Digital Radio Technical Code

DRAFT

This document is a draft of Ofcom's Digital Radio Technical Code. It is being published as part of our consultation on revisions to the Code.

Subject to consultation responses which we receive on the content of this draft, after the consultation closes Ofcom will publish a final version of this Digital Radio Technical Code. Given that Ofcom is currently consulting, Ofcom's thinking and final decisions will depend on feedback received during the consultation process. Areas of proposed change from the current Technical Guidance Policy are highlighted; the final version may differ from this draft.

NB: Until such time as Ofcom announces the implementation of the new Code, the current Code (dated 1 July 2014) remains in force.

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Section

1. Introduction

1.1 Radio Multiplex licences and the associated Wireless Telegraphy Act (WT Act) Licences (or relevant parts thereof) issued by Ofcom require adherence to this Digital Radio Technical Code, which incorporates technical requirements common to all licences. Additional technical requirements specific to individual licences are given in Part V of the Annex to national multiplex licences and Part IV of the Annex to local multiplex licences; and in the associated WT Act licences[1]. Future classes of radio multiplex licence (e.g. small-scale DAB) can be expected to follow a similar structure in relation to additional requirements.

1.2 A separate document 'Technical Policy Guidance for DAB Multiplex Licensees' gives guidance on the principles which Ofcom will apply to the application of this Code. That document may change in response to changing market conditions and to further experience gained in the deployment of digital radio multiplexes.

1.3 This Code, and specific requirements within individual licences, are additional to, or specify the applicable options within, the applicable digital radio standards published by recognised standards bodies referred to within this document and listed in Section 5, References Abbreviations used within this Code are defined within th3ose standards, unless explicitly defined herein.

Other Responsibilities

1.4 The conditions in this Code relate solely to the requirements that Ofcom places on digital radio multiplex licensees under their Broadcasting Act Licences and associated Wireless Telegraphy Act licences . Compliance with these requirements does not absolve the licensee from other legal responsibilities in areas such as (but not limited to) electromagnetic field exposure, electromagnetic compatibility, and compliance with the general requirements of the 2003 Communications Act which are outside the explicit scope of broadcast licences; particularly in respect of Part 2, Chapter 1 (Electronic Communications Networks and Services).

[1] The relevant provisions should in principle be applied respectively as follows: constraints on transmitters and their radiated signals in the WT Act licence, coverage obligations and multiplex management (transport streams, capacity use etc.) in the Broadcasting Act (B Act) licence. However, for the time being some detailed aspects of transmission constraint are contained within the B Act licence (see Section 2 of this Code). All licensees must adhere to the terms of both licences, which have been drawn up so as to avoid inconsistency.

2. Radiated Signals

Commissioning tests and subsequent modifications

2.1 Tests will need to be carried out by or on behalf of the licensee before it is permitted to transmit to air from any given transmitter. Ofcom will require satisfactory evidence of compliance with this specification, and the particular conditions of the licence, at least four weeks before such permission might be expected to be granted (assuming compliance is achieved). The tests and associated evidence should provide a reasonable confidence level that transmissions will remain compliant after commissioning.

2.2 Ofcom reserves the right to conduct its own tests on-site before giving permission to transmit, or at any time thereafter. If such tests are deemed by Ofcom to be necessary because of inadequacies or ambiguities in the evidence supplied by the licensee, then an additional fee will be payable to Ofcom at its sole discretion.

2.3 No modification or adjustment to the RF characteristics of the transmission system, including aerials, may be carried out without the prior permission of Ofcom. Four weeks' notice of such changes will normally be required.

Inspection and Monitoring

2.4 Ofcom will have access to the transmitter installation from time to time to conduct inspections, and tests thereof, to verify continued compliance with this specification. Ofcom also reserves the right to conduct such other tests as it sees fit, including the remote measurement of the licensees' transmissions, without notifying the licensee. Licensees should ensure that arrangements made with third parties, and the quality and availability of documentation facilitate any of these inspections and tests.

