impact if our Spectrum Planning team considers such a visit would be beneficial.

4.18 Transmitter proposals failing a Case 3 sensitivity analysis will be rejected, with proposers having to submit a revised technical plan including measures to mitigate the predicted impact (through measures such as amending transmitter powers, antenna patterns, seeking an alternative site, or offering to build a low power transmitter for the affected other multiplexes to fill-in the reception hole).

4.19 Ofcom will monitor any complaints of interference or loss of radio services following the launch of new transmitters, and our Spectrum Planning team may consider visiting a small sample of locations to further verify our predictions, if required.

4.20 Should an impact be found to be larger than that predicted, the licensee will need to propose and implement mitigating measures to bring the real-world impact under the threshold. Licence Award letters to small-scale DAB licence awardees already make clear that they would need to take mitigating measures should the impact on other services be greater than expected. The measures are as listed in 4.18 above, or can also include providing better performing radio sets if the number of households experiencing a loss of service is small.

4.21 We also confirm that any relaxation to protection ratios is purely carried out for the purposes of assessing hole punching impact only and the sensitivity of the modelling to parameters such as the varying adjacent channel performances of different DAB radios. We have no intention of changing any protection ratios for co-channel interference (as most DAB radios have similar co-channel performances) or any other established planning parameters. In response to the point raised by the BBC on population data, we have been using household data from 2016 for assessments of hole punching impact, and expect to move to a more up to date set of data during 2023.

Potential interference to non-broadcast users of spectrum

4.22 We note FCS's concerns that DAB services may cause interference to business radio users. Our calculations reach similar conclusions to those provided by FCS to us and show that a DAB transmitter's out of band emissions have the potential to cause interference to a business radio installation where these are located close together, or on the same transmitter site[7]. The extent and likelihood of the interference is however highly dependent upon the coupling between the DAB transmit and business radio receive antennas and also how closely the performance of the DAB system matches the maximum out-of-band power permitted by the spectral mask.

4.23 DAB transmitters have been in service in the UK for many years, and the number of reported cases of interference to other users has been very small. The 'critical' spectral mask that licensees are required to comply with reaches its maximum rejection at ±1.75 MHz from the centre of a DAB signal and is then flat out to wider frequency separations. The closest frequencies used by business radio are over 2.5 MHz from block 7D, the lowest frequency block to be used by small-scale DAB. In principle therefore a DAB service on any frequency block is just as likely to cause interference to business radio, as a service on block 7D (and perhaps even more so from higher power DAB transmissions in higher frequency blocks). In practice however, we understand that the magnitude of transmitter out of band emissions falls with increasing frequency separation and therefore the frequency blocks closest to business radio receive frequencies are the most likely to

[7] DAB out of band emissions into a Business Radio receiver may exceed the blocking threshold of -116 dBm in 12.5 kHz, depending on the DAB transmitter power and the location of the respective transmitting and receiving antennas

cause interference, as in practice the out of band performance of DAB transmitters falls well below the masks with the levels reducing with greater frequency separations.

4.24 There have been cases where the introduction of DAB transmitters has caused issues for other spectrum users, although these have been relatively few. Where problems have occurred, interference has mostly been caused by mechanisms such as intermodulation in affected or nearby devices, rather than out of band emissions. We therefore believe it is not proportionate to require the use of a more stringent filter characteristic in general.

4.25 However, we recognise that cases of interference may occur, particularly as small-scale DAB commences using frequencies that are closer to business radio. We propose to deal with the issue in the following ways:

a) We will share with FCS details of the areas where we anticipate that frequency block 7D will be used, and provide an estimated range of dates when a DAB service may launch if we are able to license a service in each of those areas. We will update FCS periodically as and when we make changes to the plan, as we continue to optimise it over the next few years. For example, we do not yet know where in the south and east of England block 7D will be used.

b) Using information we hold or are able to obtain from business radio licensees, we will avoid use of block 7D in locations where there is known business use of Band III frequencies, where feasible.

c) Where a DAB service is expected to launch on block 7D, we will ensure that the DAB operator is alerted to the possibility that mitigating measures to protect business radio users may be necessary. We will advise them to take care in the siting of their antenna, particularly where we can identify where DAB services are due to launch near or at sites used by business radio.

d) When we agree a technical plan for a DAB service that will use block 7D, we will make available to FCS or the relevant business radio licensee details of the locations where the DAB licensees' transmitter(s) are due to be located, and an estimate of when they are due to come on-air.

