



**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
digital Private Mobile Radio (dPMR)
General System Design**

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

Modal verbs terminology

In the present document "**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).

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Introduction

The present document has been produced to provide an introduction to dPMR for potential system purchasers, network operators and service users.

It is in relation to ETSI TS 102 490 [i.1] and ETSI TS 102 658 [i.2] covering the technical requirements for digital Private Mobile Radio (dPMR), as identified below:

- ETSI TS 102 490 [i.1].
- ETSI TS 102 658 [i.2].

It provides an overview, a description of the dPMR services and facilities, technical background and radio aspects, protocol and service performance, and guidance on numbering and addressing.

It should be understood that, as in all standard setting activities, there is an inherent conflict between the wish to have as broad a standard as possible and at the same time wanting to have as much of that broad standard available and implemented right from the beginning. Potential system purchasers, network operators and service users should make sure they influence the suppliers to have their required functionality available when they need it.

Equipment manufacturers will use the broad flexibility provided within the present document to develop and implement systems in various ways, and still be conforming according to the present document. This broad availability of systems, each optimized around certain features and functionalities, needs to be carefully analysed by a network operator and system user to find the supplier with a system suited best for their needs.

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1 Scope

1.0 General

The present document covers digital Private Mobile Radio (dPMR) equipment using FDMA technology with channel spacing of 6,25 kHz supporting voice and data applications capable of operating in the existing licensed land mobile service frequency bands below 1 000 MHz.

The present document includes the baseband signal processing parameters of the Physical Layer (PL) and the protocol structure at the air interface. The protocol supports different levels of functionality from peer to peer mode to managed base station access mode: the equipment is based on FDMA with channel spacing of 6,25 kHz supporting voice and data applications.

dPMR equipment is designed to be compliant with the appropriate harmonized standard for spectrum use, ETSI EN 301 166-2 [i.4].

1.1 Scope of ETSI TS 102 490

ETSI TS 102 490 [i.1] covers digital private mobile radio equipment operating in peer-to-peer mode only. It covers only handportable equipment complying with ETSI EN 301 166-2 [i.4] and having an integral antenna.

This equipment is for use:

- i) In accordance with ECC/DEC/(05)12 [i.7] on harmonized frequencies, technical characteristics, exemption from individual licensing and free carriage and use of digital PMR446 applications operating in the frequency band 446,100 MHz to 446,200 MHz.

The equipment conforms to the technical requirements for Digital PMR 446 included in ECC/DEC/(05)12 [i.7]. This permits operation in the frequency range 446,100 MHz to 446,200 MHz, maximum e.r.p of 500 mW, and a maximum transmitter time-out-time of 180 seconds.

- ii) In the frequency band 149,01875 MHz to 149,11875 MHz under exemption from individual licensing. This permits a maximum e.r.p of 500 mW, and a maximum transmitter time-out-time of 180 seconds.

1.2 Scope of ETSI TS 102 658

ETSI TS 102 658 [i.2] supports different levels of functionality from peer to peer mode to managed base station access mode:

- Mode 1 Peer to peer (direct mode) operation without Base Stations or infrastructure.
- Mode 2 dPMR systems incorporating one or more Base Stations for repeating or providing system gateways.
- Mode 3 dPMR systems operating under a managed access mode in systems incorporating one or more Base Stations.

All three modes of operation of the present air interface are designed to be compliant with the appropriate harmonized standard for spectrum use, ETSI EN 301 166-2 [i.4]. A polite spectrum access protocol for sharing the physical channel has also been specified.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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 TS 102 490: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Peer-to-Peer Digital Private Mobile Radio using FDMA with a channel spacing of 6,25 kHz with e.r.p. of up to 500 mW".
- [i.2] ETSI TS 102 658: "Digital Private Mobile Radio (dPMR) using FDMA with a channel spacing of 6,25 kHz".
- [i.3] IEC EN 61162-1 (2008): "Maritime navigation and radio communications equipment and systems - Digital Interfaces - Part 1: Single talker and multiple listeners".
- [i.4] ETSI EN 301 166-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment for analogue and/or digital communication (speech and/or data) and operating on narrow band channels and having an antenna connector; Part 2: Harmonized EN covering essential requirements of article 3.2 of the R&TTE Directive".
- [i.5] CEPT Recommendation T/R 25-08: "Planning criteria and coordination of frequencies in the Land Mobile Service in the range 29.7-921 MHz".
- [i.6] CEPT ERC Report 25: "The European table of frequency allocations and utilizations covering the frequency range 9 kHz to 275 GHz".
- [i.7] CEPT ECC/DEC/(05)12: "ECC Decision of 28 October 2005 on harmonized frequencies, technical characteristics, exemption from individual licensing and free carriage and use of digital PMR 446 applications operating in the frequency band 446,1-446,2 MHz".
- [i.8] Draft CEPT ECC Decision (06)06 (WGFM, Cavtat, April 2006): "ECC Decision on the availability of frequency bands for the introduction of Narrow Band Digital Land Mobile PMR/PAMR in the 80 MHz, 160 MHz and 400 MHz bands".
- [i.9] ETSI TS 102 726-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Conformance testing for Mode 1 of the digital Private Mobile Radio (dPMRTM); Part 1: Protocol Implementation Conformance Statement (PICS) proforma".
- [i.10] ETSI TS 102 726-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Conformance testing for Mode 1 of the digital Private Mobile Radio (dPMR); Part 2: Test Suite Structure and Test Purposes (TSS&TP) specification".
- [i.11] ETSI TS 102 726-3: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Conformance testing for Mode 1 of the digital Private Mobile Radio (dPMRTM); Part 3: Interoperability Test Suite Structure and Test Purposes (TSS&TP) specification".
- [i.12] ETSI TS 102 587-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Peer-to-Peer Digital Private Mobile Radio; Part 1: Conformance testing; Protocol Implementation Conformance Statement (PICS) proforma".