Radiated Signals

2.5 Radiated signals shall comply with the specifications EN 300 401[i] and EN 302 077[ii]. Options within clauses 14 and 15 of the specification should be applied as detailed below.

a) Transmission Mode I.

b) Transmitter Identification Information (TII). Use of these codes is optional, but if transmitted at all, they must be both accurate and appropriate, within the provisions of EN 300 401.

c) Spectrum Mask. Unless specifically permitted otherwise in the licence, the radiated output of all transmitters, measured downstream of all combining and filtering equipment, must comply with the critical case ('Case 1') mask as specified in Section 4.2.5 of EN 302 077, intended to ensure compatibility with adjacent channels. In some situations it may instead be possible for transmitter systems to comply with the more relaxed uncritical case ('Case 2') mask, and the licence will explicitly notify where this is

permitted in respect of individual transmitter sites. The respective mask characteristics require that at frequencies (f_r) relative to the centre carrier frequency (f_c) emissions should not exceed those in tables 1 & 2 below:

Table 1: Critical case mask characteristic ('Case 1')

Frequency difference from centre carrier frequency F_c (MHz)	Low Power ($P_c \leq 25$ watts): Absolute Level (dBm)	*Low Power: Relative restriction (dB)*	Medium Power ($P_c >$ 25 watts and ≥ 1000 watts): Relative level (dBc)	*Medium Power: Relative restriction (dB)*	High Power ($P_c > 1000$ watts: Absolute level (dBm)	*High Power: Relative restriction (dB)*
±0.77	18		-26		34	
±0.97	-27	*-45*	-71	*-45*	-11	*-45*
±1.75	-62	*-80*	-106	*-80*	-46	*-80*
±3.0	-62	*-80*	-106	*-80*	-46	*-80*

Table 2: Uncritical case mask characteristic ('Case 2')

Frequency difference from centre carrier frequency F_c (MHz)	Low Power ($P_c \leq 25$ watts): Absolute Level (dBm)	*Low Power: Relative restriction (dB)*	Medium Power ($P_c >$ 25 watts and ≥ 1000 watts): Relative level (dBc)	*Medium Power: Relative restriction (dB)*	High Power ($P_c > 1000$ watts: Absolute level (dBm)	*High Power: Relative restriction (dB)*
±0.97	18		-26		34	
±0.97	-12	*-30*	-56	*-30*	4	*-30*
±3.0	-62	*-80*	-106	*-80*	-46	*-80*

Notes to Tables 1 and 2:

Pc = Conducted power (watts) per OFDM block

The absolute power levels shown are mean power levels measured in a 4 kHz bandwidth.

For convenience, relative restrictions with respect to the first break point are shown in italics

i) Demonstration of compliance will require use of a capable spectrum analyser with appropriate input filtering, resolution bandwidth and averaging. It may be necessary for adjacent channel transmitters combining onto the same antenna, to be switched off during the relevant part of these tests.

ii) For the avoidance of doubt, transmitters placed into service before [*date which this revised Code comes into force*] are required to comply with the spectral mask

requirements in the previous version of this Code (available from Ofcom on request).

iii) Where Very Low Power Repeaters are being used, these are permitted to radiate from (and including) Block 10B (211.648 MHz) to Block 12D (229.072 MHz). These devices will be required to meet the critical case mask as defined above, out to 3 MHz below block 10B fc and 3 MHz above 12D f_c. For spurious emissions outside of those two limits, EN 302 077 will again apply. These devices and associated antennas are not to be capable of radiating an ERP of more than 10mW, and will be required to employ both input and output filtering to ensure adherence to spurious emission limits, even under conditions of instability.

d) Frequency Accuracy. The centre carrier (which may be nulled) must be within 1 kHz of the assigned frequency. In practice, the operator will seek to achieve far greater accuracies than this, to ensure the integrity of any multiplex using more than one transmitter.

e) Timing. Offsets may be determined by the licensee and subject to adjustment as required to optimise coverage to the licensee's requirements consistent with, or better than, its originally proposed Technical Plan. Ofcom requires to be informed of timing offsets once the network has stabilised.

2.6 Other requirements in respect of the radiated signals are that:

a) an absolute limit of radiated power from any one transmitter should be respected, of not more than -50 dBm in a 50 kHz band centred on 243 MHz[2];

b) vertical polarisation only shall be employed; and

c) specific out-of-band requirements relating to the protection of other services may be applied if necessary, and will be notified in the Licence.

