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Technical Report

**Terrestrial Trunked Radio (TETRA);
User Requirement Specification TETRA Release 2.1;
Part 12: Direct Mode Operation (DMO)**

ETSI

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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Terrestrial Trunked Radio (TETRA).

The present document is part 12 of a multi-part deliverable covering the User Requirement Specifications (URSs) for TETRA Release 2 and Release 2.1, as identified below:

Part 1: "General Overview";

Part 2: "High Speed Data";

Part 3: "Codec";

Part 4: "Air Interface Enhancements";

Part 5: "Interworking and Roaming";

Part 6: "Smart Card (SC) and Subscriber Identity Module (SIM) ";

Part 7: "Security";

Part 8: "Air - Ground - Air services";

Part 9: "Peripheral Equipment Interface";

Part 10: "Local Mode Broadband";

Part 11: "Over The Air Management";

Part 12: "Direct Mode Operation".

Introduction

The Terms of Reference for TC TETRA approved at ETSI Board meeting #69, November 2008 is to produce ETSI deliverables (and maintenance thereafter) in accordance with the following requirements:

The Terms of Reference for TC TETRA are to produce ETSI deliverables (and maintenance thereafter) in accordance with the following requirements:

a) The provision of user driven services, facilities and functionality as required by traditional Professional Mobile Radio (PMR) user organizations such as the Emergency Services, Government, Military, Transportation, Utility and Industrial organizations as well as Public Access Mobile Radio (PAMR) Operators.

b) The evolution and enhancement of TETRA as required by the market with the provision of new services, facilities and functionality made possible by new technology innovations and standards.

c) Further enhancements of the TETRA standard in order to provide increased benefits and optimization in terms of spectrum efficiency, network capacity, system performance, quality of service, security and other relevant parameters.

d) The backward compatibility and integration of the new services, facilities and functionality with existing TETRA standards in order to future-proof the existing and future investments of TETRA users.

Technical Objective:

TETRA is one of a number of digital wireless communication technologies standardized by ETSI.

ETSI TC TETRA produces standards and/or adapts existing standards for efficient digital PMR and PAMR voice and data services, including broadband evolution.

The URS is required by TC TETRA to guide the enhancement of the current TETRA DMO standard.

1 Scope

The present document provides the User Requirement Specifications (URSs) for the TETRA Direct Mode Operation.

The present document is applicable to the specification of TETRA Release 2.1 equipment.

The user requirements contained in the present document are described in non-technical terms and are based on discussions in TC TETRA WG1 and on an analysis of the results for DMO from the 2001 TETRA Release 2 Market Questionnaire and the 2007 Future of TETRA workshop [i.1].

2 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 reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://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.

2.1 Normative references

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

Not applicable.

2.2 Informative references

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 102 621: "Terrestrial Trunked Radio (TETRA); TWC2007 Future of TETRA workshop report".

3 Definitions and abbreviations

3.1 Definitions

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

TETRA Release 2: Work Programme with new terms of reference within ETSI Project TETRA to enhance the services and facilities of TETRA in order to meet new user requirements, utilize new technology and increase the longevity of TETRA within the traditional market domains of PMR and PAMR

TETRA Release 2.1: Work Programme within TC TETRA to enhance the services and facilities of TETRA in order to meet new user requirements, utilize new technology and increase the longevity of TETRA within the traditional market domains of PMR and PAMR

3.2 Abbreviations

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

DMO	Direct Mode Operation
ETSI	European Telecommunications Standards Institute
FSK	Frequency Shift Keying
MS	Mobile Station
PAMR	Public Access Mobile Radio
PMR	Professional (or Private) Mobile Radio
RF	Radio Frequency
SC	Smart Card
SIM	Subscriber Identity Module
TEDS	TETRA Enhanced Data Service
TETRA	TErrestrial Trunked RAdio
TMO	Trunked Mode Operation
TR	Technical Report
URS	User Requirement Specification

4 User Requirement Specification

4.1 Introduction

TETRA networks provide users with advanced services, mobile and portable coverage and typically wide area mobility. Still it may not be possible and economical to fulfil all operational scenarios 100 % of the time with a TETRA network. For specific operational scenarios and in specific circumstances there is a need for network independent communication, further to be called Direct Mode Operation or DMO in the present document.

