

ETSI ES 201 980 V4.3.1 (2023-11)



**Digital Radio Mondiale (DRM);
System Specification**

(<https://standards.iteh.ai>)

Document Preview

[ETSI ES 201 980 V4.3.1 \(2023-11\)](https://standards.iteh.ai/catalog/standards/sist/1b590410-bef5-4baf-973b-8e51115676b6/etsi-es-201-980-v4-3-1-2023-11)

<https://standards.iteh.ai/catalog/standards/sist/1b590410-bef5-4baf-973b-8e51115676b6/etsi-es-201-980-v4-3-1-2023-11>

EBU

ReferenceRES/JTC-DRM-38

Keywordsbroadcasting, digital, DRM, radio

ETSI650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from:

<https://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

If you find a security vulnerability in the present document, please report it through our

Coordinated Vulnerability Disclosure Program:

<https://www.etsi.org/standards/coordinated-vulnerability-disclosure>

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2023.

© European Broadcasting Union 2023.

All rights reserved.

Contents

Intellectual Property Rights	8
Foreword.....	8
Modal verbs terminology.....	8
Introduction	9
1 Scope	10
2 References	10
2.1 Normative references	10
2.2 Informative references.....	11
3 Definition of terms, symbols, abbreviations and conventions.....	11
3.1 Terms.....	11
3.2 Symbols.....	12
3.3 Abbreviations	13
3.4 Conventions.....	14
4 General characteristics	15
4.1 System overview	15
4.2 System architecture	15
4.3 Audio source coding.....	17
4.4 Transmission modes.....	18
4.4.1 Signal bandwidth related parameters	18
4.4.2 Transmission efficiency related parameters.....	18
4.4.2.0 General	18
4.4.2.1 Coding rates and constellations.....	18
4.4.2.2 OFDM parameter set.....	18
5 Source coding modes.....	19
5.1 Overview	19
5.1.0 Introduction.....	19
5.1.1 Extended HE-AAC audio coding (xHE-AAC)	20
5.1.2 AAC audio coding	20
5.1.3 MPEG Surround coding.....	22
5.2 Audio super framing.....	22
5.3 xHE-AAC coding	23
5.3.1 xHE-AAC	23
5.3.1.0 Introduction.....	23
5.3.1.1 xHE-AAC audio super frame	24
5.3.1.2 xHE-AAC audio frame	26
5.3.1.3 Transport of xHE-AAC audio frames within the payload section	26
5.3.2 xHE-AAC decoder configuration	28
5.3.3 xHE-AAC error concealment	32
5.3.3.0 Introduction.....	32
5.3.3.1 Frequency Domain coding (AAC based coding and TCX).....	33
5.3.3.2 ACELP	34
5.3.3.3 SBR	34
5.3.3.4 MPS212 parametric stereo	36
5.3.3.5 MDCT based Complex Prediction	36
5.3.3.6 Forward Aliasing Cancellation.....	36
5.3.4 xHE-AAC + MPS	36
5.3.5 Loudness metadata.....	37
5.4 AAC coding.....	37
5.4.1 AAC.....	37
5.4.2 AAC + SBR	39
5.4.3 Parametric Stereo coding	40
5.4.4 AAC error concealment	41
5.4.4.0 Introduction.....	41

