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Reference Parameters for Digital Terrestrial Television Transmissions in the United Kingdom

Version 8: DRAFT FOR CONSULTATION

Publication Date: TBC

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1. Introduction

1.1 This document describes the currently applicable transmission standards used by all licensees providing a service under an Ofcom Multiplex Service Licence, as referred to by the Ofcom Television Technical Performance Code[1]. It describes a reference system for digital terrestrial television multiplex transmissions and specifies the minimum necessary parameters to ensure that receivers can demodulate and decode all services.

1.2 The 1996 Broadcasting Act required the Independent Television Commission (ITC) to have regard to certain matters in awarding a multiplex licence, including proposals by applicants for promoting equipment capable of receiving all the multiplex services available in a given area. In its Invitation To Apply, the ITC required that such proposals be made. In order to maintain the ability to receive all the multiplex services, it was necessary to specify certain technical requirements covering common methods of delivering video, audio, text and data applications, together with an explanation of the constraints imposed by the Broadcasting Act on data capacity use in digital terrestrial services. These particular requirements were previously contained in the draft 'ITC Rules of Operation on the use of the DVB-T Specification'[2]. They were subsequently updated in September 2002 and incorporated in the former ITC Community Digital Standard[3].

1.3 This document also contains parameter sets for UK digital terrestrial television services which are not provided under an Ofcom Multiplex Service Licence, but which are required to observe the 'Reference Parameters' by their Wireless Telegraphy Act licences.

2. Reference System

2.1 Where a feature is mandatory the word “shall” is used. All other features and recommendations are optional but where used, shall conform to the provisions of the relevant ETSI standard or associated guideline.

Modulation and Channel Coding: DVB-T Multiplexes

2.2 EN 300 744[4] specifies the modulation and channel coding for DVB-T systems.

2.3 The frequency offset applied to the carriers on individual channels is 0, or +/-$^{1}/_{6}$ MHz (+/- approximately 167 kHz).

2.4 In order to maximise the commonality of digital terrestrial transmissions the sub-set of EN 300 744 as described in Option 1A shall be used by any Ofcom Multiplex Licensee carrying a Channel 3, Channel 4, or Channel 5 service in standard definition form.

2.5 The Local Television Service Multiplex Licensee (the multiplex service licensed by Ofcom under the Local Digital Television Programme Services Order 2012[5]) shall adopt the sub-set of EN 300 744 described in Option 1C.

2.6 Other Ofcom Multiplex Licensees may alternatively adopt the sub-set of EN 300 744 as described in Option 1B.

2.7 Multiplex Licensees may adopt alternative sub-sets of the EN 300 744 standard at specified Emitting Points with the prior written consent of Ofcom. Should Ofcom consent to the use of alternative modulations modes on a permanent basis, additional sub-sets of EN 300 744 will be incorporated in future revisions of this document.

Table 1: DVB-T OFDM Parameters

OFDM Parameter	Option 1A Value	Option 1B Value	Option 1C Value
Number of carriers	6817	6817	6817
Modulation	64 QAM	64 QAM	QPSK
Outer Coding R_C	2/3	3/4	3/4
Guard Interval (Δ/T_U)	1/32	1/32	1/32
Carrier spacing	1.116 kHz	1.116 kHz	1.116 kHz
Spacing between carriers (k_{max} & k_{min})	7.61 MHz	7.61 MHz	7.61 MHz

Modulation and Channel Coding: DVB-T2 Multiplexes

2.8 EN 302 755[6] specifies the modulation and channel coding for DVB-T2 systems.

2.9 Multiplex Licensees authorised to use the DVB-T2 system shall adopt the subset of EN 302 755 standard described in Option 2A of Table 2.

2.10 Use of the extended bandwidth mode is optional.

2.11 The subset of EN 302 755 currently adopted by the Northern Ireland Multiplex (providing Republic of Ireland television services within Northern Ireland) is described in Option 2B on an informative basis only.

2.12 Multiplex Licensees who are authorised to use the DVB-T2 system may adopt alternative sub-sets of the EN 302 755 standard at specified Emitting Points with the prior written consent of Ofcom. Should Ofcom consent to the use of alternative modulation modes on a permanent basis, additional sub-sets of EN 302 755 will be incorporated in future revisions of this document.