Transmitter Equipment – general

2.7 Multiplex licensees are advised to take reasonable precautions against the inadvertent adjustment of transmissions by unauthorised persons.

2.8 The transmitter must incorporate a suitable meter indicating, or uniquely related to, the RF output power. For transmitter systems whose output is combined with other multiplexes to feed a common antenna system a forward/reverse monitor point and associated calibration data must also be provided, presented as fixed coaxial connectors (50 ohm), fed via suitable directional coupling mechanisms from the transmitter RF output, downstream of all combining and filtering equipment. These provisions are to facilitate regulatory checks respectively of output power and spectral content without, if possible, interrupting the multiplex service. Nevertheless, Ofcom reserves the right to take any transmitter out of service at 15 minutes' notice and without compensation to inspect any aspect of the

[2] Required for protection of the international Aircraft Emergency frequency

equipment's set up and operation, for which the licensee must provide reasonable assistance as required.

Feeder Arrangements and Performance

2.9 Provision should be made for any transmitter which is in or may be switched into the transmission chain, to be fed into a dummy load to facilitate testing without the transmitter being on-air. The transmitting aerial must be matched to the characteristic impedance of its RF feeder cable to provide a reflected power of no more than -16 dBc. The reflected power presented to the transmitter RF output, or to the combiner output in the case of multiple transmitters, must not be greater than -14 dBc. These performances must be achieved over a bandwidth of at least 1.5 MHz at all of the relevant frequencies. The requirements for feeder performance are to ensure that a useful correlation will exist between measurements taken of transmitters when they are, and are not radiating.

3. Multiplex Technical Management

General principles

3.1 The effects of the multiplexer's handling and referencing of services carried within the multiplex must be in accordance with EN 300 401[i], accurate, effective and (particularly between sound programme services) non-discriminatory.

3.2 Information relating to individual services should reflect the preferences and interests of the service provider concerned, including those with reserved capacity, provided that this does not unreasonably impinge on the interests of other services on this (or other) multiplex(es).

Technical Quality: channel capacity

3.3 The attribution of channel capacity to individual programme services on the multiplex must be consistent with the provision of generally high standards of technical quality across the audio services carried by the multiplex, taken as a whole.

3.4 Ofcom regards the basic quality of audio as originated and supplied to the multiplex operator as being a matter for the sound programme service licensee to control and agree with the multiplex operator.

3.5 Audio quality should generally be of a standard consistent with reasonable expectations for the majority of listeners, taking into account the nature of the content and the sound programme service concerned. Factors relevant to expectations may include the target audience, and the quality with which the service concerned may be delivered on other platforms.

3.6 The licensee shall broadcast sound programme services whose principal packaging characteristics[3] are as recorded in the technical annex to the multiplex licence.

Audio encoding

3.7 Audio encoding shall conform to either:

- the MPEG Layer II model as described in ISO/IEC 11172-3[iii], ISO/IEC 13818-3[iv] and EN 300 401[i] or
- the subset of the MPEG-4 High Efficiency Advanced Audio Coding v2 (HE AAC v2) Layer 2 profile described in ISO/IEC 14496-3[v] and TS 102 563[Error! Bookmark not defined.]. In cases w here it is proposed to migrate an existing service from MPEG Layer II to HE AAC v2, multiplex licensees must liaise with the relevant Digital Sound Programme licensee(s) with the aim of providing timely and appropriate advice to listeners (for example in the

[3] For the purposes of this clause, technical packaging characteristics means the parameters ‘stereo or mono’ and ‘full or half rate coding’.

form of announcements) alerting them to the forthcoming change, and advising on how listeners can continue receiving the service (e.g. by using a DAB+-capable receiver).

Supplementary signalling

3.8 Transmission of the Traffic Programme (TP) flag by sound broadcast services is not permitted unless dynamic control of the Traffic Announcement (TA) flag is available and in current use.

Relationship between multiplex elements

3.9 The interruption of services on a multiplex in order to carry announcements should only be by agreement with the programme service provider concerned.