5.4.4.1	Interpolation of one corrupt frame	41
5.4.4.2	Fade-out and fade-in	42
5.4.4.3	Concealment granularity	42
5.4.4.4	SBR error concealment	42
5.4.4.5	Parametric Stereo concealment	45
5.4.5	AAC + MPS.....	45
6	Multiplex definition.....	47
6.1	Introduction	47
6.2	Main Service Channel (MSC)	47
6.2.1	Introduction.....	47
6.2.2	Structure.....	47
6.2.3	Building the MSC	47
6.2.4	Reconfiguration	48
6.3	Fast Access Channel (FAC)	48
6.3.1	Introduction.....	48
6.3.2	Structure.....	48
6.3.3	Channel parameters.....	48
6.3.4	Service parameters.....	51
6.3.5	CRC	53
6.3.6	FAC repetition	53
6.4	Service Description Channel (SDC).....	54
6.4.1	Introduction.....	54
6.4.2	Structure.....	54
6.4.3	Data entities	55
6.4.3.0	Introduction.....	55
6.4.3.1	Multiplex description data entity - type 0	56
6.4.3.2	Label data entity - type 1.....	56
6.4.3.3	Conditional access parameters data entity - type 2	57
6.4.3.4	Alternative frequency signalling: Multiple frequency network information data entity - type 3.....	58
6.4.3.5	Alternative frequency signalling: Schedule definition data entity - type 4	60
6.4.3.6	Application information data entity - type 5	61
6.4.3.7	Announcement support and switching data entity - type 6	62
6.4.3.8	Alternative frequency signalling: Region definition data entity - type 7	64
6.4.3.9	Time and date information data entity - type 8	65
6.4.3.10	Audio information data entity - type 9	66
6.4.3.11	FAC channel parameters data entity - type 10	68
6.4.3.12	Alternative frequency signalling: Other services data entity - type 11.....	70
6.4.3.13	Language and country data entity - type 12	73
6.4.3.14	Alternative frequency signalling: detailed region definition data entity - type 13	73
6.4.3.15	Packet stream FEC parameters data entity - type 14.....	74
6.4.3.16	Extension data entity - type 15.....	75
6.4.3.16.0	General	75
6.4.3.16.1	Service linking information data entity - type 15, extension 0.....	75
6.4.3.16.2	Other data entity type 15 extensions.....	77
6.4.4	Summary of data entity characteristics	77
6.4.5	Changing the content of the SDC	78
6.4.6	Signalling of reconfigurations.....	79
6.4.6.0	Introduction.....	79
6.4.6.1	Service reconfigurations.....	79
6.4.6.2	Channel reconfigurations	80
6.5	Text message application	80
6.6	Packet mode	82
6.6.0	Introduction.....	82
6.6.1	Packet structure.....	82
6.6.1.0	Introduction.....	82
6.6.1.1	Header	83
6.6.1.2	Data field.....	83
6.6.2	Asynchronous streams	84
6.6.3	Files	84
6.6.4	Choosing the packet length.....	84
6.6.5	Forward Error Correction (FEC) for packet mode streams.....	84

6.6.5.0	Introduction.....	84
6.6.5.1	Encoding of FEC Packets.....	85
6.6.5.2	Transport of FEC packets.....	87
6.6.5.3	Receiver considerations	88
6.7	Presentation of service labels and text messages.....	88
6.7.1	Introduction.....	88
6.7.2	Encoding of the text control field	89
6.7.3	Transport of the text control field	90
6.7.3.1	SDC data entity type 1 labels	90
6.7.3.2	Text messages	91
6.7.4	Display of RTL and bidirectional text	91
6.7.4.1	Introduction.....	91
6.7.4.2	Minimum RTL implementation	91
6.7.4.3	Simplified bidirectional algorithm	92
7	Channel coding and modulation.....	93
7.1	Introduction	93
7.2	Transport multiplex adaptation and energy dispersal	94
7.2.1	Transport multiplex adaptation.....	94
7.2.1.0	General	94
7.2.1.1	MSC	94
7.2.1.2	FAC.....	95
7.2.1.3	SDC.....	95
7.2.2	Energy dispersal.....	96
7.3	Coding	97
7.3.1	Multilevel coding.....	97
7.3.1.0	Introduction.....	97
7.3.1.1	Partitioning of the bitstream.....	98
7.3.2	Component code	99
7.3.3	Bit interleaving	104
7.3.3.0	Introduction.....	104
7.3.3.1	FAC.....	105
7.3.3.2	SDC.....	105
7.3.3.3	MSC.....	105
7.4	Signal constellations and mapping	106
7.5	Application of coding to the channels	108
7.5.1	Coding the MSC	108
7.5.1.0	Introduction.....	108
7.5.1.1	Coding.....	108
7.5.2	Coding the SDC	109
7.5.3	Coding the FAC	110
7.6	MSC cell interleaving.....	110
7.7	Mapping of MSC cells on the transmission super frame structure	112
8	Transmission structure	113
8.1	Transmission frame structure and robustness modes	113
8.2	Propagation-related OFDM parameters.....	115
8.3	Signal bandwidth related parameters.....	115
8.3.1	Parameter definition.....	115
8.3.2	Simulcast transmission	117
8.4	Pilot cells.....	117
8.4.1	Functions and derivation.....	117
8.4.2	Frequency references	117
8.4.2.0	Introduction.....	117
8.4.2.1	Cell positions.....	117
8.4.2.2	Cell gains and phases	118
8.4.3	Time references	119
8.4.3.0	Introduction.....	119
8.4.3.1	Cell positions and phases	119
8.4.3.2	Cell gains	122
8.4.4	Gain references	122
8.4.4.0	Introduction.....	122

