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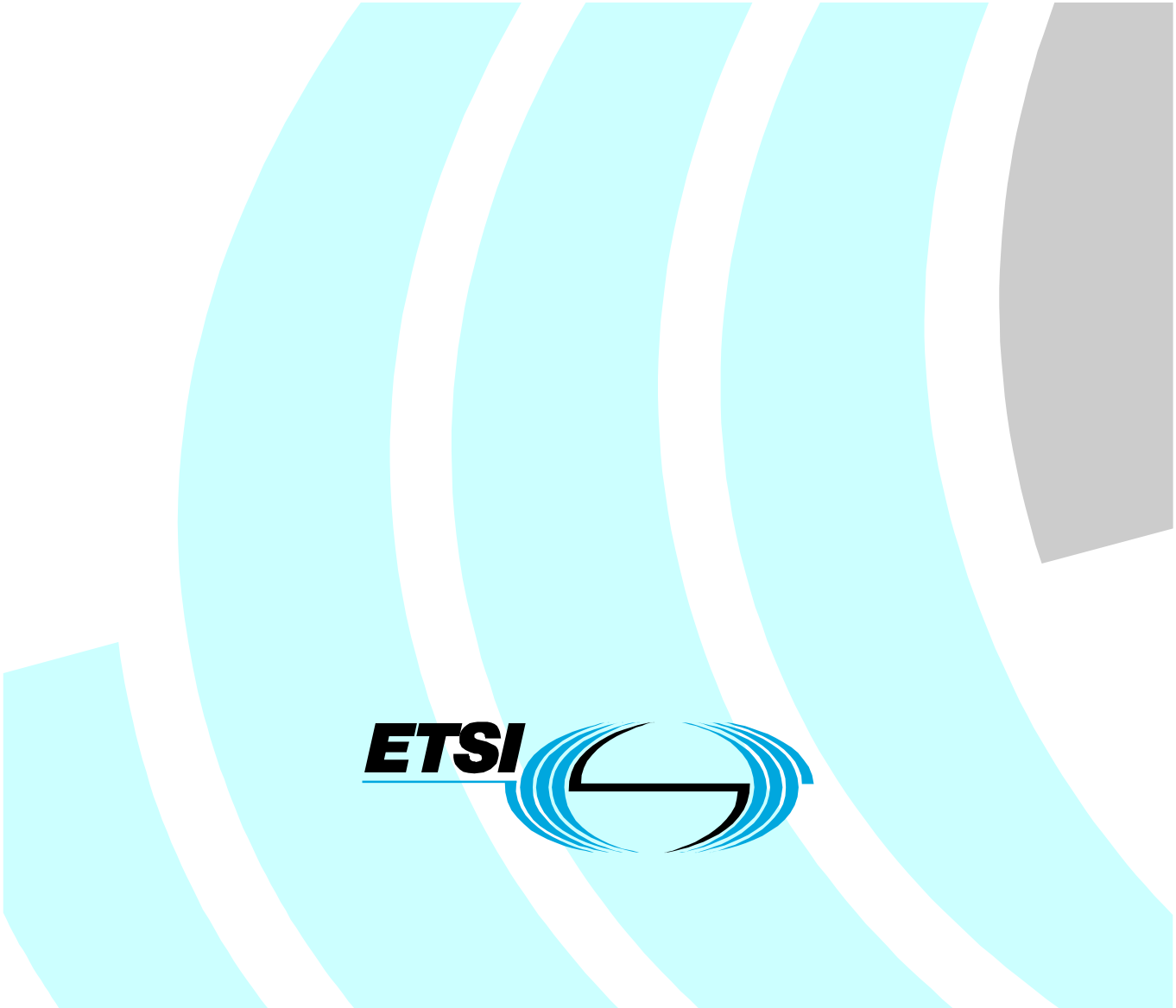
Technical Report

Electromagnetic compatibility and Radio spectrum Matters (ERM); Digital Private Mobile Radio (DPMR) using a channel spacing of 6,25 kHz and operating in the frequency range from 446,1 MHz to 446,2 MHz under general authorization without individual rights; System reference document



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Foreword

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

The present document covers the Electromagnetic compatibility and Radio spectrum Matters (ERM); System reference document for Digital Private Mobile Radio (DPMR) using a channel spacing of 6,25 kHz and operating in the frequency range from 446,1 MHz to 446,2 MHz under general authorization without individual rights.

