

ETSI TS 102 361-1 V2.6.1 (2023-05)



Electromagnetic compatibility and Radio spectrum Matters (ERM); Digital Mobile Radio (DMR) Systems; Part 1: DMR Air Interface (AI) protocol

[ETSI TS 102 361-1 V2.6.1 \(2023-05\)](https://standards.iteh.ai/catalog/standards/sist/aada08ab-6901-4c05-a4f6-ff06417b1e2e/etsi-ts-102-361-1-v2-6-1-2023-05)

<https://standards.iteh.ai/catalog/standards/sist/aada08ab-6901-4c05-a4f6-ff06417b1e2e/etsi-ts-102-361-1-v2-6-1-2023-05>

Reference

RTS/ERM-TGDMR-379

Keywords

digital, PMR

ETSI

650 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://standards.iteh.ai/> <https://portal.etsi.org/People/CommitteeSupportStaff.aspx> 6-f06417b1e2e/etsi-

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.
All rights reserved.

Contents

Intellectual Property Rights	9
Foreword.....	9
Modal verbs terminology.....	9
1 Scope	10
2 References	10
2.1 Normative references	10
2.2 Informative references.....	11
3 Definitions of terms, symbols and abbreviations	11
3.1 Terms.....	11
3.2 Symbols.....	14
3.3 Abbreviations	14
4 Overview	16
4.0 Overview introduction.....	16
4.1 Protocol architecture.....	17
4.1.0 Protocol architecture - Introduction	17
4.1.1 Air Interface Physical Layer (layer 1).....	18
4.1.2 Air Interface Data Link Layer (layer 2).....	18
4.1.3 Air Interface Call Control Layer (CCL) (layer 3).....	19
4.2 DMR TDMA structure	19
4.2.1 Overview of burst and channel structure	19
4.2.2 Burst and frame structure.....	21
4.3 Frame synchronization	22
4.4 Timing references.....	23
4.4.1 Repeater mode BS established timing relationship.....	23
4.4.2 Repeater mode MS established timing relationship.....	24
4.4.3 Direct mode timing relationship	24
4.4.4 TDMA direct mode timing relationship.....	24
4.5 Common Announcement Channel (CACH).....	24
4.6 Basic channel types	25
4.6.1 Traffic channel with CACH.....	25
4.6.2 Traffic channel with guard time.....	25
4.6.3 Bi-directional channel.....	26
5 Layer 2 protocol description.....	27
5.0 Layer 2 protocol description - Introduction.....	27
5.1 Layer 2 timing	27
5.1.1 Channel timing relationship	27
5.1.1.0 Channel timing relationship - Introduction	27
5.1.1.1 Aligned channel timing.....	27
5.1.1.2 Offset channel timing.....	28
5.1.2 Voice timing	28
5.1.2.1 Voice superframe	28
5.1.2.2 Voice initiation.....	28
5.1.2.3 Voice termination.....	29
5.1.3 Data timing	30
5.1.3.0 Data timing - Introduction.....	30
5.1.3.1 Single slot data timing.....	30
5.1.3.2 Dual slot data timing	31
5.1.4 Traffic timing.....	31
5.1.4.1 BS timing	31
5.1.4.2 Single frequency BS timing	32
5.1.4.3 Direct mode timing	33
5.1.4.4 Time Division Duplex (TDD) timing.....	33
5.1.4.5 Continuous transmission mode	33
5.1.4.6 TDMA direct mode timing.....	34