8.4.4.1	Cell positions.....	122
8.4.4.2	Cell gains	122
8.4.4.3	Cell phases	123
8.4.4.3.0	Introduction	123
8.4.4.3.1	Procedure for calculation of cell phases	123
8.4.4.3.2	Robustness mode A	124
8.4.4.3.3	Robustness mode B	124
8.4.4.3.4	Robustness mode C	124
8.4.4.3.5	Robustness mode D	125
8.4.4.3.6	Robustness mode E.....	125
8.4.5	AFS references.....	125
8.4.5.0	Introduction.....	125
8.4.5.1	Cell positions and phases	126
8.4.5.2	Cell gains	127
8.5	Control cells	127
8.5.1	General.....	127
8.5.2	FAC cells	128
8.5.2.1	Cell positions.....	128
8.5.2.2	Cell gains and phases	130
8.5.3	SDC cells	130
8.5.3.1	Cell positions.....	130
8.5.3.2	Cell gains and phases	131
8.6	Data cells	131
8.6.1	Cell positions	131
8.6.2	Cell gains and phases.....	131
Annex A (informative): Simulated system performance.....		132
Annex B (informative): Definition of channel profiles.....		133
B.1	Robustness modes A, B, C and D	133
B.2	Robustness mode E	135
Annex C (informative): Example of mapping of logical frames to multiplex frames.....		138
Annex D (normative): Calculation of the CRC word		140
Annex E (informative): RF protection ratios.....		142
Annex F (informative): Alternative Frequency and announcement signalling		143
F.0	Introduction	143
F.1	Possibilities of the Alternative Frequency Signalling feature	143
F.2	Possibilities of the announcement feature	144
F.3	SDC data entities overview for Alternative Frequency and announcement signalling	146
F.4	SDC data entities and setup for alternative frequency signalling.....	147
F.5	SDC data entities and setup for announcement.....	147
F.6	Alternative frequency and announcement signalling - coding example.....	149
Annex G (informative): Guidelines for receiver implementation.....		152
G.0	Introduction	152
G.1	Alternative Frequency checking and Switching (AFS).....	152
G.2	Station buttons for DRM services	153
G.3	Seamless Alternative Frequency checking and Switching (AFS).....	154
Annex H (informative): Service capacity and bit rates		157

Annex I:	Void	158
Annex J (informative):	Numbers of input bits	159
Annex K (informative):	Simulcast transmission, alternate sources and enhancement signalling	161
Annex L (informative):	Pilot reference illustrations	164
Annex M (informative):	MSC configuration examples.....	171
Annex N (informative):	Signalling Warning/Alarm announcements	174
Annex O (normative):	Interpretation of schedules for Alternative Frequency Signalling	175
Annex P (informative):	Transmit diversity.....	177
Annex Q (informative):	Seamless reconfiguration	178
Annex R (informative):	Seamless receiver switching between DRM, DAB, AM and FM broadcasts	180
R.1	Overview	180
R.2	General network timing considerations.....	180
R.3	Network synchronization rules.....	181
R.4	Receiver implementation rules	182
R.5	Definition of broadcast signal time references	183
Annex S (informative):	Combined transmission of DRM and FM	184
Annex T (informative):	Assignment of Service identifiers	185
T.0	Introduction	185
T.1	Domestic services.....	185
T.2	International services.....	185
History	186

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

Foreword

This ETSI Standard (ES) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECTrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

European Broadcasting Union
 CH-1218 GRAND SACONNEX (Geneva)
 Switzerland
 Tel: +41 22 717 21 11
 Fax: +41 22 717 24 81

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The frequency bands used for broadcasting below 30 MHz are:

- Low Frequency (LF) band: from 148,5 kHz to 283,5 kHz, in ITU Region 1 [i.3] only;
- Medium Frequency (MF) band: from 526,5 kHz to 1 606,5 kHz, in ITU Regions 1 [i.3] and 3 [i.3] and from 525 kHz to 1 705 kHz in ITU Region 2 [i.3];
- High Frequency (HF) band: a set of individual broadcasting bands in the frequency range 2,3 MHz to 27 MHz, generally available on a Worldwide basis.