Examples of operational scenarios that (sometimes) cannot rely on a network only are:

- Police covert and special operations.

- Fire brigade on-scene and in-building communication to smoke divers.

Examples of specific situations and circumstances where there is a need for an additional communication solution are:

- Contingency operational reasons e.g. when trunked system is not operational due to fault or is overloaded and the access time cannot be guaranteed.

- Urban areas with limited coverage e.g. in-building, car parks and underground.

- Rural areas with no infrastructure.

4.2 General requirements

The service requirements for DMO are very similar to those valid for communication via the network. As in TMO also in DMO there is a need for both voice and data services and the communication should be robust, secure, flexible and frequency efficient. As in TMO, Group call is considered to be a very important feature in DMO.

DMO communication should be possible with the same radio that is used for communication in TMO.

The maximum transmit power and antenna configuration to be used for DMO communication should be such that Health and Safety issues are avoided.

4.3 DMO variants

First of all there is a need for DMO radio-to-radio communication. This mode of operation is similar to conventional half duplex radio communication.

It is recognised that not all scenarios can be fulfilled with DMO radio-to-radio communication only.

For situations where DMO radio-to-radio communication does not provide the required operational range there is a need for the possibility for communicating via a repeater. A strategically positioned DMO repeater re-transmitting the information it receives can significantly extend the DMO range and improve communication reliability.

For situations where DMO users need to cooperate and communicate with colleagues on a TETRA network there is a need for a DMO gateway that re-transmits the information that is received on the DMO channel on the TETRA network and vice versa. A DMO gateway relieves DMO users operational isolation.

In situations where the DMO operation and communication is primarily isolated, one or some of the team members may want to be reachable for colleagues on the TETRA network or vice versa. For these situations there is a need for a mode where the radio, while in DMO mode, also scans the TMO network for activity or vice versa. This mode is called Dual Watch operation.

4.4　　Operational scenarios in more detail

4.4.1　　Fire brigade on scene and in-building communication

During their operations fire brigades often have to enter buildings to attack the fire. As in many Public Safety TETRA networks indoor coverage cannot be guaranteed, the fire brigades in those networks operationally use Direct Mode Operation for their on-scene communications within the teams (see figure 1).

The commanding officer is also in contact with the team commanders and the control room using TMO. Most of the on scene DMO communication is done as Direct Mode radio-to-radio communications, in some cases the communication runs via a DMO repeater.
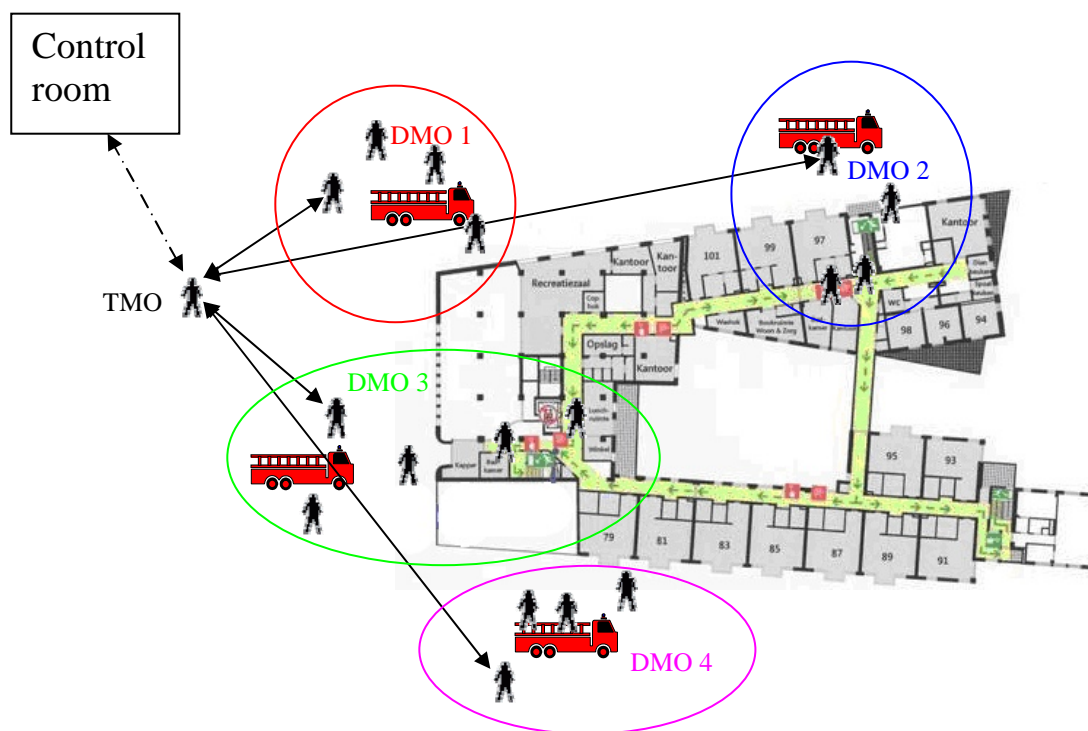

