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Terrestrial Trunked Radio (TETRA); Harmonized EN for TETRA equipment covering essential requirements under article 3.2 of the R&TTE Directive; Part 2: Direct Mode Operation (DMO)

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Candidate Harmonized European Standard (Telecommunications series)

**Terrestrial Trunked Radio (TETRA);
Harmonized EN for TETRA equipment covering essential
requirements under article 3.2 of the R&TTE Directive;
Part 2: Direct Mode Operation (DMO)**

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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 - NAF 742 C
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Foreword

This Candidate Harmonized European Standard (Telecommunications series) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

The present document is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the 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") [1].

The present document is part 2 of a multi-part deliverable covering Harmonized EN for TETRA equipment covering essential requirements under article 3.2 of the R&TTE Directive, as identified below:

Part 1: "Voice plus Data (V+D)"; **(standards.iteh.ai)**

Part 2: "Direct Mode Operation (DMO)".

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Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 March 2002
Date of withdrawal of any conflicting National Standard (dow):	31 March 2002

Introduction

The present document is part of a set of standards designed to fit in a modular structure to cover all radio and telecommunications terminal equipment under the R&TTE Directive [1]. Each standard is a module in the structure. The modular structure is shown in figure 1.

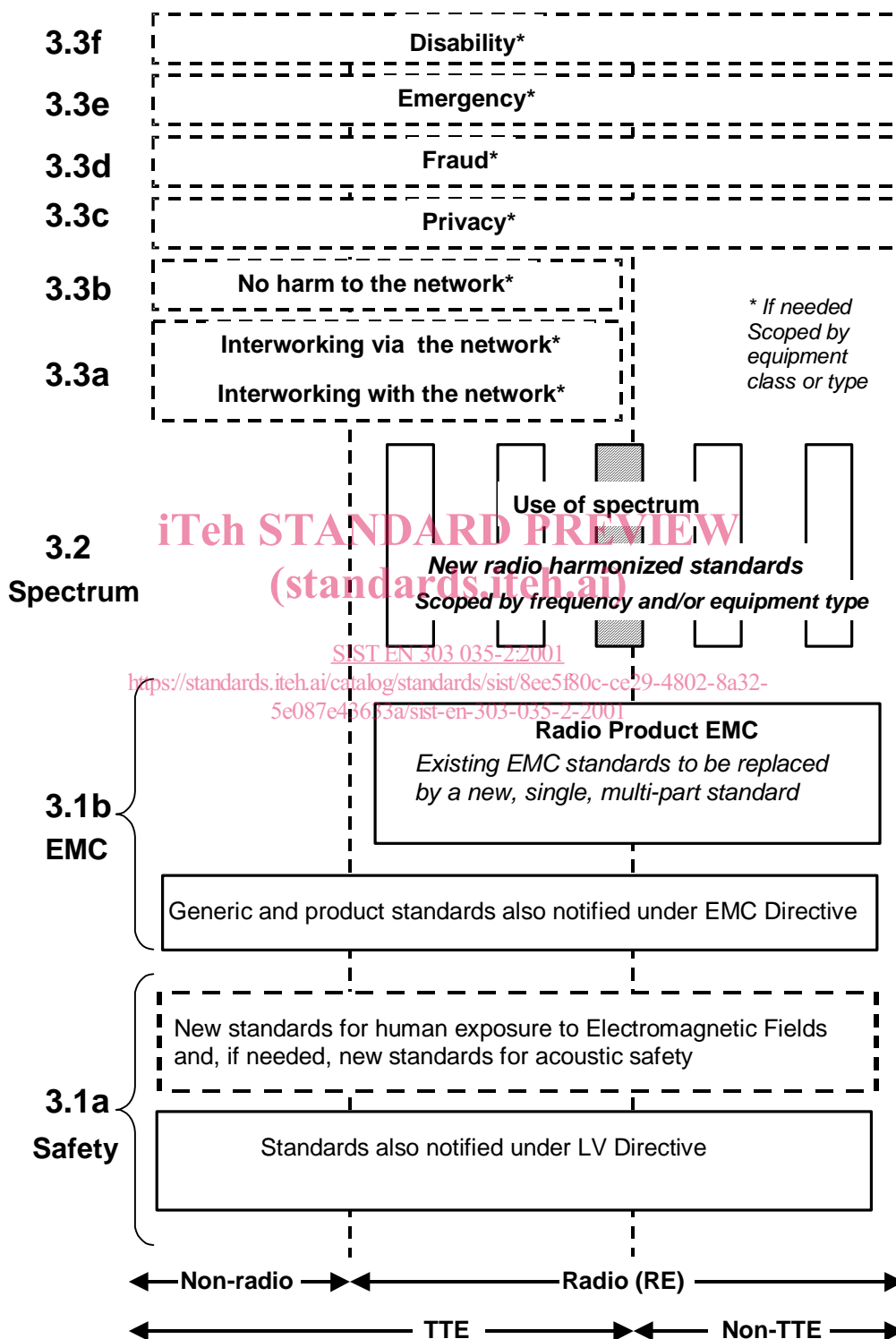


Figure 1: Modular structure for the various standards used under the R&TTE Directive

The left hand edge of the figure shows the different clauses of article 3 of the R&TTE Directive [1].