[i.13] MPT 1318. Engineering Memorandum: "Trunked Systems in the LandMobile Radio Service" February 1986. Revised and reprinted January 1994.

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

active_hang_time: time during which a Mode 2 BS preserves the channel for the parties involved in a call

Appended_Data: message carrying principally data that is formatted according to the present document

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

beacon channel: channel that carries synchronous beacon frames timed from a BS

bearer service: type of telecommunication service that provides the capability for the information transfer between user network interfaces, involving only low layer functions (layers 1 to 3 of the OSI model)

NOTE: Confirmed Data and Unconfirmed Data are examples of bearer services.

burst: short duration RF signal that may cause interference to a dPMR transmission item

call: complete sequence of related transactions between MS

NOTE: Transactions may consist of more than one or more item containing specific call related information.

Caller Line Identity (CLI): ability to see who is calling you before answering the telephone

call_hang_time: time during which a Mode 1 or Mode 2 channel is available for an emergency pre-emption

complementary service: dPMR service that enables complementary data to be passed between MS and BS as part of the call set-up phase of another service (such as voice)

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

downlink: transmission from BS to MS(s)

extended address: address of an entity that is not a native MS/BS individual/talkgroup identity

feature: attribute intrinsic to a station, e.g. MS has an address

intrinsic service: service which is inherent within a voice or data service

item: complete transmission, the conclusion of which the transmission is ended

late entry: where receiving stations that have missed the start of a transmission are able to recover all information about the call from subsequent message frames

line connected: call whereby one end of the call is connected to the radio system that does not use the DMR Air Interface

NOTE: Examples may be connection to the PSTN or a PABX.

logical channel: distinct data path between logical endpoints

Manufacturers ID (MID): 8 bit identifier assigned to a particular manufacturer

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

mode: class of operation of a dPMR system

multi-part call set-up: call set-up procedure whereby the full information to be exchanged between entities cannot be accommodated in a single message frame

NOTE: The UDT procedure is invoked to transfer the address information using UDT signalling. UDT is also invoked to transport complementary and user data between dPMR entities.

network personalization: configuration parameters appropriate to network configuration programmed into an MS that may be set by an external agency but not by the user of an MS

payload: part of a data stream representing the user information

peer-to-peer mode: mode of operation where MS may communicate outside the control of a network

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

personalization: address and configuration information that characterizes a particular dPMR MS

NOTE: This information may be implanted by the installer before putting an MS into service.

physical channel: FDMA transmission

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.

prefix: most significant digit of an MS address in the user domain

radio frequency channel: radio frequency carrier (RF carrier)

NOTE: This is a specified portion of the RF spectrum. The RF carrier separation is 6,25 kHz.

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

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

NOTE: Simplex is also known as half duplex.

superframe: four concatenated FDMA frames

NOTE: A superframe has a length of 320 ms.

supplementary service: supplementary service modifies or supplements a tele-service or bearer service

NOTE: Consequently, it cannot be offered to a user as a standalone service. It is offered together with or in association with a tele-service or bearer service. The same supplementary service may be common to a number of telecommunication services. Late entry is an example of supplementary service.

talkgroup: MS IDs that are associated with the group call service

traffic channel: channel in which control/payload frames are exchanged asynchronously

uplink: transmission from MS to BS

user numbering: decimal representation of dPMR air interface addresses, as seen by the user, i.e. user visible numbering

telecommunication service: offered by a dPMR entity in order to satisfy a specific telecommunication requirement

tele-service: type of telecommunication service that provides the complete capability, including terminal equipment functions, for communication between users

NOTE: Individual voice calls and group voice calls are examples of tele-services.

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

vocoder socket: 216 bits vocoder payload

wildcard: character in the user domain that represents all digits 0 to 9

3.2 Symbols

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

B_2	algorithm that converts MS dialable talkgroup addresses between the User Interface and the Air Interface
dBm	absolute power level relative to 1 mW, expressed in dB
dBp	Power relative to the average power transmitted during a transmitted item in dB
Hz	frequency
Eb	Energy per bit
ms	milli-seconds
No	Noise per Hz
ppm	parts per million

3.3 Abbreviations

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

4FSK	Four-level Frequency Shift Keying
ACK	ACKnowledgment
AI	Air Interface
BCD	Binary Coded Decimal
BS	Base Station
CC	Channel Code
CCH	Control CHannel
CLI	Caller Line Identity
COCH _n	CO-CHannel Identity n (n = 1 to 15)
C-plane	Control-plane
CRC	Cyclic Redundancy Checksum

NOTE: For data error detection.

CSF	Configured Services and Facilities
dPMR	digital Private Mobile Radio
e.r.p	effective radiated power
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FN	Frame Numbering
GPS	Global Positioning System
HI	Header Information
ID	Identifier
IP	Internet Protocol
IPV	Internet Protocol Version
ISF	Initial Services and Facilities
IT	Information Technology
LBT	Listen Before Transmit
MI	Message Information
MID	Manufacturers ID
MMI	Man Machine Interface
MS	Mobile Station
MSs	Multiplicity of mobile or handportable Stations
NACK	Negative ACKnowledgment
OACSU	Off Air Call Set Up
PABX	Private Automatic Branch eXchange
PC	Personal Computer