5.1.5	Reverse Channel (RC) timing.....	34
5.1.5.0	Reverse Channel (RC) timing - Introduction	34
5.1.5.1	Embedded outbound Reverse Channel (RC).....	34
5.1.5.2	Dedicated outbound Reverse Channel (RC)	35
5.1.5.3	Standalone inbound Reverse Channel (RC).....	36
5.1.5.4	Direct mode Reverse Channel (RC).....	36
5.2	Channel access	37
5.2.0	Channel access - Introduction.....	37
5.2.1	Basic channel access rules	39
5.2.1.1	Types of channel activity	39
5.2.1.2	Channel status	39
5.2.1.3	Timing master	39
5.2.1.4	Hang time messages and timers	40
5.2.1.5	Slot 1 and 2 dependency	40
5.2.1.6	Transmit admit criteria.....	40
5.2.1.7	Transmission re-tries.....	41
5.2.2	Channel access procedure.....	41
5.2.2.0	Channel access procedure - Introduction	41
5.2.2.1	Direct mode Channel Access	42
5.2.2.1.0	Direct mode Channel Access - Introduction.....	42
5.2.2.1.1	MS Out_of_Sync Channel Access.....	42
5.2.2.1.2	MS Out_of_Sync_Channel_Monitored Channel Access.....	44
5.2.2.1.3	MS In_Sync_Unknown_System Channel Access	45
5.2.2.1.4	MS Not_in_Call Channel Access	46
5.2.2.1.5	MS Others_Call Channel Access	46
5.2.2.1.6	MS My_Call Channel Access.....	46
5.2.2.2	Repeater mode channel access	46
5.2.2.2.0	Repeater mode channel access- Introduction.....	46
5.2.2.2.1	MS Out_of_Sync Channel Access.....	46
5.2.2.2.2	MS Out_of_Sync_Channel_Monitored Channel Access.....	48
5.2.2.2.3	MS In_Sync_Unknown_System channel access	49
5.2.2.2.4	MS TX_Wakeup_Message.....	50
5.2.2.2.5	MS Not_In_Call channel access.....	51
5.2.2.2.6	MS Others_Call channel access	52
5.2.2.2.7	MS My_Call channel access.....	52
5.2.2.2.8	MS In_Session channel access	52
5.2.2.3	Non-time critical CSBK ACK/NACK channel access.....	52
5.2.2.4	TDMA direct mode channel access	53
5.2.2.4.0	TDMA direct mode channel access - Introduction.....	53
5.2.2.4.1	MS Out_of_Sync channel access	53
5.2.2.4.2	MS Out_of_Sync_Channel_Monitored channel access.....	56
5.2.2.4.3	MS In_Sync_Unknown_System channel access	57
5.2.2.4.4	MS Not_in_Call channel access	58
5.2.2.4.5	MS Others_Call channel access	58
5.2.2.4.6	MS My_Call channel access.....	58
5.2.2.4.7	Immediate response channel access.....	58
6	Layer 2 burst format.....	58
6.0	Layer 2 burst format - Introduction	58
6.1	Vocoder socket.....	59
6.2	Data and control	60
6.3	Common Announcement Channel burst.....	61
6.4	Reverse Channel.....	62
6.4.1	Standalone inbound Reverse Channel burst.....	62
6.4.2	Outbound reverse channel (RC) burst.....	63
7	DMR signalling.....	63
7.1	Link Control message structure.....	63
7.1.0	Link Control message structure - Introduction	63
7.1.1	Voice LC header.....	64
7.1.2	Terminator with LC	65
7.1.3	Embedded signalling.....	66