1 Scope

The present document has been developed in order to provide information on the usage of radio frequencies for digital land mobile radio equipment offering peer-to-peer functionality complying with DPMR specifications (referenced later in the present document as "DPMR") using a channel spacing of 6,25 kHz and operating in the 446,1 MHz to 446,2 MHz frequency band, under general-authorization-with-no-individual-rights operation.

It includes necessary information to support the co-operation between ETSI and the Electronic Communications Committee (ECC) of the European Conference of Post and Telecommunications administrations (CEPT), including:

- Detailed market information (annex A).
- Technical information (annex B).
- Expected compatibility issues (annex C).

2 References

For the purposes of this Technical Report (TR) the following references apply:

[1] ETSI ETS 300 230: "Radio Equipment and Systems (RES); Land mobile service; Binary Interchange of Information and Signalling (BIIS) at 1 200 bit/s (BIIS 1 200)".

[2] ETSI EN 301 166-1: "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 1: Technical characteristics and methods of measurement".

[3] 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 under article 3.2 of the R&TTE Directive".

[4] ERC/DEC(98)25: "ERC Decision of 23 November 1998 on the harmonized frequency band to be designated for PMR 446".

[5] ERC/DEC(98)26: "ERC Decision of 23 November 1998 on Exemption from Individual Licensing of PMR 446 equipment".

[6] ERC/DEC(98)27: "ERC Decision of 23 November 1998 on free circulation and use of PMR 446 equipment in CEPT member countries enlarging the field of application of ERC/DEC/(95)01".

[7] ERC Report 25: "The European table of frequency allocations and utilizations covering the frequency range 9 kHz to 275 GHz".

[8] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

[9] 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".

[10] ETSI EN 300 296-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment using integral antennas intended primarily for analogue speech; Part 1: Technical characteristics and methods of measurement".

[11] CEPT/ECC FM(05)065 "Minutes of the 24-28 January 2005 meeting of WG FM".

3 Definitions and abbreviations

3.1 Definitions

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

DPMR: peer-to-peer narrow band (6,25 kHz) digital PMR application currently being standardized within ETSI

peer-to-peer: communication technique where any radio unit may communicate with one or more other radio units without the need for any additional equipment (e.g. repeater)

plug and play: of or pertaining to the ability of certain operating systems to automatically:

a) detect a new device that has been added to the system;

b) uniquely identify that device; and

c) install the appropriate drivers and system files for that device.

PMR446: license-exempt PMR equipment operating under ERC/DEC(98)25 [4], ERC/DEC(98)26 [5] and ERC/DEC(98)27 [6], and complying with EN 300 296-1 [10]

3.2 Abbreviations

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

BIIS1200	Binary Interchange of Information and Signalling at 1 200 bit/s
CEPT	European Conference of Post and Telecommunications administrations
DMR	Digital Mobile Radio
DPMR	Digital Private Mobile Radio
ECA	European Common Allocations table
ECC	Electronic Communications Committee
ERC	European Radiocommunications Committee
ERP	Effective Radiated Power
GSM	Global System for Mobile communication
ITU	International Telecommunication Union
PAMR	Public Access Mobile Radio
PMR	Private Mobile Radio
PWAP	Private Wide Area Paging
RF	Radio Frequency
RR	Radio Regulations
RSSI	Received Signal Strength Indication
SRDoc	System Reference Document
TETRA	TErrestrial Trunked RAdio

4 Executive summary

4.1 Status of the System Reference Document

Draft version 1.1.1_0.0.4 has been created by ERM TG DMR. The present document has been approved by ERM RM#30 (3-6 May 2005) and is now forwarded to CEPT for consideration and to ERM#26 (13-17 June 2005) for approval for publication.

4.2 Technical issues

DPMR is a new generation of digital PMR radio that is designed to operate within 6,25 kHz channels (compliant with EN 301 166-1 [2] and EN 301 166-2 [3]). The equipment will be without an external antenna socket (integral antenna equipment) but fitted with a permanent internal or a temporary internal 50 Ω RF connector (necessary to ensure compliance with EN 301 166-1 [2] and EN 301 166-2 [3]).

It will operate with a limited functionality that offers only simplex, peer-to-peer voice and data communications and is proposed as suitable for low cost and for general-authorization-with-no-individual-rights operation in the frequency band from 446,1 MHz to 446,2 MHz.

