

Arqiva submission to Ofcom's consultation, *Revisions to Digital Radio Technical Codes*

About Arqiva

Arqiva is a communications infrastructure and media services company, operating at the heart of the broadcast and mobile communications industry. Arqiva provides much of the infrastructure behind television, radio, mobile and other wireless communications in the UK and we are at the forefront of network solutions and services in an increasingly digital world.

Arqiva operates more than 1,500 transmission sites for broadcasting, providing coverage to over 99% of the population for terrestrial broadcasting in the UK. We are a shareholder and operator for both commercial national DAB radio multiplexes and service provider for the BBC national DAB radio multiplex. We also work with independent radio groups, such as Bauer Media and Global Radio.

Through our wholly owned subsidiaries, Now Digital Ltd and Now Digital (Southern) Ltd, and our joint ventures Now Digital (East Midlands) and South West Digital Radio, Arqiva operates 23 DAB digital radio multiplexes. These multiplexes cover a number of regions of the UK, predominantly in the Midlands, South West and the south of England.

Arqiva is a founder member and shareholder of DRUK, Freeview, YouView and Digital UK. Freeview is the largest TV platform in the UK delivering over 60 digital TV channels, including 15 HD channels, and 24 radio stations free to the UK public. Arqiva owns and operates the networks for all of the Freeview multiplex licence holders and is the licence holder for four of the DTT multiplexes. DRUK works to promote digital radio via liaison with the UK supply chain, business-to-business and consumer marketing.

Our major customers include the BBC, Bauer Media, Global Radio, Wireless, ITV, Channel 4, Five, BSkyB, UKTV, Sony, AMC, Ideal World, QVC, Russia Today, Al Jazeera Networks, BT and the four UK mobile operators.

Arqiva is owned by a consortium of infrastructure investors and has its headquarters in Hampshire, with major UK offices in London, Buckinghamshire and Yorkshire and operational centres in Greater Manchester, West Midlands and Scotland.

Summary and Recommendations

Summary

Arqiva is grateful for the opportunity to contribute to Ofcom's consultation on its draft revised Digital Radio Technical Codes. We recognise that changes to the market, both technical, regulatory and commercial, mean that a revision to the 2014 Code has become both necessary and desirable.

In our submission we set out a number of concerns over Ofcom's proposals and suggest modifications which would minimise any adverse impact to the broader radio sector. In particular, we focus on the following:

- ACI/Blocking Procedures: while we support the objective of having industry-led procedures to facilitate a greater number of lower power transmitters, the proposals in their current form are imbalanced and do not reflect the realities of how existing multiplex operators conduct their businesses. In particular:
 - They would likely lead to unreasonable administrative burdens being placed on existing industry players who would be the victims of the interference, rather than the new entrants who would be the beneficiaries
 - More specifically, we do not believe that the ten-day turnaround time for a "green application" can be met where there is a high volume of applications
 - By proposing different regulatory approaches to audio quality for small scale DAB multiplexes as compared to national and local services, Ofcom is undermining a level playing field between services who may, ultimately, be competing for the same listeners.
- Spectrum masks: we urge caution on Ofcom's proposals to update the spectrum mask to align with recognised international specifications. Our submission sets out the risks on making this decision at present given the lack of information on the performance of receivers in the market; and
- We make a number of technical detailed proposals in this submission which we consider will minimise any further risks to the radio platform if adopted by Ofcom.

On these issues, we urge Ofcom to engage in further dialogue with the industry to fully understand the actual impact of its proposals. For example, multiplex operators will incur costs if they request technical advice from Arqiva Transco as part of any assessments of small scale DAB applications. The implications of this for applications is not yet clear but Ofcom needs to consider this when developing its proposals as minimising impacts on industry should be at the heart of its approach.

We understand that there is significant political momentum behind the introduction of small scale DAB services and multiplexes. However, the introduction of those services will themselves be put at risk if the policy underpinning them is not sufficiently robust. If new multiplexes are approved as a result of a rushed approval procedure or under technical conditions which increase interference into services, then listeners may be deprived of access to existing popular stations with an established base of listeners. This is an outcome which is in nobody's interest.