7.1.3.0	Embedded signalling - Introduction	66
7.1.3.1	Outbound channel	66
7.1.3.2	Inbound channel	67
7.1.4	Short Link Control in CACH	67
7.2	Control Signalling Block (CSBK) message structure	68
7.2.0	Control Signalling Block (CSBK) message structure - Introduction	68
7.2.1	Control Signalling Block (CSBK)	68
7.3	Idle message	69
7.4	Multi Block Control (MBC) message structure	70
7.4.0	Multi Block Control (MBC) message structure - Introduction	70
7.4.1	Multi Block Control (MBC)	71
8	DMR Packet Data Protocol (PDP)	73
8.0	DMR Packet Data Protocol (PDP) - Introduction	73
8.1	Internet Protocol	73
8.2	Datagram fragmentation and re-assembly	74
8.2.0	Datagram fragmentation and re-assembly - Introduction	74
8.2.1	Header block structure	75
8.2.1.0	Header block structure - Introduction	75
8.2.1.1	Unconfirmed data Header	76
8.2.1.2	Confirmed data header	77
8.2.1.3	Response data header	77
8.2.1.4	Proprietary data header	77
8.2.1.5	Status/precoded short data header	78
8.2.1.6	Raw short data header	79
8.2.1.7	Defined short data header	79
8.2.1.8	Unified Data Transport (UDT) data header	80
8.2.2	Data block structure	80
8.2.2.0	Data block structure - Introduction	80
8.2.2.1	Unconfirmed data block structure	80
8.2.2.2	Confirmed data block structure	83
8.2.2.3	Response packet format	86
8.2.2.4	Hang time for response packet	87
8.2.2.5	Unified Data Transport (UDT) last data block structure	88
8.2.3	Single Block Data structure	89
8.2.3.0	Single Block Data structure - Introduction	89
8.2.3.1	Unified Single Block Data block structure	89
9	Layer 2 PDU description	90
9.0	Layer 2 PDU description - Introduction	90
9.1	PDUs for voice bursts, general data bursts and the CACH	91
9.1.1	Synchronization (SYNC) PDU	91
9.1.2	Embedded signalling (EMB) PDU	91
9.1.3	Slot Type (SLOT) PDU	92
9.1.4	TACT PDU	92
9.1.5	Reverse Channel (RC) PDU	92
9.1.6	Full Link Control (FULL LC) PDU	93
9.1.7	Short Link Control (SHORT LC) PDU	93
9.1.8	Control Signalling Block (CSBK) PDU	93
9.1.9	Pseudo Random Fill Bit (PR FILL) PDU	93
9.2	Data related PDU description	94
9.2.0	Data related PDU description - Introduction	94
9.2.1	Confirmed packet Header (C_HEAD) PDU	94
9.2.2	Rate $\frac{3}{4}$ coded packet Data (R_3_4_DATA) PDU	94
9.2.3	Rate $\frac{3}{4}$ coded Last Data block (R_3_4_LDATA) PDU	94
9.2.4	Confirmed Response packet Header (C_RHEAD) PDU	95
9.2.5	Confirmed Response packet Data (C_RDATA) PDU	95
9.2.6	Unconfirmed data packet Header (U_HEAD) PDU	96
9.2.7	Rate $\frac{1}{2}$ coded packet Data (R_1_2_DATA) PDU	96
9.2.8	Rate $\frac{1}{2}$ coded Last Data block (R_1_2_LDATA) PDU	96
9.2.9	Proprietary Header (P_HEAD) PDU	97
9.2.10	Status/Precoded short data packet Header (SP_HEAD) PDU	97

9.2.11	Raw short data packet Header (R_HEAD) PDU	97
9.2.12	Defined Data short data packet Header (DD_HEAD) PDU	98
9.2.13	Unified Data Transport Header (UDT_HEAD) PDU	98
9.2.14	Unified Data Transport Last Data block (UDT_LDATA) PDU	99
9.2.15	Rate 1 coded packet Data (R_1_DATA) PDU	99
9.2.16	Rate 1 coded Last Data block (R_1_LDATA) PDU	100
9.3	Layer 2 information element coding	100
9.3.0	Layer 2 information element coding - Introduction	100
9.3.1	Colour Code (CC)	100
9.3.2	Pre-emption and power control Indicator (PI)	101
9.3.3	LC Start/Stop (LCSS)	101
9.3.4	EMB parity	101
9.3.5	Feature set ID (FID)	101
9.3.6	Data Type	102
9.3.7	Slot Type parity	102
9.3.8	Access Type (AT)	102
9.3.9	TDMA Channel (TC)	102
9.3.10	Protect Flag (PF)	103
9.3.11	Full Link Control Opcode (FLCO)	103
9.3.12	Short Link Control Opcode (SLCO)	103
9.3.13	TACT parity	103
9.3.14	RC parity	103
9.3.15	Group or Individual (G/I)	103
9.3.16	Response Requested (A)	104
9.3.17	Data Packet Format (DPF)	104
9.3.18	SAP identifier (SAP)	104
9.3.19	Logical Link ID (LLID)	104
9.3.20	Full message flag (F)	105
9.3.21	Blocks to Follow (BF)	105
9.3.22	Pad Octet Count (POC)	105
9.3.23	Re-Synchronize Flag (S)	105
9.3.24	Send sequence number (N(S))	106
9.3.25	Fragment Sequence Number (FSN)	106
9.3.26	Data Block Serial Number (DBSN)	107
9.3.27	Data block CRC (CRC-9)	107
9.3.28	Class (Class)	107
9.3.29	Type (Type)	107
9.3.30	Status (Status)	107
9.3.31	Last Block (LB)	108
9.3.32	Control Signalling Block Opcode (CSBKO)	108
9.3.33	Appended Blocks (AB)	108
9.3.34	Source Port (SP)	108
9.3.35	Destination Port (DP)	108
9.3.36	Status/Precoded (S_P)	109
9.3.37	Selective Automatic Repeat reQuest (SARQ)	109
9.3.38	Defined Data format (DD)	109
9.3.39	Unified Data Transport Format (UDT Format)	110
9.3.40	Void	110
9.3.41	Supplementary Flag (SF)	110
9.3.42	Pad Nibble	110
9.3.43	Service Type	110
10	Physical Layer	111
10.1	General parameters	111
10.1.0	General parameters - Introduction	111
10.1.1	Frequency range	111
10.1.2	RF carrier bandwidth	111
10.1.3	Transmit frequency error	111
10.1.4	Time base clock drift error	112
10.2	Modulation	112
10.2.1	Symbols	112
10.2.2	4FSK generation	112