4.2.1 Applications

DPMR is specifically targeted at small PMR systems in all areas where analogue PMR or PMR446 is currently applied today. It will provide voice and data services (typically such as short messages data services).

4.2.1.1 Spectrum requirement and justifications

There is a demand for a suitable frequency designation offering a service similar to PMR446 but using digital technology that also provides users with simple data transmission.

The frequency band 446,1 MHz to 446,2 MHz has already been identified by CEPT WG FM as a preferred and possible solution to satisfy the demand [11], based on a questionnaire sent to administrations. A draft ECC decision for this frequency band is in preparation within WG FM.

This frequency band (as being directly above the analogue PMR 446 frequency band) is considered as the ideal candidate for license-exempt Digital PMR and also provides the propagation characteristics required. It is desirable that the frequencies are made available all over Europe, so that the corresponding equipment could be classified as Class 1 under the R&TTE Directive (1999/5/EC [8]).

Regulatory authorities have been approached by manufacturers to permit data over PMR446, which has been discussed in ECC and so far has not been accepted.

License-exempt Digital PMR is envisaged as complementing the current analogue PMR446 by providing other additional features that are currently being developed in the air-interface standards for DMR and DPMR.

4.2.2 Spectrum parameters

4.2.2.1 Radiated power

DPMR radios for this application will be operating with the same RF power as PMR446 radios, i.e. 500 mW. The equipment will be a handheld terminal with an integral antenna only.

DPMR handheld terminals may also offer dynamic RF power control. This will have the effect of increasing the frequency re-use and thus improving spectrum efficiency (capacity) over that of PMR446.

DPMR handheld terminals will operate in half the channel bandwidth of current PMR446 radios and improve spectrum efficiency even further.

4.2.2.2 Transmitted bandwidth

The transmitted bandwidth will comply with the spectrum mask required for 6,25 kHz channels as defined in EN 301 166-1 [2] and EN 301 166-2 [3].

4.2.2.3 Frequency considerations

A requirement has been identified for sixteen 6,25 kHz harmonized channels for DPMR, not too far from the PMR446 allocation, for general-authorization-with-no-individual-rights operation.

Within the frequency range of 446,1 MHz to 446,2 MHz, the following centre frequencies (nominal channel centre frequencies) are intended:

446,103125 MHz; 446,109375 MHz; 446,115625 MHz; 446,121875 MHz; 446,128125 MHz; 446,134375 MHz; 446,140625 MHz; 446,146875 MHz; 446,153125 MHz; 446,159375 MHz; 446,165625 MHz; 446,171875 MHz; 446,178125 MHz; 446,184375 MHz; 446,190625 MHz; 446,196875 MHz.

The maximum frequency error of the DPMR equipment does not exceed 1/10 of the channel spacing, i.e. 0,625 kHz, which is mandatory in order to comply with EN 301 166-1 [2] and EN 301 166-2 [3].

4.2.3 Current regulations

For radio spectrum coexistence the radio equipment will comply with the current harmonized standard EN 301 166-2 [3].

4.2.4 Compatibility issues

It is also intended that DPMR will co-exist in the same spectrum with DMR tier 1 peer-to-peer digital PMR application which is based on 12,5 kHz channel spacing (TR 102 335-1 [9]). In order to optimize the sharing, centre frequencies of both types of peer-to-peer DMR applications are offset.

The proposed equipment for DPMR will also have transmitter time-out functionality for both voice and data applications. Unmodulated, unused carriers will not be transmitted.

When accessing a channel to transmit, the equipment may take into account activity present on the channel. This could include other DPMR, digital or analogue activity. It is envisaged to include this listen-before-talk functionality in the product standard. The listen-before-talk function may differentiate between various parameters such as RSSI, channel synchronization as well as group or colour code.

5 Main conclusions

5.1 Business importance

The transition to digital technology in all sectors of radio communications is vital in order to meet the user expectations whilst improving spectrum efficiency. To date, the smaller market sectors of digital PMR have not been addressed in ETSI digital PMR standardization. The success of the proposed DPMR will be crucial to the future of the low-end mobile radio market.