4.26 If a DAB transmitter is brought on-air and that results in a case of interference to business radio (or any other legitimate user of spectrum) and that interference is reported to us, our Spectrum Assurance field team will investigate the issue, and work with the relevant licensees to find a solution to the problem. As a general principle, we expect that the latest party on-air in a particular location to be responsible for implementing any mitigating measures, unless there is a significant shortcoming in the installation of the party suffering interference. In the specific case of a new DAB transmitter affecting operation of an established Band III licensee's equipment, the DAB licensee would need to take mitigating measures: these could include fitting additional filtering to the DAB transmitter to reduce its out of band emissions, providing additional filtering for the business radio system, or making changes to the DAB transmitter such as a power reduction, relocating the transmitting antenna on the site or even ceasing service and finding another transmission site in a severe case.

4.27 We will continue to monitor cases of reported interference and review the requirement for DAB licensees to apply more stringent filtering on DAB transmitters should it become apparent that business radio services are routinely experiencing interference from DAB making use of frequency block 7D.

4.28 We have considered Sonova's comment regarding potential interference to Assisted Listening Devices (ALDs) and do not expect that what we are proposing as part of this consultation will have any impact upon users of those services. ALDs make use of spectrum including block 5A (174.160 to 175.696 MHz) which is separated from the closest frequencies used by DAB in the UK by around 18 MHz. As for the potential interference to business radio, we will investigate any cases of interference that are reported to us, and take steps to address any shortcomings that may be attributable to DAB licensees, or to the licensing of those services if necessary. We believe that typical separation distances from DAB transmitters mean that in practice interference will not occur.

Final position

4.29 We will introduce the streamlined method including sensitivity analysis as proposed, effective from the date of publication of this statement.

5. DAB spectrum masks (DAB Technical Code)

Our proposals in brief – Consultation Question 3

5.1 Our consultation did not suggest making any changes to the DAB spectral mask set out in our Digital Radio Technical Code at this time. However, to help us to decide whether to consider making changes to a future revision of the Code, we proposed carrying out some work on potentially allowing use of the non-critical mask defined in the ETSI specification covering DAB transmitter emissions, EN 302 077. We envisaged that this work would include engaging with industry stakeholders to explore the issues and opportunities associated with use of non-critical filtering, and potentially permitting deployment on a trial basis. We sought views on this proposal.

Consultation Question 3

Do you have any comments on our proposals for investigating and potentially permitting use of the non-critical mask?

Comments received

5.2 Our proposals received mixed responses. Some respondents, mainly those representing smaller or new licensees, welcomed the proposals. The more established broadcasters or transmission operators were more cautious, flagging the potential for increased interference to adjacent services, although generally welcomed the opportunity to engage in further work. Two respondents expressed concerns about interference to business radio, and to hearing aids, and urged Ofcom to take those users into account.

5.3 **Arqiva** referred to the response it sent to our previous consultation[8] on revisions to the digital radio technical codes in 2019. It suggested that measurements are needed of the Adjacent Channel Leakage Ratio (ACLR) and Adjacent Channel Selectivity (ACS) of typical receivers. Arqiva believes that allowing the non-critical mask would significantly increase interference into immediately and next adjacent services, and believes that it is very unlikely that it could be permitted where immediately and next adjacent frequency blocks are in use.

5.4 **BBC** welcomed the opportunity to take part in more work on this subject. It stated that if use of the non-critical mask is permitted, then our assessment of hole punching would need to take that into account.