Key Policy Recommendations

As well as number of suggested technical revisions, we set out a number of key policy recommendations throughout this submission on how the draft Technical Code can be improved. These are:

- 1) Small scale DAB applicants should cover the costs, through an agreed rate card, incurred by multiplex operators who undertake these technical assessments
- 2) Ofcom should set out clearly what it means by a “competent engineer” and/or what it would expect to see in a technically robust assessment in an application
- 3) Ofcom should clearly define what it means by “undue interference”, possibly by drawing on the work of the 2006 industry MOU
- 4) Timescales for incumbent multiplex operators’ responses to small scale DAB applications to be amended to:
 - a. the deadline for Green applications is changed from 10 to **20 working days**¹
 - b. the deadline for Amber applications is changed from 20 to **30 working days**
 - c. all application deadlines should be subject to extension with the agreement of Ofcom where the multiplex operator can demonstrate a genuine reasonable requirement for one
 - d. all applications which do not provide the correct data to allow analysis are rejected and the applicant and Ofcom are notified
- 5) Ofcom should ensure that regulatory obligations on sound quality are consistent for all DAB multiplex operators

¹ 20 days is consistent with the proposed timescale for Ofcom itself to agree a licence for applicants who commission tests as part of their applications.

Responses to questions

Question 1: Do you agree with our proposed changes to the ACI/blocking procedures?

We welcome Ofcom's continuing position that addressing ACI/blocking issues should be *primarily* a matter for industry. This reflects, to some extent, Ofcom's long-established principal that industry understands the functioning of its own market better than the regulator or Government does. However, for industry to work within the relevant regulatory framework, it requires clear definitions from Ofcom to ensure that it can be confidently compliant with its regulatory obligations.

With that in mind, our key concerns as they relate to Ofcom's proposed amendments to the ACI-blocking procedures are threefold, namely:

- The imprecision of some key definitions within the revised code. These will lead to confusion amongst industry players and likely undermine Ofcom's objective to streamline the overall process. Specifically, there is insufficient clarity on what is meant by:
 - "competent engineers with experience of radio broadcast engineering", and
 - "undue interference"
- Linked to the above, the administrative burden that will inevitably fall on incumbent multiplexes as (potentially multiple) applications are submitted to them. This will particularly be the case if new small scale DAB services are asserted, on the back of uncertain engineering expertise, to be "Green" and thereby subject to only ten working days response time; and
- The contrasting regulatory approaches to audio quality for small scale DAB when compared to national or local DAB services and the risk that this will undermine a level playing field when competing for listeners.

Under the current proposals, we consider that there is an unacceptable risk on incumbent multiplex operators who may face very significant costs associated with multiple applications for small scale DAB multiplexes. As a result, we would argue that small scale DAB applicants should cover the costs, through an agreed rate card, incurred by multiplex operators who undertake these technical assessments.

RECOMMENDATION: Small scale DAB applicants should cover the costs, through an agreed rate card, incurred by multiplex operators who undertake these technical assessments

Ofcom does not define "competent engineers"

By driving to streamline the processes for addressing ACI/blocking, Ofcom risks introducing significant uncertainty for stakeholders as to how to interpret their regulatory obligations. We recognise the ambition to enable access to DAB for smaller and less well-resourced organisations. However, it is critical for this process that technical work undertaken by these smaller organisations must be rigorous and credible.

To be clear, Small Scale DAB licensees can be commercial entities and so they should be held to the same standard as we are.

Ofcom needs to give a firm steer on this and needs to set out in more detail what it expects *specifically* from applicants in terms of demonstrating this expertise. This might involve a central list of approved engineers or some other form of accreditation from Ofcom. Ofcom may want to consider giving further guidance on what type of tests it would expect to see as part of an application and what type of equipment should be used to undertake those tests.

The risk of not adopting a more prescriptive approach in this area is that applicants may have an incentive of providing minimal evidence to the incumbent multiplex operator. Under the current proposals, the incumbent multiplex operator would inherit the cost and administrative burden of carrying out more detailed technical analysis of its own (in order to ensure listeners are protected). We set out further below the implications of this for the timescales that Ofcom are proposing.

Our view is that the term “competent engineer” and “experience of radio broadcast engineering” are too vague to ensure that these scenarios are prevented from happening. The incumbent does not gain any benefit from this, rather it incurs costs to try to avoid harm occurring to listeners. It has to be right, therefore, that the main costs of ensuring that work is carried out to a competent standard is covered by the applicant for a new licence.

We note that, in respect of the above, there is no sanction in place for any organisation which demonstrably submits an application lacking the required information and appropriate evidence. Organisations with relatively poor funding may not be able to afford technical analysis and in effect may rely upon the existing mux operator performing the analysis on their behalf for free by submitting a poor technical proposal.

