

**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**



Reference

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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 is part 1 of a multi-part deliverable covering the Electromagnetic compatibility and Radio spectrum Matters (ERM); System reference document for harmonized use of Digital Mobile Radio (DMR), as identified below:

Part 1: **"Tier 1 DMR#, expected to be for general authorization with no individual rights operation";**

Part 2: "Systems operating under individual licences in the existing land mobile service spectrum bands".

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 DMR specifications (referenced later in the present document as "DMR#") operating in the 406,1 MHz to 410 MHz or 440 MHz to 450 MHz simplex frequency bands, 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 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".
- [3] 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 essential requirements under article 3.2 of the R&TTE Directive".
- [4] 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".
- [5] 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".
- [6] 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".
- [7] ERC/DEC(98)25: "ERC Decision of 23 November 1998 on the harmonized frequency band to be designated for PMR 446".
- [8] ERC/DEC(98)26: "ERC Decision of 23 November 1998 on Exemption from Individual Licensing of PMR 446 equipment".
- [9] 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".
- [10] ERC Report 25: "The European table of frequency allocations and utilizations covering the frequency range 9 kHz to 275 GHz".
- [11] ITU Radio Regulations.

- [12] 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).

3 Definitions and abbreviations

3.1 Definitions

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

DMR#: peer-to-peer application of the DMR product 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: licence-exempt PMR equipment operating under ERC/DEC(98)25 [7], ERC/DEC(98)26 [8] and ERC/DEC(98)27 [9], and complying with EN 300 296-1 [4]

polite protocol: medium access protocol that implements a "listen before transmit" protocol in order to ensure that the channel is free before transmitting

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 |
| 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 |
| PMR | Private Mobile Radio |
| RF | Radio Frequency |
| SRDoc | System Reference Document |
| TETRA | TErrestrial TRunked RAdio |

4 Executive summary

4.1 Status of the System Reference Document

The present document excluding the text in square brackets in clause C.3 has been approved by the 27th meeting of ETSI working group ERM RM. The text in square brackets in clause C.3 was proposed by ERM-TG32DMR after ERM RM#27. ERM RM will submit the present document to ERM#23 (21-25 June 2004) for approval for publication. ERM#23 is requested to make a decision on the proposed text in square brackets in clause C.3.

4.2 Technical issues

DMR# is a new generation of digital PMR radio that is designed to operate within the existing channel rasters or spacing (compliant with EN 300 390-1 [5] and EN 300 390-2 [6] operating on 12,5 kHz channels) used in land mobile frequency bands in Europe. 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.

4.2.1 Applications

DMR# 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.

DMR# is the Tier 1 product (Low Tier) of a family of three tiers covered in the DMR standard:

- Tier 1: DMR# (expected to be for general-authorization-with-no-individual-rights operation);
- Tier 2: For the professional market offering peer-to-peer mode and repeater mode (expected to be licensed and as described in TR 102 335-2);
- Tier 3: Trunked or Simulcast operation (expected to be licensed and as described in TR 102 335-2).

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 data transmission. The simplex bands 406,1 MHz to 410 MHz or 440 MHz to 450 MHz would be ideal candidates to provide the propagation characteristics required. It is desirable that the frequencies are made available all over Europe, so that the corresponding equipment can be classified as Class 1 under the R&TTE Directive [12].

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

DMR# would be an ideal candidate to facilitate a digital PMR complementing PMR446, which would provide other additional features that are currently being developed in the air-interface standard.

4.2.2 Spectrum parameters

4.2.2.1 Radiated power

DMR# radios for this application will be operating with the same RF power as PMR446 radios, i.e. 500 milliwatts for handheld terminals only (integral antenna equipment).

DMR# 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.

4.2.2.2 Transmitted bandwidth

The transmitted bandwidth will comply with the spectrum mask required for 12,5 kHz channels as defined in EN 300 113-1 [2], EN 300 113-2 [3], EN 300 390-1 [5] and EN 300 390-2 [6].

4.2.2.3 Frequency considerations

A requirement has been identified for 8 x 12,5 kHz dedicated harmonized channels for DMR#, not too far from the PMR446 allocation, for general-authorization-with-no-individual-rights operation.

Dual operation, PMR446 and DMR#, has been considered for migration purposes, in which case these channels should be within those currently used by analogue PMR radio systems in the 406,1 MHz to 410 MHz or 440 MHz to 450 MHz simplex bands.

If dedicated DMR# channels cannot be identified, then to ensure coexistence between analogue terminals and digital DMR# terminals, the medium access protocol will be polite.

4.2.3 Current regulations

For radio spectrum coexistence the radio equipment will comply with the current, harmonized standard EN 300 390-2 [6]. However, other technical requirements are required for DMR, which will be published in a new harmonized ETSI standard.