DPMR has a very simple level of functionality that should be treated in a similar manner as the analogue PMR equivalent. The entry-level of the analogue equivalent is the PMR446 specification and an entry-level of DPMR should be available under similar terms with a defined set of channels and a specification that allows a general-authorization-with-no-individual-rights status. It is important that the corresponding frequencies are harmonized throughout the European Community. A pan-European harmonized frequency designation would give the economy of scale required to produce terminals at a price that can compete with analogue technology.

5.2 Expected timing for products to market

It is expected that the relevant parts of the DPMR standard will be completed by mid 2005. It is estimated that commercial DPMR products would be available for first customer shipments within 12 months of the standard being published. Therefore, a decision for the harmonized spectrum is required to be available for general-authorization-with-no-individual-rights by mid 2005. However, it is also expected that some countries may need a longer transition time to free the spectrum from existing usage until it will become available.

5.3 Requested ECC actions

ETSI requests that the ECC considers the present document when preparing a new ECC Decision, within the timeframe defined in clause 5.2. Sixteen dedicated 6,25 kHz contiguous channels within planned frequency range from 446,1 MHz to 446,2 MHz frequency band are requested, on a harmonized European wide basis for a simplex, peer-to-peer digital speech and data service for general-authorization-with-no-individual-rights operation.

This is in addition to the earlier requested spectrum for DMR tier 1 (TR 102 335-1 [9]). It is requested that the narrowband digital PMR peer-to-peer application (DPMR) covered by the present document coexists in the same spectrum with the 12,5 kHz DMR tier 1 peer-to-peer application as defined in TR 102 335-1 [9], i.e. the new ECC decision is proposed to include both 6,25 kHz and 12,5 kHz channel spacings.

Annex A:
Detailed market information

A.1 Range of applications

DPMR will be especially effective in those applications currently served by PMR446 analogue voice where the new technology will offer data communications as well as digital speech.

Given the increase in voice plus signalling applications in analogue PMR today, DPMR will be most effective in increasing spectrum efficiency by means of doubling of usable RF channels compared to current 12,5 kHz technology.

A.2 Market size and value

The current European PMR market is estimated at more than 1,5 million terminals (see note) per year throughout the member states, with a total value likely to exceed 500 million Euros in 2005.

NOTE: IMS Research June 2001.

If we disregard the "high-end" digital market that is represented for example by TETRA and other similar technologies, we still have just less than 1,5 million analogue terminals entering the market each year.

There is little growth in the traditional licensed services, but there is an explosive growth in the license exempt services such as PMR446.

The existing license-exempt service offers an easy access to PMR technology and the benefits that this brings. It is seen as a crucial reason for this growth. The introduction of spectrum for DPMR for general-authorization-with-no-individual-rights operation, coupled with its additional unique features is expected to accelerate this growth provided that any transition periods proposed by CEPT administrations are kept to a minimum.

The functionality and features of such a low cost digital technology will bring new users into this market, as well as providing overwhelming reasons to upgrade for existing users.

A.3 Traffic evaluation

Voice traffic evaluation will be similar to current analogue PMR deployment. However, DPMR will offer considerable improvement in voice and data applications, where the channel data throughput will be enhanced by an order of at least double compared to current PMR technology such as BIIS1200, combined with a spectrum efficiency of almost double that offered by BIIS1200.

DPMR may also offer dynamic RF power control by the terminals. This will have the effect of increasing the frequency re-use by radio users thus improving spectrum efficiency even further.

Annex B:
Technical information

B.1 Detailed technical description

B.1.1 Overview

DPMR is based on the technical and signalling characteristics of low cost, low complexity terminals based on a fully digital implementation and FDMA.

DPMR is two or more radios in peer-to-peer mode and in spectrum identified for general-authorization-with-no-individual-rights usage. This may be likened to a digital version of PMR446 but with the added virtues of data, privacy and additional unique features.

B.1.2 Key user features

Clauses B.1.2.1 through B.1.2.5 list of DPMR technical features visible to the user that offer advancement over existing license-exempt analogue PMR.

B.1.2.1 Battery life

A criticism of PMR, particularly the digital formats, is the short operational period before batteries need to be recharged. GSM handsets have set user's expectations for battery life. Attention to the protocol complexity and built in "power save" are characteristics of the DPMR signalling standard. The result is that DPMR handsets will potentially have a considerably better battery life than today's analogue PMR handsets.