For article 3.3 various horizontal boxes are shown. Dotted lines indicate that at the time of publication of the present document essential requirements in these areas have to be adopted by the Commission. If such essential requirements are adopted, and as far and as long as they are applicable, they will justify individual standards whose scope is likely to be specified by function or interface type.

The vertical boxes show the standards under article 3.2 for the use of the radio spectrum by radio equipment. The scopes of these standards are specified either by frequency (normally in the case where frequency bands are harmonized) or by radio equipment type.

For article 3.1b the diagram shows the new single multi-part product EMC standard for radio, and the existing collection of generic and product standards currently used under the EMC Directive [2]. The parts of the present document will become available in the second half of 2000, and the existing separate product EMC standards will be used until it is available.

For article 3.1a the diagram shows the existing safety standards currently used under the LV Directive [3] and new standards covering human exposure to electromagnetic fields. New standards covering acoustic safety may also be required.

The bottom of the figure shows the relationship of the standards to radio equipment and telecommunications terminal equipment. A particular equipment may be radio equipment, telecommunications terminal equipment or both. A radio spectrum standard will apply if it is radio equipment. An article 3.3 standard will apply as well only if the relevant essential requirement under the R&TTE Directive [1] is adopted by the Commission and if the equipment in question is covered by the scope of the corresponding standard. Thus, depending on the nature of the equipment, the essential requirements under the R&TTE Directive [1] may be covered in a set of standards.

The modularity principle has been taken because:

- it minimizes the number of standards needed. Because equipment may, in fact, have multiple interfaces and functions it is not practicable to produce a single standard for each possible combination of functions that may occur in an equipment;
- it provides scope for standards to be added:
 - under article 3.2 when new frequency bands are agreed; or
 - under article 3.3 should the Commission take the necessary decisions;
 without requiring alteration of standards that are already published;
- it clarifies, simplifies and promotes the usage of Harmonized Standards as the relevant means of conformity assessment.

1 Scope

The present document specifies the technical characteristics to be provided by Terrestrial Trunked Radio (TETRA) radio and telecommunications terminal equipment, which uses the TETRA technology for Direct Mode Operation at the air interface to support the Direct Mode Operation (DMO) functionality.

The present document applies at the TETRA Direct Mode Operation (DMO) Air interface of the following radio and telecommunications terminal equipment types:

- 1) TETRA Direct Mode Mobile Station (DM-MS);
- 2) TETRA Direct Mode Gateway (DM-GATE);
- 3) TETRA Direct Mode Repeater type 1 (DM-REP1);
- 4) TETRA Direct Mode Repeater type 2 (DM-REP2).

In addition to the basic technical characteristics of a DM-MS required for operation with another DM-MS (MS-MS), the technical characteristics for operation with DM-GATE (MS-GW), DM-REP1 (MS-REP1) and DM-REP2 (MS-REP2) are specified.

It applies to terminal equipment operating within the frequency ranges, allocated to TETRA by the ERC Decisions ERC/DEC/(96)01 [33] and ERC/DEC/(96)04 [34].

These radio equipment types are capable of operating in all or any part of the frequency bands given in table 1.

Table 1: Radiocommunications service frequency bands

Type of Service	Radiocommunications service frequency bands (MHz)
Emergency Access, ERC/DEC/(96)01 [33]	380 to 385
Emergency Access, ERC/DEC/(96)01 [33]	390 to 395
Civil Access, ERC/DEC/(96)04 [34]	410 to 430
Civil Access, ERC/DEC/(96)04 [34]	870 to 876
Civil Access, ERC/DEC/(96)04 [34]	915 to 921
Civil Access, ERC/DEC/(96)04 [34]	450 to 470
Civil Access, ERC/DEC/(96)04 [34]	385 to 390
Civil Access, ERC/DEC/(96)04 [34]	395 to 399,99

The present document is intended to cover the provisions of Directive 1999/5/EC (R&TTE Directive) [1], article 3.2, which states that "..... radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference".

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the R&TTE Directive [1] will apply to equipment within the scope of the present document.

NOTE: A list of such ENs is included on the web site <http://www.newapproach.org/>.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

- [1] 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).
- [2] Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).
- [3] Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).
- [4] ETSI TS 100 394-1 (V2.3.1): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 1: Radio".
- [5] ETSI ETS 300 394-4-1 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 1: Test Suite Structure and Test Purposes (TSS&TP) for Mobile Station to Mobile Station (MS-MS) Air Interface (AI)".
- [6] ETSI ETS 300 394-4-2 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 2: Abstract Test Suite (ATS) for Mobile Station to Mobile Station (MS-MS) Air Interface (AI)".
- [7] ETSI TS 100 394-4-3 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 3: Test Suite Structure and Test Purposes (TSS&TP) for Mobile Station (MS) Repeater type 1".
- [8] ETSI TS 100 394-4-4 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 4: Test Suite Structure and Test Purposes (TSS&TP) for Direct Mode Repeater (DM-REP) type 1".
- [9] ETSI TS 100 394-4-5 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 5: Abstract Test Suite (ATS) for Mobile Station (MS) Repeater type 1".
- [10] ETSI TS 100 394-4-6 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 6: Abstract Test Suite (ATS) for Direct Mode Repeater (DM-REP) type 1".
- [11] ETSI ETS 300 394-4-7 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 7: Test Suite Structure and Test Purposes (TSS&TP) for Mobile Station to Gateway (MS-GW) Air Interface (AI)".
- [12] ETSI ETS 300 394-4-8 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 8: Test Suite Structure and Test Purposes (TSS&TP) for Direct Mode Gateway (DM-GATE)".