Table 2: DVB-T2 OFDM Parameters

OFDM Parameter	**Option 2A Value**	Option 2B Value (Informative)
Number of carriers:		
Normal Mode	27265	27265
Extended bandwidth mode	27841	n/a
Modulation	256 QAM	QPSK
Outer Coding R_C	2/3	2/3
Guard Interval (Δ/T_U)	1/128	1/128
Carrier spacing	279 Hz	279 Hz
Spacing between carriers (k_{max} & k_{min}):		
Normal mode	7.61 MHz	7.61 MHz
Extended bandwidth mode	7.77 MHz	n/a

Source Coding of Video Signals

2.13 Video encoding conforms to ISO/IEC 13818-2[7] and observes the implementation guidelines contained in TS 101 154[8]. Table 3 shows the configuration for all digital programme services and Qualifying Services carried on the multiplex:

Table 3: Video Parameters

Parameter	Value
MPEG-2 Profile	Main
MPEG-2 Level	Main
Frame Rate	25Hz
Aspect Ratio	4:3 or 16:9

2.14 It is recommended that appropriate Active Format Description (AFD) be included in the user data of the video elementary stream. Commonly referred to as having an AFD value in the range 0-7, this should be taken from AFD 0-3 or 5-7 as shown in Table 4. The table lists the corresponding values of active_format in TS 101 154 that should be included.

Table 4: Values of active_format

AFD	active_format	Aspect ratio of the "area of interest"
0	1000	Active region is the same as the coded frame
1	1001	4:3 (centre)
2	1010	16:9 (centre)
3	1011	14:9 (centre)
4	1100	Reserved for future use
5	1101	4:3 (with shoot and protect 14:9 centre)
6	1110	16:9 (with shoot and protect 14:9 centre)
7	1111	16:9 (with shoot and protect 4:3 centre)

Advanced Video Coding (AVC)

2.15 Where the prior written consent of Ofcom has been obtained, advanced video encoding may be employed that conforms to ISO/IEC 14496-10[9] and observes the implementation guidelines contained in TS 101 154[8]. Table 5 shows the configuration for standard definition digital programme services or Qualifying Services carried on the multiplex and Table 6 shows the configuration for high definition digital programme services or Qualifying Services carried on the multiplex:

Table 5: Video parameters for standard definition services

Parameter	Value
AVC Profile	Main
AVC Level	3
Frame Rate	25 or 50Hz
Aspect Ratio	4:3 or 16:9

Table 6: Video parameters for high definition services

Parameter	Value
AVC Profile	High
AVC Level	4.0
Frame Rate	25 or 50Hz
Aspect Ratio	16:9

2.16 Alternative video coding standards may be employed at specified Emitting Points with the prior written consent of Ofcom. Should Ofcom consent to the use of alternative encoding standards on a permanent basis, such standards will be incorporated in future revisions of this document.

Source Coding of Audio Signals

2.17 Audio encoding conforms to ISO/IEC 13818-3[10] and observes the Implementation Guidelines contained in TS 101 154[8].

2.18 Additional audio channels, such as Audio Description or foreign language services, within the programme channel may be included in conformance with the general requirements outlined in TS 101 154.

Alternative Audio Encoding

2.19 Where the prior written consent of Ofcom has been obtained, audio encoding may be employed that conforms to ISO/IEC 14496-3[11] or TS 102 366[12] and observes the Implementation Guidelines contained in TS 101 154[8]

Multiplexing Of Signals

2.20 The multiplexing of baseband signals conforms to ISO/IEC 13818-1[13] and observes the Implementation Guidelines contained in TS 101 154[8].

2.21 In summary, all of the individual components of a service are combined into a single MPEG-2 compatible Transport Stream subject to the constraints outlined in the Implementation Guidelines on the use of MPEG-2 Systems in TS 101 154.

2.22 The Broadcasting Act 1996 requires that 90% of the multiplex capacity must be available for the transmission of digital programme services. Further information on Ofcom's interpretation of how the statutory limits apply to the constituent parts of a multiplex is available in Ofcom's Guidance on Data Limits on Digital Terrestrial Television Multiplexes[14].

Program Specific Information

2.23 Transport Streams provide the tables and descriptors of Program Specific Information (PSI) as required by ISO/IEC 13818-1[13], TS 101 154[8], EN 300 468[15] and TR 101 211[16]. These and any additional items are used in the manner required by these specifications and guidelines.

2.24 In summary each Transport Stream carries the following PSI tables: PAT, PMT and NIT. Transport Streams carrying scrambled services also carry a CAT.