RECOMMENDATION: Ofcom should set out clearly what it means by a “competent engineer” and/or what it would expect to see in a technically robust assessment in an application

Ofcom does not define “undue interference”

Given the rapid turnaround time of (as little as) ten days that Ofcom is proposing for incumbent multiplex operators to respond to an application, it is of crucial importance that those assessments are informed by clear definitions of what would constitute grounds to approve or not approve. Ofcom sets out in paragraph 3.5, for example:

It is essential to avoid undue interference at the transmission network design stage

We agree with this as a matter of principle and with other similar articulations within the consultation. But this is not helpful in guiding a multiplex operator in assessing when a threshold of “undue interference” has actually been met. It is perfectly possible that incumbent multiplex operators and new applicants will take a differing view on whether interference falls under the definition of “undue” during the application process. It is, therefore, in everyone’s interests (including both listeners and Ofcom) to set out *precisely* what it means when it talks of “undue interference”. This should be in the form of what impact there is likely to be on both households and on road networks. By not providing definitive guidance on interference the new licence applicants may have to incur additional costs by having to make a proposal and then subsequently having to modify that proposal in order to meet interference criteria.

One approach Ofcom could consider would be to refer to the definitions it had developed with industry for its 2006 MOU for new DAB services. That document suggested that single transmitter coverage of a population lower than 375,000 would be deemed to be interfering if 150 households were affected. We consider the numbers developed as part of that work to be reasonable and could be used as a basis for a definition in this case. We would further suggest that lower coverage populations (as we would expect with small scale DAB populations) should involve a commensurately lowered household threshold as set out in the 2006 MOU.

For example, a proposed coverage area of c150k should be deemed to be causing undue interference where 75 households are affected. Or a coverage area of c100k would be causing undue interference where 50 households are affected. Our judgement is that anything higher than these magnitudes would be unacceptable to listeners and start to undermine any goodwill towards new small scale DAB services among the public. It also risks disenfranchising existing listeners to some of the most popular radio programmes and stations in the UK.

In terms of roads, the MOU set out the need to avoid a continuous loss of service on motorways, A Roads or main thoroughfares within 1km of a proposed transmitter site. It states the requirement to avoid 5 seconds continuous loss when driving at 18km/h² in urban areas and 50km/h in rural areas. Again, given other market developments, this could at least act as a basis for any definition that Ofcom could offer as clarity to all stakeholders.

Ofcom may wish to consider that clarity in this case would also give incumbent multiplex operators confidence that they were acting to the intent of the Technical Code and service and could serve to expedite assessments of applications. Failure to address the definition of "undue interference" at this stage could lead to more disputes during the application process and involve Ofcom in additional licencing work.

RECOMMENDATION: Ofcom should clearly define what it means by "undue interference, possibly by drawing on the work of the 2006 industry MOU.

Ten days is not sufficient to turn around an application for a small scale multiplex

As we note above, there is clearly a significant level of political momentum behind the expeditious roll out of small scale DAB multiplexes. However, we are concerned that this may be manifesting itself here in a way which risks the operations of existing services and create burdens for existing multiplex operators.

As a matter of process, there would need to be a defined point where the application is deemed by Ofcom to formally have been made. An email delivery of the application would, in our view, be insufficient for that purpose as it may not have been properly received by the multiplex operator and/or the application itself may be incomplete or incorrectly made. We would suggest therefore, that the date of application is where:

² 18 km/h represents, under normal circumstances, a 25m gap in service. Speeds, however, can be a lot slower at critical points of the day causing longer gaps. As a result, we would view this as an absolute maximum.

- 1) The multiplex operator confirms receipt of the application; and
- 2) The application is confirmed as complete and correctly made.

Ofcom will, of course, be aware that these proposals are being made in the context of very high levels of expressions of interests from stakeholders in response to its invitation to signal demand last year. It is further quite possible that this consultation will *itself* stimulate additional demand for small scale DAB capacity by suggesting that barriers to entry at a technical level may be borne by the incumbent multiplex operators. We have no visibility yet of the number and timing of the small scale DAB application process and licensing. The initial trials launched the applications for 10 licences at the same time. Given the recent number of expressions of interest and enthusiasm to deliver these services, we would be concerned that such a significant workload would not be manageable even with the extended timescales that we recommend.