These bands offer unique propagation capabilities that permit the achievement of:

- large coverage areas, whose size and location may be dependent upon the time of day, season of the year or period in the (approximately) 11 year sunspot cycle;
- portable and mobile reception with relatively little impairment caused by the environment surrounding the receiver.

There is thus a desire to continue broadcasting in these bands, perhaps especially in the case of international broadcasting where the HF bands offer the only reception possibilities which do not also involve the use of local repeater stations.

However, broadcasting services in these bands:

- use analogue techniques;
- are subject to limited quality;
- are subject to considerable interference as a result of the long-distance propagation mechanisms which prevail in this part of the frequency spectrum and the large number of users.

As a direct result of the above considerations, there is a desire to effect a transfer to digital transmission and reception techniques in order to provide the increase in quality which is needed to retain listeners who, increasingly, have a wide variety of other programme reception media possibilities, usually already offering higher quality and reliability.

In order to meet the need for a digital transmission system suitable for use in all of the bands below 30 MHz, the Digital Radio Mondiale (DRM) consortium was formed in early 1998. The DRM consortium is a non-profit making body which seeks to develop and promote the use of the DRM system worldwide. Its members include broadcasters, network providers, receiver and transmitter manufacturers and research institutes. More information is available from their website (<http://www.drm.org/>).

In March 2005, the DRM Consortium voted at its General Assembly to embark on extending the capability of the DRM system to provide digital radio services at higher transmission frequencies. This range includes:

- 47 MHz to 68 MHz (Band I) allocated to analogue television broadcasting;
- 65,8 MHz to 74 MHz (OIRT FM band);
- 76 MHz to 90 MHz (Japanese FM band);
- 87,5 MHz to 107,9 MHz (Band II) allocated to FM radio broadcasting;
- 174 MHz to 240 MHz (Band III) allocated to digital broadcasting.

This extension completes the family of digital standards for radio broadcasting.

1 Scope

The present document gives the specification for the Digital Radio Mondiale (DRM) system for digital transmissions in the broadcasting bands below 300 MHz.

With respect to the previous published version, the present document adds loudness metadata provision and removes certain options from coding parameters for xHE-AAC audio.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference/>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

- [1] [ISO/IEC 14496-3](#): "Information technology - Coding of audio-visual objects - Part 3: Audio".
- [2] [ETSI EN 300 401](#): "Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers".
- [3] [ISO/IEC 10646](#): "Information technology -- Universal Coded Character Set (UCS)".
- [4] [ISO 639-2](#): "Codes for the representation of names of languages - Part 2: Alpha-3 code".
- [5] [ISO 3166 \(all parts\)](#): "Codes for the representation of names of countries and their subdivisions".
- [6] [ISO/IEC 8859-1](#): "Information technology - 8-bit single-byte coded graphic character sets - Part 1: Latin alphabet No. 1".
- [7] [ETSI TS 101 968](#): "Digital Radio Mondiale (DRM); Data applications directory".
- [8] [ISO/IEC 23003-4](#): "Information technology - MPEG audio technologies - Part 4: Dynamic Range Control".
- [9] [ISO/IEC 23003-1](#): "Information technology - MPEG audio technologies - Part 1: MPEG Surround".
- [10] [ISO/IEC 23003-3](#): "Information technology - MPEG audio technologies - Part 3: Unified speech and audio coding".
- [11] [ETSI TS 126 290](#): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; Audio codec processing functions; Extended Adaptive Multi-Rate - Wideband (AMR-WB+) codec; Transcoding functions (3GPP TS 26.290)".
- [12] [IEC 62106](#): "Radio Data System (RDS) - VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz".
- [13] [ETSI TS 102 386](#): "Digital Radio Mondiale (DRM); AM signalling system (AMSS)".
- [14] [ETSI TS 103 176](#): "Digital Audio Broadcasting (DAB); Rules of implementation; Service information features".