2.25 The PIDs of all of the transport stream packets relating to the transmission of licensed services intended for General Reception in each Transport Stream are one of the PIDs defined by ISO/IEC 13818-1 or EN 300 468 and are listed in the CAT, PAT or PMT as described above.

Service Information

2.26 All Transport Streams provide tables and descriptors of Service Information (SI) required by EN 300 468[15] and TR 101 211[16] and the additional features listed below.

Network Information Table (NIT)

2.27 Each Transport Stream carries, where reasonably practicable, NITs describing ALL the Transport Streams originating from a specific Emitting Point carrying services licensed for delivery in the UK regardless of whether they are part of the same Network. A terrestrial_delivery_descriptor is provided for each Transport Stream described.

Service Description Table (SDT)

2.28 Each Transport Stream carries, where reasonably practicable, SDTs describing the services in ALL the Transport Streams originating from a specific Emitting Point carrying services licensed for delivery in the UK regardless of whether they are part of the same Network.

2.29 A service_descriptor is provided for each service described. All of the service_descriptors carried in each SDT carry Meaningful names in respect of which are intended for identification by and display to viewers.

Event Information Table (EIT)

2.30 Each Transport Stream carries EIT present and following information for all events carried on the actual and ALL other transport streams originating from a specific Emitting Point. This does not apply to those services which do not normally make use of a schedule, for example music only services. Each EIT carries a short event name with a Meaningful name.

2.31 It is recommended that the maximum length of each name should not exceed 40 characters in length.

2.32 It is recommended that the transition between the present and following event should normally be accurate within 10 seconds of the event transition in the Digital Television Service.

Time Offset Table (TOT)

2.33 Each Transport Stream carries TOTs with a time offset descriptor for at least the United Kingdom (country code "GBR"). The values of "current time offset" and "next time offset" reflect the legal requirement in the UK at the time of broadcast.

Time and Date Table (TDT)

2.34 Each Transport Stream carries a Time and Date Table.

Allocation of SI codes

2.35 SI codes are detailed in Table 7.

Table 7: SI Codes

SI Code	Status
Original_network_id	A single value is used for all UK DTT services: **0x233A**, as registered with DVB in accordance with TS 101 162[17].
Network_id	A single value is used for all transmissions from each Service Insertion Point (SIP), from values registered with DVB in accordance with TS 101 162[17].
service_id	To be agreed by individual Qualifying Broadcasters, Digital Programme licensees and Digital Additional Service licensees for each service broadcast. Minor changes to regional content of service do not require a new value to be used.
bouquet_id	Codes are used from values registered with DVB in accordance with TS 101 162[17]

transport_stream_id	Used to uniquely identify a transport stream: licensees to determine value to be used.
ca_system_id	Codes are used from values registered with DVB in accordance with TS 101 162[17]
country code	Codes are published in ISO 3166[18] and TS 101 162[17]
private_data_specifier	A single value is used for all UK DTT services: **0x0000233A**, as registered with DVB in accordance with TS 101 162[17]

Multiplexing of Data Broadcast Services

2.36 Any stream of transport packets carrying Data Broadcast Services intended to be identified by and displayed to viewers conforms with any of the methods described in EN 301 192[19]. The data transmissions are referenced in the SI tables as described by EN 301 192 and EN 300 468[15] and observe the guidelines in TR 101 202[20] and TR 101 211[16].

2.37 Data services which are intended for general reception make use of DSM CC Object Carousels as defined in Section 9 of EN 301 192.

Data Coding

2.38 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[21] or the Hybrid Broadcast Broadband TV (HbbTV) standard[22] be used.

Subtitling

2.39 The licensee shall use the DVB Subtitling System as described in EN 300 743[23] for the carriage of subtitling data intended for general reception. The licensee shall implement subtitles using region based graphics with indexed pixel numbers as described in EN 300 743.

Closed Signing

2.40 Methods for delivering digital closed Signing services are currently under development. It is not considered that a technique is sufficiently mature, at the date of publication, to specify its use for all digital broadcasts.

Scrambling

2.41 Where scrambling is required, the Common Scrambling Algorithm defined in TS 100 289[24] would normally be used, unless there are reasonable grounds that this would compromise security.