In this context, and given the built-in incentive for applicants to self-certify as “Green” (or perhaps “Amber” where there are more obvious technical challenges which would be more properly certified as “Red”) we strongly argue that ten days is clearly not sufficient for applications to be considered.

Ofcom also needs to consider the possibilities of scenarios where numerous applications are, say, submitted during a holiday period and/or where other urgent spectrum planning priorities are calling on internal resources of multiplex operators. Under the terms of the current proposals, the threat of not redirecting resources at very short notice would be the automatic approval of a small scale DAB application once the deadline has been passed.

The most adversely affected group here would be the listeners of existing services, who could lose access to valued services as a result of harmful interference. Ofcom should prioritise their interests equally to those of any potential new listeners of new services, adopting an objective to find a solution that allows both to co-exist. While we would seek to deal with applications as quickly as possible, ten days is unreasonable for the reasons we set out above.

Our final concern with this proposed approach is the lack of clarity on what process would be followed in the event that an incumbent multiplex operator objects to an application. Ofcom needs to set out what would need to happen practically in those circumstances and what would be the impact on the deadline (for example, would it reset to the start of the specified period?)

We strongly believe, therefore, that this proposal is not tenable in its current form. Our preference is that the deadlines should be removed although we recognise that this may be in conflict with the overall objective to streamline the approval process. Alternatively, and with specific reference to our own resourcing practices, we suggest that:

RECOMMENDATION:

Timescales for incumbent multiplex operators' responses to small scale DAB applications to change by:

- the deadline for Green applications is changed from 10 to **20 working days**
- the deadline for Amber applications is changed from 20 to **30 working days**
- all application deadlines should be subject to extension with the agreement of Ofcom where the multiplex operator can demonstrate a genuine reasonable requirement for one
- all applications which do not provide the correct data to allow analysis are rejected and the applicant and Ofcom are notified

It is worth emphasising that the above changes would, in part, need to sit alongside Ofcom providing the clarity on applicants' engineering expertise and clarity on the definition of "undue interference" as we discuss earlier in this submission. We also note that the suggested 20 working days is aligned with Ofcom's own deadline for granting permission to licensees who commission tests as part of complying with conditions for a licence (as set out in Paragraph 2.1 of the new draft Technical Code.)

Regulatory provisions for audio quality should be the same for all DAB multiplexes

In our response to DCMS's consultation on small scale DAB in March 2018, we set out reasons why there should be, as far as practicable, a level competitive playing field between small scale DAB operators and existing local and national DAB operators multiplex. These related to the general principle that we would likely be competing for the same listeners and that no service should be given a regulatory advantage over another.

Paragraph 2.5 of the draft revised Technical Code states that regulatory obligations on audio quality will not apply to small scale DAB but does not explain why this should be the case. In our view, there is no reason why these particular provisions should not apply to small scale DAB as it does to other multiplexes. Ofcom appears to offer scope for small scale DAB multiplexes to reduce costs where such opportunities would not be open to other operators. We propose that this discrepancy should be removed and small scale DAB have the same obligations as they relate to audio sound quality.

RECOMMENDATION: Ofcom should ensure that regulatory obligations on sound quality are consistent for all DAB multiplex operators.

Ofcom needs to avoid the perception of a conflict of interest on multiplex operators

We are conscious that there may be an influx of small scale DAB multiplex applications as the policy for licensing these is approved later this year. When this happens, we would credibly expect to receive under these proposals numerous applications to assess.

It is unclear what specific legal obligations we - or any other incumbent multiplex operator - would be under as the recipient of this information under these circumstances. This is

important as we will be competing with many potential small scale DAB operator for listeners yet will be instrumental in the process which approves their applications.

We would therefore be grateful for guidance from Ofcom in this respect as to what regulatory framework this process would fall under.