Figure 1: Fire brigade on scene scenario

4.4.2 Police covert and special operation

Many of the operations of special police teams largely benefit from a wide area network. Some of their operations cannot rely on network coverage. An example scenario is an arrest team entering a building to seize a dangerous suspect. Because part of the operation is indoor, where network coverage may be not available, DMO will be used for communication. Depending on the size of the operation and the building either DMO radio-to-radio is used or the communication is done via a DMO repeater.

# 5 Future of TETRA workshop 2007: New ideas and improvement areas

5.1 Future of TETRA workshop

In the future of TETRA workshop of 2007 requirements were gathered for DMO also. The outcome of the workshop was documented in [i.1].

As some of the respondents had some years of operational experience with DMO implementations while others had no operational experience with DMO yet, the workshop had an interesting mixture of results. On the one hand new ideas were gathered from current and future DMO users while on the other hand essential enhancement areas were identified by experienced DMO users.

5.2 New Ideas

As can been seen in figure 2 that is extracted from clause 5.2 of [i.1], the main interest of the total of respondents for DMO is in increased range performance, increased service reliability/availability, increased spectrum efficiency and increased data rate.

DMO All respondents
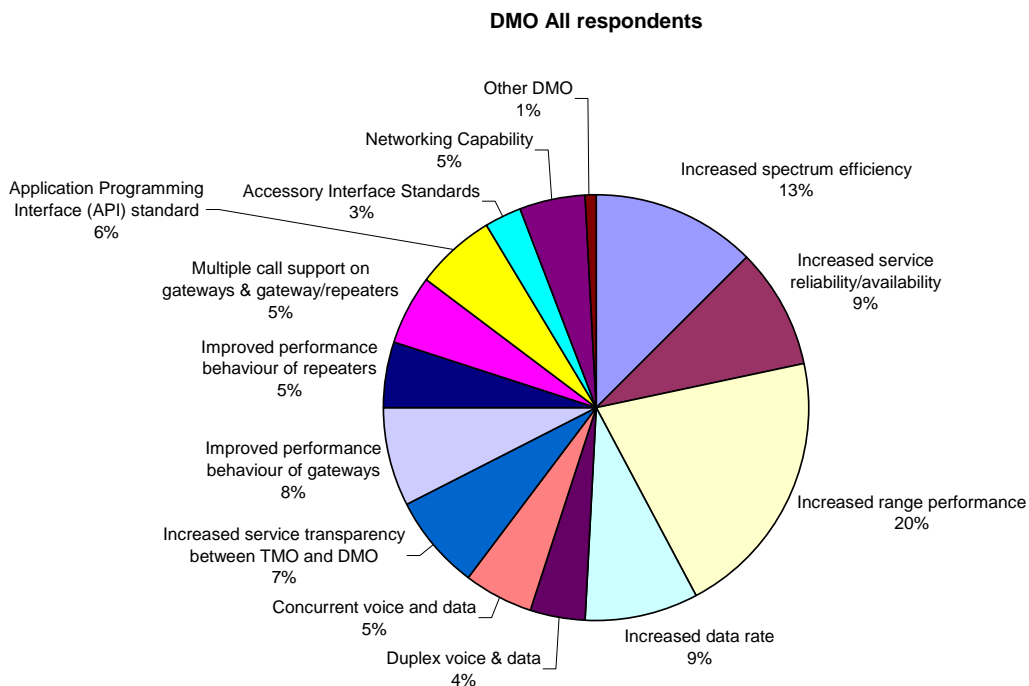
Figure 2: All workshop respondents view on DMO enhancements