5.5 **Digris** supports the use of the non-critical mask where there are no other spectrum users within 3MHz. Digris believes use of the non-critical mask would be "*transformative for the DAB opportunity"* and open the door to economically viable low power gap filling transmitters.

Consultation on revisions to Digital Radio Technical Codes

5.6 **FCS** set out its view that both the critical and non-critical masks are insufficient to avoid interference where DAB is on a frequency block close to business radio services. It recommends that the more stringent filters specified in EN 302 077 be specified, particularly for block 7D (the frequency block used by DAB that is closest to business radio frequencies in Band III). FCS said that use of the non-critical mask may be acceptable at higher frequency blocks, although detailed technical investigation would first be needed.

5.7 **Muxnet UK** asked Ofcom to consider permitting the non-critical mask, as the cost of achieving the critical mask becomes a disproportionate cost for transmitters operating at 25 watts or less.

5.8 **News Broadcasting** stated that in view of the technical nature of the topic, it deferred to Arqiva's view that use of the non-critical mask is likely to significantly increase the interference to any transmissions in the immediately and next adjacent frequency blocks.

5.9 **Sonova UK** requested that Ofcom consults hearing aid manufacturers regarding our proposal.

5.10 **UK Community Radio Network (UKCRN)** strongly supported Ofcom's proposal to investigate the use of the non-critical mask.

5.11 A confidential response suggested that the non-critical mask would be acceptable for use on any frequency block from 8A upwards. The respondent stated that the non-critical mask has been deployed in many countries without issues occurring, and that doing so in the UK would reduce the cost of deploying DAB systems.

Ofcom's responses and next steps

5.12 We welcome feedback from respondents on our proposals. It is clear that there is an increased interest in the benefits that use of non-critical filtering might bring for deployment of smaller-scale and lower powered DAB services. It is however important that due account is taken of the impact that deploying the non-critical mask might have not just on reception of other DAB services, but also on the operation of non-broadcast services in nearby spectrum.

5.13 We therefore propose to proceed cautiously, and carry out some internal work to review what information exists on areas such as the performance of DAB receivers, and where there are shortcomings in our knowledge. We intend to discuss our findings with directly impacted stakeholders (broadcast and non-broadcast) in due course.

5.14 Although we have not yet carried out detailed assessment work, our view at this stage is that any use of the non-critical mask is likely to be limited to relatively low power use, with transmitters operating at no more than a few tens of watts. We will also pay careful attention to frequency separation in light of the comments made by FCS. At this stage it seems unlikely that use of the non-critical mask would be permitted, at least on the lower

frequency side of block 7D to avoid causing interference to business radio services, and PMSE[9].

[9] Programme Making and Special Events – there are several frequencies in Band III in which uses such as wireless microphones are licensed alongside Business Radio and DAB radio.

6. Acceptance test results and compliance checks (DAB Guidance - informative)

Our proposals in brief – Consultation Question 4

6.1 Section 6 of the consultation dealt with our approach to acceptance tests and compliance checks for new DAB transmitter installations. We set out the limited circumstances in which Ofcom staff might attend new, or modified, DAB transmitter sites to ensure that transmitter systems are compliant with the requirements of a licensee's Wireless Telegraphy Act licence. We explained that we intended to provide additional guidance for DAB licensees to help them carry out the checks needed to ensure compliance with the technical aspects of their licences and the DAB Technical Code.

6.2 This section of the consultation was informative in that it did not propose adding or removing any formal regulatory requirements: licensees have always been ultimately responsible for ensuring that their transmitters are technically compliant, and Ofcom has always had the right to carry out technical checks on broadcast transmitter installations. However, we invited comments on our approach as part of the Technical Codes consultation process.

Consultation Question 4

Do you have any observations on Ofcom's processes and information we are providing and proposing to provide in relation to acceptance tests and compliance checks? Is there anything missing that would help make the process smoother or easier from your perspective?