Other suggested improvements to the draft proposed code

In terms of the more technical elements of the draft revised Code, we offer the following suggestions to Ofcom to consider. We consider that these would improve the implementation of the overall policy if adopted:

- It is critical that Ofcom retains a central record of up-to-date contact details for each multiplex operator given the ambitious deadlines which are being proposed;
- Table 1 of Ofcom's consultation sets out a requirement to provide information on site locations according to 6 figure grid references which gives an accuracy of up to 100m. We would suggest changing this to a 10-figure reference which is generated by domestic and commercial GPS receivers.
- Linked to the above, we would require the antenna radiation pattern shown in both VRP and HRP as a log scale in 5-degree steps. This should be given electronically to allow easy import to standard modelling systems (and would therefore enable us to offer a more efficient service to our customers);
- The proposed test transmissions for "Amber" applications as set out by Ofcom should last no longer than six hours and should avoid drive time and should therefore take place in the window 10am to 4pm on a week day. The site under test should have a published diary of test transmissions so those coming significant distances to do measurements arrive when transmissions are on air; and
- A common impact measurement tool should be used across the industry which meets the minimum receiver performance as defined in ETSI TS 103 461 V1.1.1 (2017-08)

Question 2: Do you have any comments on the adoption of the new ETSI mask characteristic and on the potential use of the non-critical spectrum mask?

We recommend that the ETSI Critical Mask continues to be adopted in the UK until there is further information on the performance of receivers. At present there is a single protection ratio and it is unclear to Arqiva as to which is the dominant effect between ACI or blocking. To that end, we would be keen on exploring with Ofcom the option of working together in the coming weeks and months to take measurements of a range of portable and car receivers to see what is the dominant effect.

As the split of the impact between blocking and ACI in the generation of the protection ratios is dependent on the receiver design so a single protection ratio for all receivers is inappropriate. It is very difficult to fully predict the impact of using the non-Critical Mask as the numbers and performance of all receivers in the market is unknown. Therefore, we suggest Ofcom continues to use the Critical Mask until Ofcom has a data set of receiver tests which shows the true performance of the Critical and Non-Critical Mask on 1st and 2nd adjacent services. Only at that point and with that knowledge could a truly informed decision be made.

For the avoidance of doubt, the new ETSI Radio Equipment Directive (RED) standards for DAB transmission systems is not yet published but is going through its final drafting. We do not, however, expect the technical element to change. The existing spectrum mask adopted in the UK in 1999 meets the new ETSI RED even with its new definitions on power classes. All existing transmitters deployed by Arqiva meet the RED.

We have provided a Technical Annex to this submission which looks at the issues raised in Question 2. This sets out our observations in more detail.

Question 3: Do you agree with our proposed changes on DAB+ audio encoding?

We broadly agree with this proposal.

However, in terms of error protection profiles, DAB+ EEP-3A gives similar performance in terms of coverage as Mpeg 1 layer II (48 kHz) protected with UEP level 3 so Arqiva agrees this should be the minimum EEP. Also Ofcom should note in ETSI 300 401 there are profiles A (services multiple of 16 kbits/s) and B (services multiple of 32 kbits/s) for EEP, so 4A should be allowed along with 2B, 3B and 4B. These all give greater protection than 3A in terms of convolutional coding.³

Question 4: Do you agree with our other proposed revisions to the Digital Radio Technical Code outlined in Section 6 of this document? Do you have any views on alternative models for dealing with the administration of Sid and TII codes?

We have a number of observations on this question which we address on a paragraph by paragraph basis with reference to the draft Technical Code as expressed in Annex 6 of Ofcom's consultation.

Paragraph 2.1: as we set out above, we note that Ofcom has given itself a 4-week deadline to approve transmission from a site after testing. This is aligned with our own proposal for a minimum of 20 working days to process a "Green" application from a small scale multiplex operator

Paragraph 2.5b: SFN issues cannot be easily resolved without TII codes. Therefore, Arqiva needs the ability to continue to use TII codes across all DAB transmitters that it provides for Arqiva's customers and recommends to any Operator the use of TII codes when using SFNs.

We believe there is no benefit for TII codes to be allocated for single transmitters which are not in a SFN. To protect the finite number of TII codes, we recommend that codes are not issued for multiplexes using only a single transmitter. In ETSI 300 401 there are 70 Main IDs and 24 Sub IDs thus giving 1,680 unique codes. If small scale DAB is successful, these codes could run out..