5.3   Improvement areas

5+_Exp_Resp DMO Q2
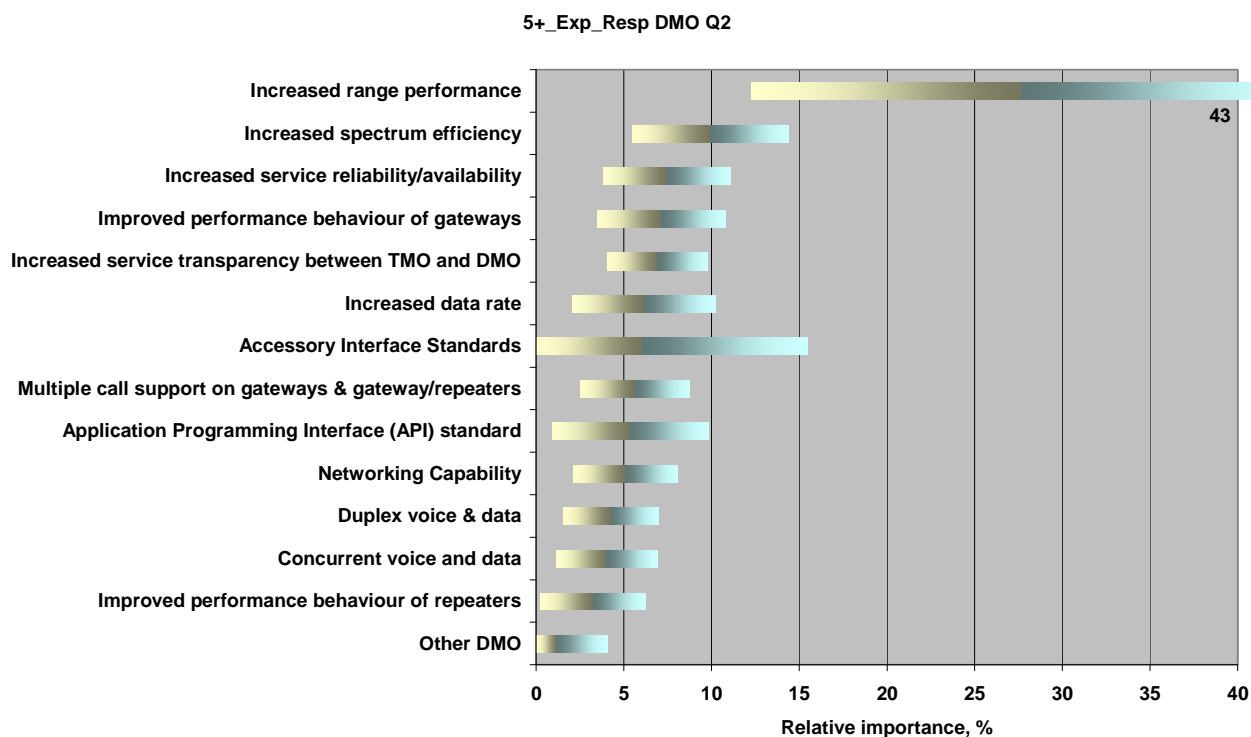
Figure 3: Experienced respondents view on DMO enhancements

Figure 3, extracted from clause 11.2 in [i.1] shows that experienced respondents rate the Increased range performance for DMO of very high importance. Way behind that Increased spectrum efficiency is seen as the second important area.

The other DMO enhancement areas are seen as of equal importance.

6   Requirements developed after 2007

6.1   Introduction

After the 2007 workshop new customer requirements for DMO have been gathered and documented by ETSI TC TETRA. This clause describes these new requirements.

6.2   Callout

6.2.1   Description

Callout is a service for reliably alerting users about an incident that they need to respond to. This is normally sent from a central location to personnel in the field, at work or at home. The Callout Service should have the capability of engaging and informing the users while at the same time giving the central location a clear indication of the available resources for the incident, e.g. by prompting the users to send back a response indicating whether they are able to respond to the incident.