10.2.2.0	4FSK generation - Introduction.....	112
10.2.2.1	Deviation index	112
10.2.2.2	Square root raised cosine filter.....	113
10.2.2.3	4FSK Modulator	113
10.2.3	Burst timing	113
10.2.3.0	Burst timing - Introduction.....	113
10.2.3.1	Normal burst	114
10.2.3.1.0	Normal burst - Introduction.....	114
10.2.3.1.1	Power ramp time.....	114
10.2.3.1.2	Symbol timing	115
10.2.3.1.3	Propagation delay and transmission time	115
10.2.3.2	Reverse channel (RC) burst.....	116
10.2.3.2.0	Reverse channel (RC) burst - Introduction.....	116
10.2.3.2.1	Power ramp time.....	117
10.2.3.2.2	Symbol timing	117
10.2.3.2.3	Propagation delay	118
10.2.3.3	Synthesizer Lock-Time constraints	118
10.2.3.4	Transient frequency constraints during symbol transmission time	118
Annex A (normative):	Numbering and addressing	119
Annex B (normative):	FEC and CRC codes	120
B.0	FEC and CRC codes - Introduction.....	120
B.1	Block Product Turbo Codes	121
B.1.1	BPTC (196,96)	121
B.2	Variable length BPTC	125
B.2.1	Variable length BPTC for embedded signalling.....	125
B.2.2	Single Burst Variable length BPTC.....	126
B.2.2.1	Non-Reverse Channel Single Burst BPTC	126
B.2.2.2	Reverse Channel Single Burst BPTC.....	128
B.2.3	Variable length BPTC for CACH signalling.....	129
B.2.4	Rate $\frac{3}{4}$ Trellis code.....	131
B.2.5	Rate 1 coded data	135
B.3	Generator matrices and polynomials	136
B.3.1	Golay (20,8)	136
B.3.2	Quadratic residue (16,7,6).....	137
B.3.3	Hamming (17,12,3)	137
B.3.4	Hamming (13,9,3), Hamming (15,11,3), and Hamming (16,11,4).....	138
B.3.5	Hamming (7,4,3)	138
B.3.6	Reed-Solomon (12,9)	139
B.3.7	8-bit CRC calculation.....	141
B.3.8	CRC-CCITT calculation.....	142
B.3.9	32-bit CRC calculation	142
B.3.10	CRC-9 calculation	144
B.3.11	5-bit Checksum (CS) calculation.....	145
B.3.12	Data Type CRC Mask	145
B.3.13	7-bit CRC calculation.....	146
B.4	Interleaving.....	147
B.4.1	CACH interleaving.....	147
Annex C (informative):	Example timing diagrams	148
C.0	General	148
C.1	Direct mode timing.....	148
C.2	Reverse Channel timing	148
Annex D (normative):	Idle and Null message bit definition	149
D.0	Idle and Null message bit definition - Introduction.....	149

D.1	Null embedded message bit definitions.....	149
D.2	Idle message bit definitions.....	150
Annex E (normative):	Transmit bit order	152
Annex F (normative):	Timers and constants in DMR.....	165
F.0	Timers and constants in DMR - Introduction.....	165
F.1	Layer 2 timers.....	165
F.2	Layer 2 constants.....	166
Annex G (informative):	High level states overview	167
G.0	High level states overview - Introduction	167
G.1	High Level MS states and SDL description	167
G.1.0	General	167
G.1.1	MS Level 1 SDL	167
G.1.2	MS Level 2 SDL	170
G.2	High level BS states and SDL descriptions.....	172
G.2.0	High level BS states and SDL descriptions - Introduction	172
G.2.1	BS Both Slots SDL.....	172
G.2.2	BS Single Slot SDL.....	173
Annex H (normative):	Feature interoperability	175
H.0	Feature interoperability - Introduction	175
H.1	Feature set ID (FID)	175
H.2	Application for Manufacturer's Feature set ID	175
Annex I (informative):	Void	176
Annex J (informative):	Change requests.....	177
History		179