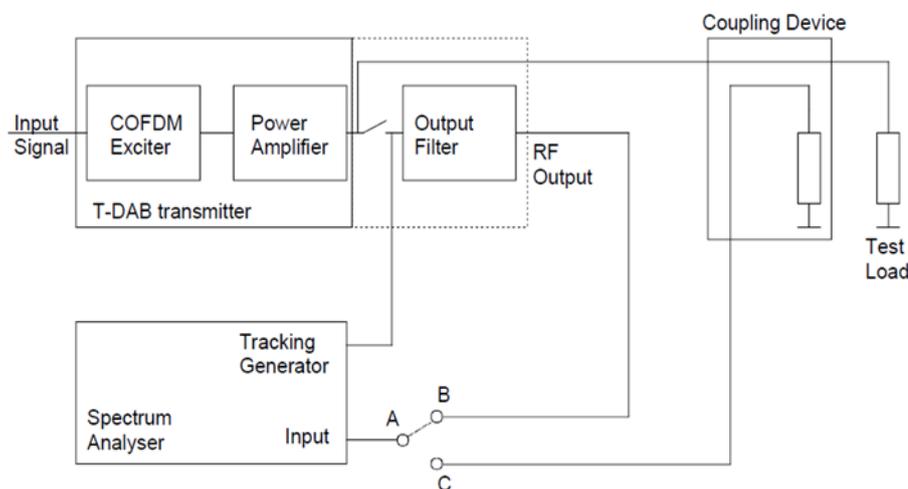
To this end, we recommend that the TII codes are repeated in the Nations, England, Scotland, Wales and Northern Ireland. Main IDs are allocated to major metropolitan areas for example five Main IDs for the London Area allowing 120 transmitters, two Main IDs for Nottinghamshire allowing 48 transmitters followed by Hampshire and Yorkshire.

³ See ETSI 300 401 - 11.3.2 Equal Error Protection (EEP) coding

Paragraph 2.5c: As we set out above, the use of the Critical Mask should be adhered to in all circumstances unless Ofcom can show that ACI does not contribute to the adjacent channel protection ratio both DAB to DAB and DAB to PMSE and the adjacent channel protection ratio is dominated by blocking.

Paragraph 2.5c(i): In order to overcome dynamic range limitations of typical spectrum analysers, we propose a composite measurement approach. Arqiva recommends the methodology described in ETSI EN 302_077 V2.1.0 Annex B1.2

The composite measurement approach enables the user to effectively increase the dynamic range of the spectrum range (from typically >60dBc) to a figure equal to that of the analyser and filter combined- typically > 100dB (dependent on filter depth). This is set out below:



To overcome dynamic range limitations of typical spectrum analysers a composite measurement approach is proposed as follows:

- NOTE 1: Disconnect the power amplifier from the output filter.
- NOTE 2: The frequency response of the output filter shall be measured and recorded (connection A to B).
- NOTE 3: The spectrum of the DAB signal at the output of the power amplifier shall be measured and recorded (connection A to C).
- NOTE 4: The out-of-band spectrum of the DAB signal shall be calculated by applying the recorded frequency response of the output filter to the recorded spectrum of the DAB signal.
- NOTE 5: If the transmitter does not include any output filter, an external filter shall be added after the transmitter for the testing arrangement. This filter shall be representative of the RF combiner or filter existing in operational conditions and viewed by the transmitted output when installed. In this case, the antenna port measurements shall be performed at the output of this extra filter.

Figure B.2: Testing arrangement for out-of-band emissions

Paragraph 2.5c iii: Tunnel Systems may need an exemption due to the multiple blocks being common amplified in an active repeater arrangement and a single filter used across all of the blocks.

Paragraph 2.8: Calibration data for the coupler should be available for Ofcom to review, forward and reverse for all channels from 7D to 12D. The coupler must be a true RF coupler not a Bird through line device. It should be accurate +/- 1dB at 20 degrees C. If it is not calibrated, then any power measurement is highly suspect.

Paragraph 3.6: Add to the final bullet point the following explanatory words:

because they have a tighter vertical radiation pattern which must be pointed at the horizon

Paragraph 3.7: Add to the first bullet point the following words:

or with wide vertical radiation patterns or down tilting the antennas.

Paragraph 3.8 The terminology used in 3.8 is using the language of RDS. This is not the terminology used in ETSI 300 401. This section should be rewritten around Announcement Support and Announcement Switching. This is more limited than the RDS specification as it is limited to the tuned to ensemble.

Paragraph 3.10: MCI repetition rates are important, so a receiver can find services in a multiplex, follow any reconfigurations etc. The FIGS which carry the MCI are not time interleaved and are therefore more prone to flat fades in the RF channel, but high repetition rates compensate for this effect.