Comments received and Ofcom's responses

6.3 Respondents were broadly supportive of our proposed approach, but some raised comments or views as summarised below.

6.4 **Arqiva** supports Ofcom attendance at acceptance tests for sites where there are a number of services present that can give rise to a risk of intermodulation occurring.

6.5 The **BBC** welcomed our intention to provide additional guidance and advice on carrying out technical checks on new transmitter installations, but stated that having Ofcom observe acceptance testing increases confidence that new services will not impact current services. The BBC also asked that Ofcom monitors interference cases that could be linked to small-scale DAB transmitters that have been self-assessed.

6.6 **Better Media** expressed concern about the transmission reliability of small-scale DAB signals and stated that the 'uptime' of small-scale DAB services should be in line with existing national and local DAB services. They also said that Ofcom should collate, track and

publish data and information relating to small-scale DAB service levels and the types of transmitter equipment used by these services.

6.7 **Digris** noted that the existing technical checks required by Ofcom do not actually check the *'fitness for purpose'* of the resulting signal. They felt that it would be proportionate to require additional measurements such as MER (modulation error ratio) or EVM (error vector magnitude) and that these measurements should meet reasonable limits, in order to provide confidence that the equipment placed into service does actually meet the standard which it is required to conform to.

6.8 **FCS** suggested that it may be beneficial if information relating to forthcoming small-scale DAB transmitter deployments were to be published. This relates to the FCS's concerns about possible interference between new small-scale DAB transmitters and business radio services (particularly where frequency block 7D is used by small-scale DAB). FCS said it "*believes that increasing the DAB services may be a valuable thing to do providing other essential services are not disrupted."*

6.9 **Maxxwave** said that it expected Ofcom to attend the first installation by each installer to witness compliance tests being undertaken using the installer's own equipment, and verifying those against Ofcom equipment. Maxxwave set out concerns that some installers lack skills or knowledge to undertake certain tests, and made some suggestions about Ofcom carrying out spot checks post commissioning to check for spectral compliance.

6.10 **UK Community Radio Network (UKCRN)** welcomed additional guidance from Ofcom in regard to compliance testing, which should help to increase the number of transmission engineers who are able to provide support for multiplex operators.

Ofcom's response and conclusions

6.11 As a general principle, Ofcom's licensees are expected to ensure that their services comply with the conditions and parameters set out in their licences. It is therefore the responsibility of each licensee to carry out whatever tests are necessary to satisfy themselves that the transmitted signals are compliant. If the licensee does not have the technical expertise to carry out the tests, they should ensure that they engage a competent and suitably equipped person to carry out the necessary tests. Ofcom will not generally attend site acceptance tests, except where there is a compelling reason to do so.

6.12 We will expect the licensees to carry out their commissioning tests and provide a copy of their measurements to Ofcom, within five working days of a transmitter coming on air as set out in the DAB Guidance. Should issues or cases of interference occur post launch, we will rely on Ofcom's existing interference investigation procedures and respond and investigate instances of interference that are reported to us, and resolve any issues identified.

6.13 Better Media's comments fall outside the scope of consultation Question 4. However as set out in Section 3, the enabling legislation for small-scale DAB requires multiplexes to achieve "*reasonable standards in terms of technical quality and reliability".* In contrast, the

corresponding legislative requirement on the national and local DAB multiplexes which are licensed by Ofcom states that these services must achieve "*high standards"* of technical quality and reliability. Ofcom's Digital Radio Technical Code reflects the differential in these minimum required standards. National and local DAB services are not required to routinely submit transmission reliability reports or equipment records and we do not believe that it would be proportionate to an impose additional burden on small-scale multiplexes in this respect. Stations and listeners who are concerned about transmission reliability should normally contact the multiplex operator in the first instance. Depending on the terms of a particular station's carriage agreement with their multiplex operator, there may also be minimum contractual reliability standards in place between the two parties.