4.2.4 Compatibility issues

If dedicated DMR# channels cannot be identified, the primary coexistence issue to consider may be that of shared spectrum usage between DMR# and analogue PMR users.

Whilst DMR# radios will be able to co-exist within the framework of a defined "polite" digital access protocol, it is uncertain whether analogue radios will be able to distinguish between noise and DMR# modulated signals. Consequently analogue PMR may be unable to obey such a polite access protocol. Coexistence may therefore prove impractical from a protocol point of view, however, geographical sharing would be possible.

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 DMR# will be crucial to the future of the low-end mobile radio market.

DMR# 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 DMR# 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 DMR# standard will be completed by mid 2004. It is estimated that commercial DMR# products would be available for first customer shipments within 24 months of the standard being published. Therefore the harmonized spectrum is required to be available for general-authorization-with-no-individual-rights DMR# by mid 2006.

5.3 Requested ECC actions

ETSI requests that the ECC considers the present document with a view to identify, within the timeframe defined in clause 5.2, a minimum of 8 dedicated 12,5 kHz contiguous channels within either the 406,1 MHz to 410 MHz or 440 MHz to 450 MHz frequency bands, on a harmonized European wide basis for a simplex, peer-to-peer digital speech and data service using a polite protocol (DMR#) for general-authorization-with-no-individual-rights operation.

Annex A: Detailed market information

A.1 Range of applications

DMR# 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, DMR# will be most effective in increasing spectrum efficiency by means of offering greater throughput for the same channel spectrum mask.

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 450 million Euros in 2003.

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 fewer 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 licence exempt services such as PMR446.

The existing licence 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 DMR# for general-authorization-with-no-individual-rights operation, coupled with its additional unique features is expected to accelerate this growth.

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, DMR# will offer considerable improvement in voice and data applications, where the channel data throughput will be enhanced by an order of at least a 5 times magnitude compared to current PMR technology such as BIIS1200.

DMR# 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.

Annex B: Technical information

B.1 Detailed technical description

B.1.1 Overview

DMR# is a sub-set of the DMR standard which defines the technical and signalling characteristics of low cost, low complexity terminals based on a fully digital implementation.

DMR# 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 that DMR offers.

B.1.2 Key user features

This is a list of DMR# technical features visible to the user that offer advancement over existing licence 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 DMR signalling standard. The result is that DMR# 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

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

B.1.2.4 Data

DMR# can provide an integral and flexible data transport mechanism with a "plug and play" type interface.

B.2 Technical justification for spectrum

B.2.1 Power

B.2.1.1 Licence-exempt operation

DMR# 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, in accordance with ERC/DEC(98)25 [7].

B.2.2 Frequency

The frequency bands referred to in the present document cover the frequency ranges of 406,1 MHz to 410 MHz or 440 MHz to 450 MHz. No guard band will be required to Land Mobile services operating in adjacent channels when these comply with EN 300 113-1 [2], EN 300 113-2 [3], EN 300 390-1 [5] or EN 300 390-2 [6].

A minimum of $8 \times 12,5$ kHz contiguous simplex channels are required to cope with expected demand.

B.2.2.1 Licence-exempt operation

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

DMR# terminals are designed to comply with similar requirements as are applicable to current licence-exempt analogue technology.

B.2.3 Bandwidth and other radio parameters

DMR# radio equipment will comply with the appropriate harmonized standard.

The specifications and operating parameters of DMR# will be no different from current analogue PMR in terms of those parameters relevant to spectrum planning and administration.

B.3 Information on current version of relevant ETSI standards

The (future) ETSI standards relevant to DMR# and DMR will be:

- the output of ETSI work item DTS/ERM-TG32DMR-052 for the operational protocol;
- the DMR standard being developed by ETSI will either meet or exceed the requirements of the existing harmonized standard EN 300 113-2 [3] and EN 300 390-2 [6].

Annex C: Expected compatibility issues

C.1 Coexistence studies (if any)

Coexistence studies with services operating in the same or adjacent bands would need to be considered, in particular with respect to analogue PMR systems.

C.2 Current ITU allocations

The frequency bands proposed are allocated to the Mobile Service in Region 1 and in the ECA. Therefore, no modifications of the allocation tables are necessary.

The band 406,1 MHz to 410 MHz is allocated to the Fixed, Mobile except aeronautical mobile and Radio Astronomy Services on a co-primary basis. The ITU Radio Regulations [11] footnote 5.149 applies.

C.3 Sharing issues

The access protocol for
General-authorization-with-no-individual-rights operation is currently under review.

History

| Document history | | |
|------------------|--------------|-------------|
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