3.10 A complete set of MCI information should normally be transmitted at least ten times per second (this may be halved in the six seconds preceding a reconfiguration of the multiplex. TS 103 176[vi] sets out that the nominal repetition rates can be achieved for multiplexes with up to 20 audio services, each carrying a slideshow, and additional data for date and time, language, programme type, service following and announcements.

3.11 It may be possible to accommodate a greater number of services and respect the nominal repetition rates depending upon the licensee's multiplex type and configuration, particularly if not all of the listed components are carried. If more than 20 services are carried, transmitted repetition rates can be slightly reduced, but they should never fall below one-third of the nominal rates specified in TS 103 176 and EN 300 401[i]. Licensees are responsible for ensuring the compliance of their transmitted signal to approved standards.

3.12 An adequate repetition rate should be maintained for Service Information (SI) carried within the FIC.

3.13 Adequate and agreed information exchange and synchronisation should be provided between service providers and the multiplex licensee, particularly in the context of multiplex reconfiguration

Error Protection

DAB

3.14 Unless Ofcom's prior written consent has been obtained, DAB-encoded services must use Unequal Error Protection level 3 ('UEP-3'). Licensees wishing to deploy a more robust level of error protection (i.e. UEP-1 or UEP-2) may seek Ofcom's consent to implement these higher protection levels. Ofcom will not consider requests to transmit services at less robust protection levels than UEP-3 (i.e. UEP-4 or UEP-5).

DAB+

3.15 DAB+-encoded services must use Equal Error Protection level 3A (EEP-3A).

4. Data services and Features

4.1 Under EN 300 401[i], data services may be sent in any of the following conduits within a digital radio multiplex:

a) a sub-channel dedicated to data; or

b) X-PAD within an audio channel; or

c) the FIDC.

Although it is possible to convey more than one data service within any one channel of any of the above types, Ofcom requires that each data service carried on the multiplex is set out in the annex to the licence as being in one and only one of the following categories:

i) an ancillary service (data related to a digital sound programme service and provided by the relevant digital sound programme service licensee) or an additional service (data related to a digital sound programme service, but not provided by the relevant digital sound programme service licensee); or

ii) an additional service carrying programme-related or stand-alone advertising material; or

iii) an additional service (general telecommunications - not carrying advertising material); or

iv) a technical service (for encryption of sound programme services).

For the purpose of enforcing its licence conditions limiting the proportion of multiplex capacity attributable to additional services each identifiable individual data channel formed by any of the means (a) to (c) above must carry data which is entirely composed of the above-defined types as described in i) to iv).

However, it will be permitted to carry within a single identifiable data channel, a combination of data types as described in i) and ii), provided that the multiplex licensee is able to provide a reasonably reliable analysis of the proportion of capacity within that data channel which is used respectively for the two types. It may not be necessary to measure the relative usage directly if the analysis is based on a well- founded derivation. If data types as described in i) and ii) are to be mixed in this way, the method of analysis must be proposed to and agreed by Ofcom beforehand.

Multiplex and Service Features

4.2 Table 3 summarises the conditions/requirements applied by Ofcom in respect of particular features defined in EN 300 401[i]. The 'Reference' column denotes whether the detail is specific to a given licence, and therefore defined therein, or defined in this Code. Inclusion of relevant Codes in the licence will in most cases be for the purpose of ensuring compatibility with other multiplexes and services, but it is intended also to enable Ofcom

to provide a centralised and accurate source of reference for outside agencies, and particularly for receiver manufacturers testing new designs.

4.3 In order to ensure compatibility between commercial and BBC multiplexes and services, where applicable, allotments of available codes have been agreed between Ofcom and the BBC.