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 Technical Specification (TS) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document is part 1 of a multi-part deliverable covering the Technical Requirements for Digital Mobile Radio (DMR), as identified below:

- Part 1: "DMR Air Interface (AI) protocol";**
- Part 2: "DMR voice and generic services and facilities";
- Part 3: "DMR data protocol";
- Part 4: "DMR trunking protocol".

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.

1 Scope

The present document contains technical requirements for Digital Mobile Radio (DMR) operating in the existing licensed land mobile service frequency bands, as identified in CEPT/ERC/T/R 25-08 [i.3].

The present document describes the Air Interface of a scalable Digital Mobile Radio system which covers three tiers of possible products:

- Tier I: DMR equipment having an integral antenna and working in direct mode (communication without infrastructure) under a general authorization with no individual rights operation.
- Tier II: DMR systems operating under individual licences working in direct mode or using a Base Station (BS) for repeating.
- Tier III: DMR trunking systems under individual licences operating with a controller function that automatically regulates the communications.

NOTE 1: Tier II and Tier III products encompass both simulcast and non-simulcast systems.

NOTE 2: The three tiers of possible products only work independently and there is no interoperability across the tiers.

(For more information see the System reference documents ETSI TR 102 335-1 [i.1] and ETSI TR 102 335-2 [i.2].)

The present document specifies the Air Interface, complying with either ETSI EN 300 113-1 [1] and ETSI EN 300 113-2 [2] or ETSI EN 300 390-1 [3] and ETSI EN 300 390-2 [4], that has been specifically developed with the intention of being suitable for all identified product tiers. A polite spectrum access protocol for sharing the physical channel has also been specified. Specifically, in this case for use in the existing land mobile service bands with the intention of causing minimum change to the spectrum planning and regulations. Thus the DMR protocol is intended to be applicable to the land mobile frequency bands, physical channel offset, duplex spacing, range assumptions and all other spectrum parameters without need for any change.

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] [ETSI EN 300 113-1](#): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 1: Technical characteristics and methods of measurement".
- [2] [ETSI EN 300 113-2](#): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".
- [3] [ETSI EN 300 390-1](#): "ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Land Mobile Service; Radio equipment intended for the transmission of data (and speech) and using an integral antenna; Part 1: Technical characteristics and test conditions".

- [4] [ETSI EN 300 390-2](#): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment intended for the transmission of data (and speech) and using an integral antenna; Part 2: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive".
- [5] [ETSI TS 102 361-2](#): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Digital Mobile Radio (DMR) Systems; Part 2: DMR voice and generic services and facilities".
- [6] [IETF RFC 791](#): "Internet Protocol; DARPA Internet Program; Protocol Specification".
- [7] Void.
- [8] [IEC 61162-1](#): "Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 1: Single talker and multiple listeners".
- [9] [ISO/IEC 646](#): "Information technology -- ISO 7-bit coded character set for information interchange".
- [10] [ISO/IEC 8859](#): "Information technology -- 8-bit single-byte coded graphic character sets".
- [11] [ETSI TS 102 361-4](#): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Digital Mobile Radio (DMR) Systems; Part 4: DMR trunking protocol".
- [12] [ETSI TS 102 361-3](#): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Digital Mobile Radio (DMR) Systems; Part 3: DMR data protocol".

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] ETSI TR 102 335-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); System reference document for harmonized use of Digital Mobile Radio (DMR); Part 1: Tier 1 DMR#, expected to be for general authorization with no individual rights operation".
- [i.2] ETSI TR 102 335-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); System reference document for harmonized use of Digital Mobile Radio (DMR); Part 2: Systems operating under individual licences in the existing land mobile service spectrum bands".
- [i.3] CEPT/ERC/T/R 25-08: "Planning criteria and co-ordination of frequencies in the Land Mobile Service in the range 29,7 - 921 MHz".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

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

1:1-mode: 1 traffic channel mode

NOTE: 1:1-mode supports one "MS to fixed end" duplex call or one simplex call with an optional inbound RC using a two frequency BS.