2.42 The specification and licensing rights to the Common Scrambling Algorithm and the Common Descrambling Algorithm are distributed separately under arrangements with the European Telecommunications Standards Institute which acts as Custodian for the companies which have developed the Common Scrambling Algorithm. For further information regarding the distribution and licensing of the specifications licensees should contact:

ETSI
Algorithms & Codes
650 Route des Lucioles
06921 Sophia Antipolis
France
tel:+ 33 4 92 94 4216
fax: +33 4 92 38 49 04
email: algorithm&codes@etsi.org

A1. Annex 1: Terms and Definitions

Digital Television Service	Any television or data service licensed by the Ofcom and broadcast in a digital format.
Delivery System	The physical means of delivering Digital Television Services to the home. This could include a digital cable system, a digital terrestrial system and a digital satellite system and a digital microwave delivery system.
Network	A Network is the collection of transport streams from a single Emitting Point none of whose components are subsequently altered. More than one reference may be made to the same physical location. Each network from such an emitting point identified by a unique network_id.
Emitting Point	An Emitting Point is a reference to the physical location of a transmitter which broadcasts a Transport Stream. This may be a terrestrial transmitting site, a cable head end or a satellite or series or of satellites operated by a single organisation at a fixed orbital position.
General Reception	A service which is being broadcast for General Reception should be available to any person in the territory (such as the UK) providing they possess an appropriate receiver and have paid any subscription or other fees if such fees are chargeable for that service.
Meaningful	A Meaningful name, as used for service and event information tables, should allow a viewer to determine easily the identity of the service or event being broadcast. This name would normally be linked to the name or brand under which the service is currently being marketed.
Data Broadcast Services	Data services which are intended for General Reception
Qualifying Services	These are: Channel 3, Channel 4, Channel 5, S4C Digital

A2. Annex 2: References

[1] Ofcom Television Technical Performance Code, [link to new version of Television Technical Performance Code]
[2] Draft ITC Rules of Operation on the use of the DVB-T Specification, Rev. 3.0, 5 October 1998
[3] ITC Community Digital Standard and Rules of Operation for Digital Terrestrial Television, Issue 1.2, September 2002
[4] ETSI EN 300 744, "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television".
[5] The Local Digital Television Programme Services Order 2012, http://www.legislation.gov.uk/uksi/2012/292/contents/made
[6] ETSI EN 302 755, "Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)"
[7] ISO/IEC Standard 13818-2, "Information Technology - Generic Coding of Moving Pictures and Associated Audio Information — Part 2: Video".
[8] ETSI TS 101 154, "Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream".
[9] ISO/IEC Standard 14496-10, "Information Technology – Coding of audio-visual objects – Part 10: Advanced Video Coding".
[10] ISO/IEC Standard 13818-3, "Information Technology - Generic Coding of Moving Pictures and Associated Audio Information – Part 3: Audio".
[11] ISO/IEC Standard 14496-3, "Information Technology – Coding of audio-visual objects – Part 3: Audio"
[12] ETSI TS 102 366, "Digital Audio Compression (AC-3, Enhanced AC-3) Standard".
[13] ISO/IEC Standard 13818-1, "Information Technology - Generic Coding of Moving Pictures and Associated Audio - Part 1: Systems".
[14] Data Limits on Digital Terrestrial Television Multiplexes - Guidance", available at https://www.ofcom.org.uk/__data/assets/pdf_file/0027/37089/guidance.pdf
[15] ETSI EN 300 468, "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in (DVB) Systems".
[16] ETSI TR 101 211, "Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)".
[17] ETSI TS 101 162, "Digital Video Broadcasting (DVB); Allocation of identifiers and codes for Digital Video Broadcasting (DVB)". See "DVB-SI Identifiers" at http://www.dvbservices.com/ for currently registered values.
[18] ISO 3166, "Codes for the representation of names of countries and their subdivisions".
[19] ETSI EN 301 192, "Digital Video Broadcasting (DVB); DVB specification for data broadcasting".
[20] ETSI TR 101 202, "Digital Video Broadcasting (DVB); Implementation guidelines for Data Broadcasting".
[21] ETSI ES 202 184, "MHEG-5 Broadcast Profile".
[22] ETSI TS 102 796, "Hybrid Broadcast Broadband TV"
[23] ETSI EN 300 743, "Digital Video Broadcasting (DVB); Subtitling Systems".
[24] ETSI TS 100 289, "Digital Video Broadcasting (DVB); Support for use of the DVB Scrambling Algorithm version 3 within digital broadcasting systems"