6.14 Digris raises an important point about desirability of testing the quality of the transmitter signal and not just the radio frequency parameters that relate to interference and coverage. We recognise that the acceptance tests required by the DAB Technical Code do not (and are not intended to) cover the full range of metrics which a reasonably competent transmission provider would be expected to check before placing a transmitter into service: instead the required tests are limited to RF aspects of the signal (power, spectral occupancy and in particular out-of-band emissions) for which Ofcom has particular responsibility as the UK's spectrum regulator. While we do not propose to add additional acceptance test requirements at this stage, we will consider whether we can add additional information to the Guidance notes[10] we provide for small-scale DAB licensees when these are next revised to encourage further checks on the quality of the transmitter signal.

6.15 More details of the FCS's specific concerns about interference interactions between small-scale DAB and business radio (and our response) are provided in Section 4 of this document. As set out in that section, we have described a number of pro-active and reactive measures for avoiding and dealing with instances of interference. Those proposals include providing information on forthcoming transmitter deployments either to FCS or potentially affected business radio licensees.

Ofcom attendance and acceptance tests - overall conclusion

6.16 Ofcom emphasises that a DAB multiplex licensee's compliance with the technical parameters in their licence – as well as with the general requirements referred to in their licence (including the out-of-band emission limits in the DAB Technical Code) remains the sole responsibility of the licensee themselves.

6.17 Ofcom staff will not generally attend DAB transmitter sites to carry out acceptance tests or related checks, and will only do so in exceptional circumstances, on a case by case basis. Our Guidance Notes for small-scale DAB licensees set out that we may charge licensees for our attendance on site in certain circumstances.

6.18 Ofcom expects that licensees will ensure that the operation of their transmission equipment is confirmed through commissioning tests undertaken by qualified personnel in

[10] Small-scale radio multiplex licences: Guidance notes for applicants and licensees:

compliance with the licence terms. Should instances of harmful interference be reported to us, these will be addressed through our Compliance and Enforcement teams who will take a risk-based approach in line with our general approach to compliance and enforcement[11].

Acceptance checks – additional technical guidance for licensees and contractors

6.19 As set out in our consultation, the revised version of the DAB guidance contains a new section (Section 4) which provides an overview of the steps which need to be completed before bringing a new or modified DAB transmitter on-air.

6.20 We will also shortly be publishing a separate document, *'DAB – Transmitter Compliance Testing'* which provides a detailed practical methodology for licensees (or their technical contractors) for checking a DAB transmitter system's compliance with the limits in the DAB technical code. The guide will shortly be available in the *Broadcast transmitter guidance* section of the Ofcom's website together with a template for recording the results of these tests.

[11] Ofcom's approach to compliance and enforcement

7. Other proposed updates

Our proposals in brief – Consultation Question 5

7.1 We proposed to make some further, relatively minor, changes to our technical codes in the following areas:

- *EMF licence condition:* all radio equipment that is authorised to transmit above 10 watts EIRP is required, as a condition of the relevant Wireless Telegraphy Act licences, to comply with international guidelines on electromagnetic field (EMF) emissions for the protection of the general public. These guidelines have been issued by the International Commission on Non-Ionizing Radiation Protection[12] (ICNIRP). Our consultation proposed to add an informative passage referencing these EMF emissions requirements to both the DAB Technical Code and to the DTT Technical Code.
- *HbbTV:* our consultation proposed adding a reference to the HbbTV[13] (Hybrid broadcast broadband TV) technical standard to the DTT Reference Parameters. HbbTV is already in use by several DTT broadcasters in the UK to provide interactive TV services and features, including broadband-delivered programmes. The previous version of the DTT Reference Parameters only references an older technical standard called MHEG-5[14].

Consultation Question 5

Do you have any comments on the EMF, HbbTV, or document format modifications proposed in this section?

EMF licence condition (informative): Ofcom's decision

7.2 No substantive comments were received on our informative proposal to add a reference to the existing EMF (Electromagnetic fields) Wireless Telegraphy Act licence condition to the DAB Technical Code and to the DTT Technical Code. We will therefore add the reference as proposed in the consultation.