2:1-mode: 2 traffic channel mode

NOTE: 2:1-mode supports two independent calls which may be either "MS to fixed end" duplex calls, simplex calls using a two frequency BS or simplex calls between MS units on a single frequency.

backward: logical channel from target to source in direct mode

Base Station (BS): fixed end equipment that is used to obtain DMR services

bearer service: telecommunication service providing the capability for information transfer between access points

burst: elementary amount of bits within the physical channel

NOTE 1: Three different bursts exist with different number of bits. The Traffic burst contains 264 bits, the CACH burst contains 24 bits and the RC burst contains 96 bits.

NOTE 2: The burst may include a guard time at the beginning and end of the burst used for power ramp-up and ramp-down.

NOTE 3: For detailed burst definition see clause 4.2.1.

call: complete sequence of related transactions between MSs

NOTE: Transactions may be one or more bursts containing specific call related information.

channel slot timing: timeslot 1 and timeslot 2 timing boundaries established by a TDMA direct mode leader

Control plane (C-plane): part of the DMR protocol stack dedicated to control and data services

conventional: non-trunked communication

NOTE: This is a communication technique where any radio unit (MS) may communicate with one or more other radio units (MSs) without using a trunking protocol, and may be either in direct mode or using any additional equipment (e.g. BS).

Digital Mobile Radio (DMR): physical grouping that contains all of the mobile and/or fixed end equipment that is used to obtain DMR services

direct mode: mode of operation where MSs may communicate outside the control of a network

NOTE 1: This is communication technique where any radio unit (MS) may communicate with one or more other radio units (MSs) without the need for any additional equipment (e.g. BS).

NOTE 2: Supports one transmission per 12,5 kHz frequency; 12,5 kHz equivalent (12,5e) spectral efficiency.

duplex: mode of operation by which information can be transferred in both directions and where the two directions are independent

NOTE: Duplex is also known as full duplex.

forward: logical channel from source to target in direct mode

frame: two contiguous timeslots labelled 1 and 2

NOTE: A frame has a length of 60 ms.

Golay code: type of error correcting code named Golay

Hamming code: type of error correcting code named Hamming

inbound: MS to BS transmission

logical channel: distinct data path between logical endpoints

NOTE: The logical channels are labelled 1 and 2. The logical channel may consist of sub-channels, e.g. SYNC, embedded signalling, etc.

Mobile Station (MS): physical grouping that contains all of the mobile equipment that is used to obtain DMR mobile services

outbound: BS to MS transmission

payload: bits in the information field

physical channel: RF carrier that is modulated with information bits of the bursts

NOTE: The RF carrier may be a single frequency or a duplex pair of frequencies. The physical channel of a DMR subsystem is required to support the logical channels.

polite protocol: "Listen Before Transmit" (LBT) protocol

NOTE: This is a medium access protocol that implements a LBT function in order to ensure that the channel is free before transmitting.

privacy: secret transformation

NOTE: Any transformation of transmitted information that is derived from a shared secret between the sender and receiver.

Protocol Data Unit (PDU): unit of information consisting of protocol control information (signalling) and possibly user data exchanged between peer protocol layer entities

Radio Frequency channel: radio frequency carrier (RF carrier)

NOTE: This is a specified portion of the RF spectrum. In DMR, the RF carrier separation is 12,5 kHz. The physical channel may be a single frequency or a duplex spaced pair of frequencies.

Received Signal Strength Indication (RSSI): root mean squared (rms) value of the signal received at the receiver antenna

Reed-Solomon code: type of error correcting code named Reed-Solomon

repeater mode: mode of operation where MSs may communicate through a BS

NOTE: This is a communication technique where any radio unit (MS) may communicate with one or more other radio units (MSs) with the need for an intermediate BS.

Reverse Channel (RC): signalling burst from target to source

signalling: exchange of information specifically concerned with the establishment and control of connections, and with management, in a telecommunication network

simplex: mode of working by which information can be transferred in both directions but not at the same time

superframe: 6 continuous traffic bursts on a logical channel labelled "A" to "F"

NOTE: A superframe has a length of 360 ms and is used for voice traffic only.