Table 3: Multiplex and Service Features

Feature	Reference	Comments
Ensemble Identifier	Licence	Unique for each multiplex. Allocated by Ofcom from the range: (Hex) "C (0-F) (8-F) (0-F)"
Ensemble Label	Licence	Unique for each multiplex. Proposed by the licensee, approved and registered by Ofcom
Country Codes	Code	Country Code for UK is (Hex) "C" Extended Country Code is (Hex) "E 1"
Time and Date	Code	Not compulsory, but must be accurate if provided
Regional Definitions and Labels	Licence	If used, to be proposed by the licensee, and approved and registered by Ofcom, at least until the desirability of standardisation across multiplexes has been further studied
TII (MainId and SubId) Main from range 00-45 Hex Sub from range 01-17 Hex	Licence	Not required, but if implemented, to be advised (by transmitter) by the licensee, and registered by Ofcom[4] [5]
Timing Offset	Licence	To be determined by the licensee and notified, for each transmitter, to Ofcom
Service Identifier (Audio)	Licence	Allocated by Ofcom from the same range as available for RDS PI Codes, i.e.: (Hex) "C (0-F) (8-F) (0-F)" To date RDS PI Codes have been confined to the range (8-B) in the third digit and the intention is to allocate Sids from the remainder, ie (C-F) in the third digit. Where, however, a service is simulcast on both VHF FM and DAB or DAB+, with no opt-outs, the existing PI Code may be used as the SId also. Alternatively different codes can be used and connected via a suitable 'linkage' mechanism

[4] Ofcom will allocate each transmitter a TII so as to provide some future proofing should use of TII become necessary. Licensees should advise Ofcom when the TII is brought into use.

[5] An on-channel repeater that is re-transmitting a signal from a transmitter that is providing a TII can suppress the TII on its output.

Service Identifier (Data)	Licence	Unique code for each service, allocated from the range: (Hex) "E 1 C (0-F) (0-F) (0-F) (8-F) (0-F)" It may prove useful to use one of the digits (probably the last) as a means of qualifying data type.
Service Label	Licence	Similar to RDS PS Name. Unique to each service. Proposed by the licensee, approved and registered by Ofcom
Linkage Set Number	Licence	These are to come from the range (Hex) "(1-F) (8-F) (0-F)" One LSN may apply to services across different multiplexes therefore until compatibility issues are fully assessed, codes will be controlled and issued by Ofcom in liaison, where applicable, with the BBC
Static PTy, Dynamic PTy, and Pnum	Code	No requirement or prohibition, but if provided it must be effective in operation, accurate, and non-discriminatory, and subject to these conditions, it should reflect the preferences/advice of the programme service provider (including simulcasters). Static PTy should be provided if dynamic PTy is not. The presence of PTy should be flagged according to whether static or dynamic.
Minimum Protection Level	Licence	Minimum levels, where required, will be detailed for each service

4.4 Service following should be implemented in accordance with ETSI TS 103 176. This specification allows hard-linking at times when stations are broadcasting identical content. This specification also allows soft-linking for 'related' services.

4.5 Ofcom has determined the definition of 'related' services as follows: soft-linking will be allowed only for stations which are also using hard-linking for a significant amount of time on a daily basis and then only at times when such stations are broadcasting separate local programming (or advertising)[6]. In all other cases, soft-linking is not permitted.

4.6 This rule applies between and within platforms (e.g. DAB to DAB, DAB to FM).

4.7 Linkage, whether 'hard' or 'soft' for handover to analogue services (and similar vectoring arrangements for announcements), is neither required nor prohibited, save that simulcast services in particular must have an adequate capacity and execution given within the FIC to

[6] Within this requirement it would be permissible to transmit both hard and soft links simultaneously and only toggling the hard link (so as to save FIC capacity and make signalling easier) at such times that stations using hard-linking for a significant amount of time on a daily basis, broadcast separate local programming (or advertising).

provide for reasonably effective handover of listeners to equivalent analogue services, to the extent that the simulcast operators concerned require it.

5. References

[i] ETSI EN 300 401 Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers

[ii] ETSI EN 302 077 Transmitting equipment for the Digital Audio Broadcasting (DAB) service; Harmonised Standard for access to radio spectrum

[iii] ISO/IEC 11172-3 Information Technology – Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbit/s – Part 3: Audio

[iv] ISO/IEC 13818-3 Information technology – Generic coding of moving pictures and associated audio information – Part 1: Systems

[v] ISO/IEC 14496-3: Information technology – Coding of audio-visual objects – Part 3: Audio

[vi] ETSI TS 103 176 Digital Audio Broadcasting (DAB); Rules of implementation; Service information features