B.1.2.2 Speech quality

Digital radio systems require a vocoder to compress and digitize the speech. There is continuous research into vocoder design. Early low bit rate vocoders, which although intelligible, were far from natural sounding. With the advances in both vocoder algorithms and digital hardware, speech quality will be at least as good as GSM.

B.1.2.3 Security

DPMR, in common with other digital formats, offers protection from the casual eavesdropper armed with a simple scanner.

B.1.2.4 Data

DPMR radios may offer the functionality of connected and/or packet data modes. These data transport mechanisms can be integrated into the radio equipment and suitable drivers to offer a plug and play interface to personal computers would be developed.

B.1.2.5 Channels

DPMR would offer users double the number of channels available compared to existing 12,5 kHz technology.

B.2 Technical justification for spectrum

B.2.1 Power

B.2.1.1 License-exempt operation

DPMR terminals for operation under a general-authorization-with-no-individual-rights regime are designed to comply with the same characteristics as those applied to equivalent analogue technology (PMR446). In this respect, the same power limit of 500 mW ERP applies, accompanied by the mandatory requirement for equipment to have an integral antenna, in accordance with ERC/DEC(98)25 [4].

B.2.2 Frequency

The frequency band referred to in the present document is from 446,1 MHz to 446,2 MHz. No guard band will be required to Land Mobile services operating in adjacent channels when these comply with EN 301 166-1 [2] and EN 301 166-2 [3].

16 × 6,25 kHz contiguous simplex channels are proposed to be accommodated within this frequency range.

B.2.2.1 License-exempt operation

DPMR terminals will only be capable of operation on the frequencies identified for general-authorization-with-no-individual-rights operation.

DPMR terminals are designed to comply with similar requirements as are applicable to current license-exempt analogue technology.

B.2.3 Bandwidth and other radio parameters

The specifications and operating parameters of DPMR will be no different from current analogue PMR in terms of those parameters relevant to spectrum planning and administration with the exception of being able to operate in half the channel bandwidth.

Annex C:
Expected compatibility issues

C.1 Coexistence studies (if any)

Coexistence studies are not envisaged to be necessary.

However, it should also be noted that the initial usage density of DPMR would be low in the first years after market placement. This could potentially be used by administrations for the provision of a transition period in which the proposed frequency band would be opened to coexistence of the existing individual licensed usage and the new license-exempt DMR usage. In addition, no new individual usage should be licensed within this transition period.

To support this suggestion, interference probability studies could provide the necessary results to allow individual countries to shorten the transition period.

C.2 Current ITU allocations

The frequency band proposed is allocated to the Mobile Service in Region 1 and in the ECA [7].

Table C.2.1: Excerpt from the European Common Allocations Table [7]

Frequency band	RR Region 1 Allocation and RR footnotes relevant to CEPT and frequency band	European Common Allocations	Utilization	Note
440 MHz to 450 MHz	FIXED MOBILE except Aeronautical Mobile Radiolocation 5.269 5.271 5.286	MOBILE except Aeronautical Mobile Radiolocation EU31	Analogue and digital land mobile PMR/PAMR	Single frequency operation
			Digital Land Mobile DMO	Within the band 445,2 MHz to 445,3 MHz
			On-site paging	Call-out and answer-back
			PMR 446	In the band 446 MHz to 446,1 MHz
5.269	Different category of service: in Australia, the United States, India, Japan and the United Kingdom, the allocation of the bands 420 MHz to 430 MHz and 440 MHz to 450 MHz to the radiolocation service is on a primary basis (see No. 5.33).			
5.271	Additional allocation: in Azerbaijan, Belarus, China, India, Latvia, Lithuania, Kyrgyzstan and Turkmenistan, the band 420 MHz to 460 MHz is also allocated to the aeronautical radionavigation service (radio altimeters) on a secondary basis. (WRC 03)			
5.286	The band 449,75 MHz to 450,25 MHz may be used for the space operation service (Earth-to-space) and the space research service (Earth-to-space), subject to agreement obtained under No. 9.21.			
EU31	The band 440 MHZ to 470 MHz is the tuning range for Private Wide Area Paging (PWAP).			

C.3 Sharing issues

It is also intended that DPMR will co-exist in the same spectrum with the DMR tier 1 peer-to-peer digital PMR application which is based on 12,5 kHz channel spacing as described in TR 102 335-1 [9]. Sharing issues during the transition period are referred to in clause C.1.

History

Document history		
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