We believe that reproducing the guidance in ETSI TS 103 176 is the best approach and receiver manufacturers will be building their receivers to this specification. Therefore, there is no risk of ambiguity between the code and TS 103 176. The Code should replace 3.10, 3.11 and 3.12 with the wording below from TS 103 176:

The FIC also carries Multiplex Configuration Information (MCI). This information describes the current multiplex in terms of services, service components and sub-channels. When the multiplex is reconfigured, the MCI also describes the next multiplex configuration. To ensure that receivers know the configuration of the multiplex quickly, all configuration information is normally signalled every 96 ms, except for FIG 0/8 for data service components and FIG 0/13 which are signalled at least every 1 s. During a reconfiguration, all configuration information for both the current and next configurations is normally signalled in 192 ms, except for FIG 0/8 for data service components and FIG 0/13 which are signalled for both the current and next configurations at least every 1 second (see ETSI EN 300 401 [1], clause 6.1).

The signalling in the FIC of both MCI and SI can achieve the nominal repetition rates for ensembles with up to 20 DAB+ audio services, each carrying a SlideShow in PAD, and with additional SI for date and time, language, programme type, service following and announcements.

However, due to the fixed capacity of the FIC, when a greater number of service components is present, the signalling rates will be lower. It is recommended that of the 12 FIBs available in each 96 ms period, a maximum of 10 are allocated to delivering the MCI and labels, with the remaining FIBs allocated to SI.

The configuration of the ensemble and the SI features supported determine the actual repetition rates signalled for each FIG, and these shall not fall below one third of the nominal rates defined in ETSI EN 300 401.

A reasonable rule of thumb is to expect the repetition rates to decline to be about half of the nominal rates as the number of service components rises to around 40, and to further decline to be about one third of the nominal rates when about 60 service components are present in an ensemble.

The number of services in the ensemble is provided by FIG 0/7, which can be used to verify when the complete MCI has been received.

The total number of service components can then be determined from FIG 0/2 to give an indication of the likely repetition rates.

Paragraph 3.11: We believe that the word “licensee” is incorrect in this context as this refers to an application process before a licence is issued. We suggest the word “applicant” or similar is used.

Paragraph 3.14: Full rate (48 kHz) Mpeg 1 layer II audio services must use UEP level 3 and seek Ofcom's permission for using higher levels of protection. For half rate services (24 kHz) we believe that EEP level 3 should be used. For Data services as the application can be designed to carry different correction algorithms the error protection profile selected in the DAB specification ETSI 300 401 should be at the Service Providers' discretion.

Paragraph 3.15: We address the issues raised in this paragraph in our answer to question 3 of this consultation.

Paragraphs 3.42-3.43: We recommend that a common impact measurement tool is used across the industry which meets the minimum receiver performance.⁴ This is important not just for the protection ratio but also for the receivers' sensitivity to ACI and blocking. This receiver has an associated GNSS receiver for location and a calibrated band III antenna for mounting on the outside of a vehicle vertically polarised (mag mount). The vehicle doing the measurement has a metal roof so creating a substantial ground plane for the antenna.

We recommend an industry recognised CSV file format, with

- location (latitude and longitude);
- dBm (this can be converted to FS with known antenna);
- frequency;
- time of day;
- pre Viterbi error correction;
- MER; and
- free text for example run number/conditions.

The receiver is capable of doing ten measurements per second or more. If two receivers can be synchronised side by side to do wanted and unwanted this would be helpful.

Paragraph 4.7: Arqiva seeks clarification on this point; If a broadcaster is broadcasting on FM and already has a PiD can they request their SiD to match their PiD if their DAB and FM services are always the same thereby taking advantage of the implicit linking?

⁴ As defined in ETSI TS 103 461 V1.1.1 (2017-08) Digital Audio Broadcasting (DAB); Domestic and in-vehicle digital radio receivers; Minimum requirements and Test specifications for technologies and products.

Paragraph 5: References should have the version number of the specification that the code refers to as these documents are updated and changed.

In our view, Ofcom must continue to generate codes. There is no organisation in the Radio Industry which has the technical capability and trust of all parties especially when small scale is launched. Ofcom should refer to the recent experience in Italy where an industry approach to generating codes was attempted and failed.

Question 5: Do you agree with our other proposed revisions to the Technical Policy Guidance for DAB Multiplex Licensees document outlined in Section 7 of this document?

We have no comment to make on this question.