- [15] [ETSI TS 102 980](#): "Digital Audio Broadcasting (DAB); Dynamic Label Plus (DL Plus); Application specification".
- [16] [ETSI TS 103 771](#): "Digital Radio Mondiale (DRM); Regional profiles".
- [17] [Unicode® standard](#).
- [18] [Unicode® bidirectional algorithm, UAX#9](#).

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] Recommendation ITU-R BS.1615: "Planning parameters" for digital sound broadcasting at frequencies below 30 MHz".
- [i.2] Recommendation ITU-R BS.1660: "Technical basis for planning of terrestrial digital sound broadcasting in the VHF band".
- [i.3] ITU Radio Regulations.
- [i.4] Recommendation ITU-R BS.1770-4: "Algorithms to measure audio programme loudness and true-peak audio level".

3 Definition of terms, symbols, abbreviations and conventions

3.1 Terms

For the purposes of the present document, the following terms apply:

cell: sine wave portion of duration T_s , transmitted with a given amplitude and phase and corresponding to a carrier position

NOTE: Each OFDM symbol is the sum of K such sine wave portions equally spaced in frequency.

energy dispersal: operation involving deterministic selective complementing of bits in the logical frame, intended to reduce the possibility that systematic patterns result in unwanted regularity in the transmitted signal

Fast Access Channel (FAC): channel of the multiplex data stream which contains the information that is necessary to find services and begin to decode the multiplex

kbit/s: kilo bits per second (1 000 bits per second)

logical frame: data contained in one stream during 400 ms or 100 ms

Main Service Channel (MSC): channel of the multiplex data stream which occupies the major part of the transmission frame and which carries all the digital audio services, together with possible supporting and additional data services

mod: modulo operator

NOTE: $(x \bmod y) = z$, where $y > 0$, such that $x = qy + z$, q is an integer and $0 \leq z < y$.

multiplex frame: logical frames from all streams form a multiplex frame

NOTE: It is the relevant basis for coding and interleaving.

OFDM symbol: transmitted signal for that portion of time when the modulating amplitude and phase state is held constant on each of the equally-spaced carriers in the signal

reserved for future addition (rfa): bits with this designation are set to zero

NOTE: Receivers need not decode these bits.

reserved for future use (rfu): bits with this designation are set to zero

NOTE: Receivers need to check these bits in order to determine the valid status of the other fields in the same scope.

Service Description Channel (SDC): channel of the multiplex data stream which gives information to decode the services included in the multiplex

NOTE: The SDC also provides additional information to enable a receiver to find alternative sources of the same data.

Single Frequency Network (SFN): network of transmitters sharing the same radio frequency to achieve a large area coverage

transmission frame: number of consecutive OFDM symbols, whereby the first OFDM symbol contains the time reference cells

transmission super frame: set of consecutive transmission frames, whereby the first OFDM symbols contain the SDC block

UEP profile: combination of protection levels and lengths of higher protected parts for unequal error protection

3.2 Symbols

For the purposes of the present document, the following symbols apply:

$E\{ \}$	expectation value of the expression in brackets
f_R	reference frequency of the emitted signal
K	number of active carriers in the OFDM symbol
K_{\max}	carrier index of the upper active carrier in the OFDM signal
K_{\min}	carrier index of the lower active carrier in the OFDM signal
L_{MUX}	number of input bits per multiplex frame for the multilevel encoding
N_{MUX}	number of MSC cells (QAM symbols) per multiplex frame
T	elementary time period, equal to $83^{1/3} \mu\text{s}$ (1/12 kHz)
T_f	duration of the transmission frame
T_g	duration of the guard interval
T_s	duration of an OFDM symbol
T_{sf}	duration of the transmission super-frame built from the set of transmission frames
T_u	duration of the useful (orthogonal) part of an OFDM symbol, excluding the guard interval
X^*	complex conjugate of value X
$\lceil \rceil$	round towards plus infinity
$\lfloor \rfloor$	round towards minus infinity