HbbTV: Comments received and Ofcom's decision

7.3 **Arqiva** and the **DTG** noted that individual programme services on DTT may run both MHEG and HbbTV applications simultaneously, and Arqiva suggested a minor typographical change to the DTT Reference Parameters to more unambiguously reflect this.

7.4 We agree with the suggested change, and have incorporated the additional text into section 2.38 of the DTT Reference Parameters as below (underlining is included only to show the amendments to our originally proposed text):

> *Data Services which are broadcast either wholly or as part of a Qualifying service shall be coded using an open standard. It is currently recommended that either the MHEG-5 Broadcast Profile and/or the Hybrid Broadcast Broadband TV (HbbTV) standard be used.*

7.5 The RNIB said they are not aware of any MHEG-5 applications which have been accessible through voice, whereas Digital UK (now known as Everyone TV) had demonstrated that a HbbTV can be accessible through voice.

7.6 The RNIB also suggested that additional, non-binding, guidance be added to the DTT Reference Parameters to encourage qualifying services to consider accessibility when building data services, and to favour technical standards that have the highest potential for future accessibility. They suggested a number of specific points of guidance and best practice in this respect.

7.7 Ofcom fully supports initiatives to enhance to the accessibility of broadcast services as part of our specific statutory responsibilities in this area. However the DTT Reference Parameters is broadly intended to establish a 'baseline' set of technical interoperability parameters for DTT services, and more in-depth technical implementation guidelines are set by other bodies (e.g., the DTG in the case of technical interoperability). Therefore we currently believe that it would not be appropriate for us to add specific guidelines on accessibility best-practice to the DTT Reference Parameters. We do (and will continue to) log and monitor concerns raised with us by people with sight or hearing loss, and by bodies which represent them, and will act where appropriate.

Updated document formats: Ofcom's decision

7.8 No substantive comments were received on our proposal to update the format of the Technical Codes and their associated documents (which particularly affect the paragraph numbering in the DTT Reference Parameters document). We will therefore update the document formats as proposed in the consultation.

Other matters raised by respondents

7.9 **Maxxwave** raised two additional points which were not directly related to the consultation questions.

7.10 The first expressed Maxxwave's disappointment that the Ofcom Analogue Radio Technical Code[15] had not yet been changed to permit the use of 9 kHz audio bandwidth, stating that such as a change is '*desperately needed by most UK AM broadcasters to improve the viability of their transmission platform'*. As the current consultation relates solely to the digital radio and TV technical codes, Ofcom cannot formally consider this matter as part of the consultation. We are however planning to consult separately on updating the analogue radio technical code later in 2023.

[15] The Ofcom Site Engineering Code for Analogue Radio Broadcast Transmission Systems

7.11 Maxxwave's second point related to apparent differences in the relative loudness of individual radio stations on different DAB multiplexes, and noted that some stations on small-scale DAB are operating at higher subjective loudness levels than stations on existing national and local DAB multiplexes, giving rise to listener annoyance and fatigue. Maxxwave felt that more work should be carried out on this subject to standardise audio levels across DAB services.

7.12 Ofcom recognises that the EBU's R128[16] recommendation on audio loudness normalisation has been widely adopted by UK TV and radio broadcasters, and has significantly contributed to reducing differences in subjective loudness between (and within) services. However the loudness of radio stations' audio output is not a characteristic which has ever been formally regulated (except to specify maximum deviation or modulation depth limits in the case of analogue radio services). While we currently believe that it would not be proportionate for us to introduce new formal requirements in this area, we will consider whether we can add some description of the issue into our Small-scale DAB Guidance Notes, and refer to the EBU's R128 recommendation when the Guidance is next revised.

[16] "Loudness normalisation and permitted maximum level of audio signals"

Annexes to this document

Annexes 1 & 2 to this document are versions of the DTT Technical Code and DTT Reference Parameters which have been marked up to highlight the revisions we have made since our initial consultation proposals. The Annexes are available on our website alongside this statement.