Technical Annex: Q2 proposed adoption of the non-Critical Mask

The proportion of the protection ratio consumed by ACS or ACLR is very dependent on the specific frontend design of the DAB receiver under test. (Definitions are provided in the Glossary at the end of this annex.) For example, a receiver with no frontend filtering which has some switchable attenuation followed by a low noise amplifier (LNA) will be very prone to ACS. The LNA will over load when near to an adjacent channel transmitter which is not co-sited with the wanted transmitter and the automatic gain control of the frontend may well start to turn down the gain of the LNA which drives the wanted signal into the noise floor of the receiver plus distortion of the LNA by being over driven by the adjacent channel signal.

It is assumed that these protection ratios come from ETSI TS 103 461.

Products shall provide adequate audio reception in the presence of interfering DAB signals at specified levels on other frequencies.

The wanted signal shall be a DAB signal at a level of -70 dBm. The interfering signal shall be a DAB signal with a frequency offset and amplitude as described in table 1.

Products shall achieve the required selectivity for an interfering signal in all adjacent channels.

Typically, these protection ratios give a loss of 1 dB C/N in a Gaussian channel for a half rate protected Mpeg1 layer II audio service with unequal error protection.

The key point is that changing the transmitter mask affects only the ACLR.

Three cases need to be considered on the impact of critical vs non-Critical Mask on 1st adjacent services.

- Case 1: when transmitter systems are co-sited sharing the same antenna and where the services ERPs are within a few dBs of each other.
- Case 2: when transmitter systems are co-sited not sharing the same antenna and where the services could be significantly different in ERP on certain bearings.
- Case 3: when the transmitter systems are no co-sited and the second site is within the coverage area of the first.

Case 1

In Case 1 the filter systems form part of the combiner. To get maximum isolation between the transmitter systems is critical especially if they are adjacent channel. In this case Arqiva recommends that the Critical Mask is used to help isolate the transmitters from each other.

In this case as the two signals are correlated at the front end of the receiver as they fade up and down as the receiver moves, the ratio of the wanted to unwanted signals stays the same and as they are very close in power ACS has very little effect. In this case the major cause of degradation is ACLR into the first adjacent so using Critical Mask has two benefits

in isolating the transmitters in the combiner and protecting the first and second adjacent service from ACLR.

Case 2

In Case 2 the signals of the wanted and unwanted will be correlated as they fade up and down as the receiver moves on a specific bearing away from the site but the ratio of the wanted to unwanted on any specific bearing will vary with the patterns of the antennas and the systems relative powers. Arqiva sets the in band IPs of a typical system to around -27 dBc in a given bandwidth, typically 10 kHz.

This is to maximise electrical efficiency of the systems and to meet the critical spectral mask. The value of – 27 dBc comes from the C/N of a Raleigh Channel for a half rate Mpeg 1 Layer II service being in the order of 14 dB to ensure that at the edge of service the self-interference of the transmitter had not created a reduction in coverage, a further 10 dB was added to the 14 dB C/N and a 3 dB margin for other impairments giving -27 dB C/I in the transmitter.

(This estimate is also borne out by practical measurement and increasing the in-band IPs further reduces the service area). If the non-Critical Mask is used the carriers adjacent to the unwanted signal in the wanted signal will have a further 30 dB + (relative effective radiated powers of the signals on that bearing) of interference added.

This will shrink the coverage of the existing service particularly on bearings where the relative ERPs are substantially greater with respect to the interfering signal. This may not be seen local to the transmitter but will be seen on the fringe of service as the signal degrades into the noise floor.

Case 3

This is more difficult as the unwanted transmission may well be a low power transmitter and may be very local in nature, targeting a very specific community so no combiner is present just a single output filter. In this case Ofcom needs to know the split between ACS and ACLR which makes up the protection ratio of a receiver. If Ofcom is convinced that for 95% plus of all receivers sold in the UK that ACS dominates in this case and ACLR has very little impact then allowing non-Critical Mask is OK.

If Ofcom has any doubt and believe that there are any receivers which are degraded by ACLR in the first or second adjacent case because they have been designed to operate well in the ACS case then Ofcom cannot relax from the Critical Mask.

Glossary

- ACS: Adjacent Channel Selectivity is the amount of power that is received from the adjacent interfering channel, depends on the victim receiver frontend filter, selecting the wanted service.

- ACLR: Adjacent Channel Leakage Ratio is the amount of the interference power that leaks into the neighbouring wanted channel. This depends on the transmitter filter of the polluter.
- Ofcom protection ratios: these include a correction for percentage locations but are based on a single protection ratio that includes ACS and ACLR.