The Callout Service also includes a user availability function which is intended to operate in conjunction with a resource management system or similar central application that gives the users the opportunity to indicate future availability for work. This is most likely to be used for longer term availability, for example a user signalling non-availability prior to going on holiday and then signalling availability on his return to work. This feature works in parallel with callout and is not tied to any particular callout incident.

6.2.2   Callout in DMO

When a DMO gateway is used to extend coverage and services to DMO users the callout service should operate transparently to the DMO users.

6.3   DMO Edge of Range Indication

DMO Edge of Range Indication introduces a real-time audible (Fire brigade users operating on scene are generally very busy with task and will not monitor the display of their radio) indication of the RF level of the radio signal during the reception of DMO calls. The audible indication should vary as a function of the RF level, should cover an RF range of at least 20 dB and should be available in parallel to the receive audio.

With the help of Edge of Range Indication the user will be able to detect fading conditions and low signal areas. With this the DMO user will become aware of the margin of signal level. Even though this will not improve the range of DMO, it will help the user to utilize the range in a more intuitive and safe way and enable the change from a digital "trial and error" to a more fuzzy "awareness based" DMO usage.

7   Market

7.1   General

A major market for DMO is developing in Germany. The German fire brigade is organised in 100 professional fire brigades with 30 000 active fire fighters and 25 000 voluntary fire brigades with 1 000 000 active fire fighters. For on-scene communication the German fire brigade is planning to use DMO. The estimated MS market size is 250 000.

Other major new markets for DMO are the fire brigades in Norway, Sweden and Denmark.

7.2   Callout

Callout is needed in DMO to support the replacement of pagers used by the German and other Fire Brigades. There are something of the order of 1,4 m fire fighters in Germany many of whom would need this capability. (There are of course other requirements that need to be met such as power consumption, size and performance in TMO). Other countries such as Norway also need this facility.

7.3   Edge of Range Indication

Edge of Range Indication is needed by fire fighters where the coverage in DMO is of concern. In some ways it is a less pressing need if Range Extension (see below) is addressed with significant improvement. To date these improvements have been requested by the Netherlands and Belgium. There are 5 500 career fire fighters and 12 000 volunteers in Belgium and about 27 000 in the Netherlands of which 75 % are volunteers. Both countries already use TETRA so the impact of these improvements would be to retain the market.

7.4   Range Extension

Whilst TETRA has been adopted in a number of fire services around the world it is said that further adoption may be inhibited by the perceived lack of DMO range when compared to analogue radios and some other digital technologies. The size of market that is at real risk here is difficult to assess but it is likely to be many thousands of radios.

Range extension would also reduce the number of in-building repeaters required to get coverage throughout Germany making this more attractive. Whilst there are figures for the value of this market in total (€150 million) the net gain for TETRA through increasing range for this market alone is difficult to assess.

Range extension has been sought for the covert community. Initially this was quite a strong demand but operational experience particularly in countries where TMO coverage is very good has reduced the demand. None the less there would be an interest in this niche market for increased range and some thousands of extra radios could be sold.

7.5 Spectrally Efficient DMO

Spectrally Efficient DMO has become more of an issue where DMO frequencies are limited and under pressure. This will likely be the case where DMO is used to achieve in-building coverage. The gains from achieving this are uncertain but possibly many thousands of radios.

Annex A:
TC TETRA WG8 input

A.1   Introduction

ETSI TC TETRA WG8 produced the following list that details their view on the future DMO roadmap.

A.2   Potential new work activity

New features:

- Voice duplex call

- Circuit mode duplex data

- Multi-call Gateway

- Single slot DMO Packet Data

- Multi-slot DMO Packet Data

- High-speed DMO TEDS

- Multi-slot Circuit Mode Data

- Concurrent voice and data

- Self-controlled DMO Repeater networking

Frequency efficiency improvements:

- Frequency efficiency using independent frequencies for traffic

- Frequency efficiency using 6,25 kHz channel

- Frequency efficiency using 12,5 kHz channel

Range improvement techniques:

- Long range using repeated slots

- Long range using 2-FSK modulation

History

Document history		
V1.1.1	August 2012	Publication