TDMA direct mode: direct mode operation that supports two transmissions per 12,5 kHz frequency

NOTE: Supports 6,25 kHz equivalent (6,25e) spectral efficiency.

timeslot (time slot or slot): elementary timing of the physical channel

NOTE: A timeslot has a length of 30 ms and will be numbered "1" or "2".

transmission: transfer period of bursts containing information or signalling

NOTE: The transmission may be continuous, i.e. multiple bursts transmission without ramp-up, ramp-down, or discontinuous, i.e. single burst transmission with ramp-up and ramp-down period.

Trellis code: type of error correcting code for modulation named Trellis

trunking: network controlled communication

NOTE: This is a communication technique where any radio unit (MS) may communicate with one or more other radio units (MSs) using a trunking protocol and all MSs will be under control of a network.

User plane (U-plane): part of the DMR protocol stack dedicated to user voice services

vocoder socket: 216 bits vocoder payload

3.2 Symbols

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

dBm	absolute power level relative to 1 mW, expressed in dB
dBp	Power relative to the average power transmitted over a burst in decibel
Dibit	2 bits grouped together to represent a 4-level symbol
Eb	Energy per bit
Nibble	4 bits grouped together
No	Noise per Hz
Octet	8 bits grouped together, also called a byte
Tribit	3 bits grouped together into a symbol for a trellis code

3.3 Abbreviations

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

4FSK	Four-level Frequency Shift Keying
AB	Appended Blocks
ACK	(positive) ACKnowledgement
AI	Air Interface
ARP	Address Resolution Protocol
ARQ	Automatic Retransmission reQuest
AT	Access Type
BCD	Binary Code Decimal
BER	Bit Error Rate
BF	Blocks to Follow
BOR	Beginning Of Receive
BPTC	Block Product Turbo Code
BS	Base Station

NOTE: A reference designating a fixed end device.

CACH	Common Announcement Channel
CC	Colour Code
CCL	Call Control Layer
C-plane	Control plane
CR	CRC bits
CRC	Cyclic Redundancy Checksum for data error detection
CS	CheckSum
CSBK	Control Signalling BloCk
CSBKO	CSBK Opcode
D_Sync	general Data burst Sync
DBSN	Data Block Serial Number
DD	Defined Data format
DLL	Data Link Layer
DMR	Digital Mobile Radio
DP	Destination Port
DPF	Data Packet Format
DT	Data Type field for General Data Bursts
EMB	EMBedded signalling field
Enc_Dibit	output Dibit from trellis Encoder

EOR	End Of Receive
ERC	European Radiocommunication Committee
ERM	Electromagnetic compatibility and Radio spectrum Matters
FEC	Forward Error Correction
FID	Feature set ID
FLCO	Full Link Control Opcode
FM	Frequency Modulation
FMF	Full Message Flag
FNS	Feature Not Supported
FSM	Finite State Machine
FSN	Fragment Sequence Number
GF	Galois Field to calculate parity checks for a RS code
GF(2)	Galois Field with 2 elements
Golay	Golay code parity check
H	Hamming parity bits
H_Cx	Hamming parity bit from Column x of a BPTC
H_Rx	Hamming parity bit from Row x of a BPTC
HC	Header Compression
HMSC	High level Message Sequence Chart
Hx	Hamming parity bit for row x of a BPTC
I	Information bit
ID	IDentifier
IP	Internet Protocol
ISO	International Standardization Organization
LB	Last Block
LBT	Listen Before Transmit
LC	Link Control
LCSS	Link Control Start/Stop
LIP	Location Information Protocol
LLC	Logical Link Control
LLID	Logical Link ID
LSB	Least Significant Bit
LSO	Least Significant Octet
MAC	Medium Access Control
MBC	Multiple Block Control packets
MFID	Manufacturer's FID
MS	Mobile Station
MSB	Most Significant Bit
MSO	Most Significant Octet
N_LC	Null LC bit
N_xxxx	Layer 2 constant

NOTE: As defined in clause F.2.

NACK	Negative ACKnowledgement
NI	(sequence) Number Indicator
NMEA	National Maritime Electronic Association
OACSU	Off Air Call SetUp
P	CACH Payload
PA	Power Amplifier
PABX	Private Automatic Branch eXchange
PC	Parity Check bit
PDP	Packet Data Protocol
PDU	Protocol Data Unit
PF	Protect Flag
PI	Privacy Indicator

NOTE: When associated with PI Header OR Pre-emption and power control Indicator when an information element in EMB field.

PL	Physical Layer
POC	Pad Octet Count
ppm	parts per million