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AAC	Advanced Audio Coding
ACELP	Algebraic Code Excited Linear Prediction
AF	Audio Frequency
AFS	Alternative Frequency Switching
AM	Amplitude Modulation
AMR-WB	Adaptive Multi-Rate WideBand
AMSS	Amplitude Modulation Signalling System
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
CA	Conditional Access
CC	Country Codes
CCIR	Comité Consultatif International des Radio-communications
CI	Continuity Index
CIRAF	Conferencia Internacional de Radiodifusión por Altas Frecuencias
C/N	Carrier to Noise
CRC	Cyclic Redundancy Check
DAB	Digital Audio Broadcasting
dBFS	decibel Full Scale
DC	Direct Current
DL	Dynamic Label
DRM	Digital Radio Mondiale
DSB	Double SideBand
ECC	Extended Country Code
EEP	Equal Error Protection
EP	Error Protection
ER	Error Robust
EW	East West
FAC	Fast Access Channel
FEC	Forward Error Correction
FIG	Fast Information Group
FM	Frequency Modulation
HCR	Huffman Codeword Reordering
HE-AAC	High Efficiency AAC
HF	High Frequency
HFCC	High Frequency Coordination Committee
ID	Identification
IdLQ	Identifier List Qualifier
IFFT	Inverse Fast Fourier Transform
ILS	International Linkage Set
ISO	International Organization for Standardization
LA	Linkage Actuator
LF	Low Frequency
LKFS	Loudness, K-weighted, relative to nominal Full Scale
LOS	Line-Of-Sight
LRI	Left-to-Right Isolate
LSb	Least Significant bit
LSN	Linkage Set Number
LTO	Local Time Offset
LTR	Left-To-Right
MDCT	Modified Discrete Cosine Transform
MDI	Multiplex Distribution Interface
MF	Medium Frequency
MJD	Modified Julian Date
MPEG	Moving Picture Experts Group
MPS	MPEG Surround
MSb	Most Significant bit
MSC	Main Service Channel

MW	Medium Wave
NS	North South
OFDM	Orthogonal Frequency Division Multiplexing
OIRT	Organization Internationale de Radiodiffusion et de Télévision
PDI	Pop-Directional-Isolate
PDS	Power Density Spectrum
PI	Programme Identifier
PNS	Perceptual Noise Substitution
PPI	Padded Packet Indicator
PRBS	Pseudo-Random Binary Sequence
PS	Parametric Stereo
QAM	Quadrature Amplitude Modulation
QMF	Quadrature Mirror Filter
RDS	Radio Data System
RF	Radio Frequency
rfa	reserved for future addition
rfu	reserved for future use
RLI	Right-to-Left Isolate
RM	Robustness Mode
RS	Reed-Solomon
RTL	Right-To-Left
RVLC	Reversible Variable Length Coding
SAC	Spatial Audio Coding
SBR	Spectral Band Replication
SDC	Service Description Channel
SFN	Single Frequency Network
SI	Side Information
SId	Service Identifier
SNR	Signal to Noise Ratio
SSB	Single SideBand
SW	Short Wave
TCX	Transform Coded eXcitation
TES	Temporal Envelope Shaping
TNS	Temporal Noise Shaping
TSD	Transient Steering Decorrelator
UEP	Unequal Error Protection
uimsbf	unsigned integer most significant bit first
UK	United Kingdom
US	United States
USAC	Unified Speech and Audio Coding
UTC	Co-ordinated Universal Time
UTF	Unicode Transformation Format
VCB11	Virtual Codebooks for Codebook 11
VHF	Very High Frequency
VSb	Vestigial SideBand
WSSUS	Wide Sense Stationary Uncorrelated Scattering model
xHE-AAC	eXtended HE-AAC
XOR	eXclusive OR

3.4 Conventions

Unless otherwise stated, the following convention, regarding the order of bits within each step of processing is used:

- in figures, the bit shown in the left hand position is considered to be first;
- in tables, the bit shown in the left hand position is considered to be first;
- in numerical fields, the Most Significant bit (MSb) is considered to be first and denoted by the higher number. For example, the MSb of a single byte is denoted "b7" and the Least Significant bit (LSb) is denoted "b0";
- in vectors (mathematical expressions), the bit with the lowest index is considered to be first.