- [13] ETSI ETS 300 394-4-9 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 9: Abstract Test Suite (ATS) for Mobile Station (MS) Gateway".
- [14] ETSI ETS 300 394-4-10 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 10: Abstract Test Suite (ATS) for Direct Mode Gateway (DM-GATE)".
- [15] ETSI TS 100 394-4-11 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 11: Test Suite Structure and Test Purposes (TSS&TP) for Mobile Station Repeater type 2".
- [16] ETSI TS 100 394-4-12 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 12: Test Suite Structure and Test Purposes (TSS&TP) for Repeater type 2".
- [17] ETSI TS 100 394-4-13 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 13: Abstract Test Suite (ATS) for Mobile station Repeater type 2".
- [18] ETSI TS 100 394-4-14 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 4: Protocol testing specification for Direct Mode Operation (DMO); Sub-part 14: Abstract Test Suite (ATS) for Repeater type 2".
- [19] ETSI ETS 300 394-5-1 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 5: Security; Sub-part 1: Protocol Implementation Conformance Statement (PICS) proforma specification".
- [20] ETSI ETS 300 394-5-2 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 5: Security; Sub-part 2: Protocol testing specification for TETRA security".
- [21] ETSI ETS 300 394-5-3 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 5: Security; Sub-part 3: Abstract Test Suite (ATS)".
- [22] ETSI ETS 300 396-2 (Edition 1, 1998): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 2: Radio aspects".
- [23] ETSI ETS 300 396-3 (Edition 1, 1998): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 3: Mobile Station to Mobile Station (MS-MS) Air Interface (AI) protocol".
- [24] ETSI TS 100 396-4 (V1.2.1, 2000): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 4: Type 1 repeater air interface".
- [25] ETSI ETS 300 396-5 (Edition 1, 2000): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 5: Gateway air interface".
- [26] ETSI ETS 300 396-6 (Edition 1, 1998): "Terrestrial Trunked Radio (TETRA); Direct Mode Operation (DMO); Part 6: Security".
- [27] ETSI TS 100 396-7 (V1.2.1, 2000): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 7: Type 2 repeater air interface".
- [28] ETSI ETS 300 396-8-1 (Edition 1, 2001): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 8: Protocol Implementation Conformance Statement (PICS) proforma specification; Sub-part 1: Mobile Station to Mobile Station (MS-MS) Air Interface (AI)".
- [29] ETSI TS 100 396-8-2 (V1.2.1, 2000): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 8: Protocol Implementation Conformance Statement (PICS) proforma specification; Sub-part 2: Type 1 repeater Air Interface (AI)".

- [30] ETSI ETS 300 396-8-3 (Edition 1, 1999): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 8: Protocol Implementation Conformance Statement (PICS) proforma specification; Sub-part 3: Gateway Air Interface (AI)".
- [31] ETSI TS 100 396-8-4 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 8: Protocol Implementation Conformance Statement (PICS) proforma specification; Sub-part 4: Type 2 Repeater Air Interface (AI)".
- [32] ETSI TS 100 396-10 (V1.1.1, 2000): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 10: Managed Direct Mode Operation (M-DMO)".
- [33] CEPT ERC/DEC/(96)01: "ERC Decision of 7 March 1996 on the harmonized frequency band to be designated for the introduction of the Digital Land Mobile System for the Emergency Services".
- [34] CEPT ERC/DEC/(96)04: "ERC Decision of 7 March 1996 on the frequency bands for the introduction of the Trans European Trunked Radio System (TETRA)".
- [35] ETSI ETR 028 (Edition 2, 1994): "Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in the R&TTE Directive [1], and the following apply.

acknowledged data transfer: service provided by the layer below which gives an acknowledgement back over the air interface from the lower layer peer entity. This service is used by the layer 3 entities to get a secure transmission including re-transmissions

changeover: within a call, the process of effecting a transfer of the master role (and hence transmitting MS) at the end of one call transaction so that another can commence

Direct Mode (DM): mode of simplex operation where mobile subscriber radio units may communicate using radio frequencies which may be monitored by, but which are outside the control of, the TETRA V+D network. DM is performed without intervention of any base station

Direct Mode Call Control (DMCC): Layer 3 entity responsible for setting up and maintaining a call in DMO

Direct Mode channel: specific grouping of timeslots in the DM multiplex structure related to a particular DM RF carrier i.e. DM frequency (or to a pair of duplex-spaced RF carriers for operation with a type 1B or type 2 DM-REP). The grouping may not always be fixed, but in DMO when operating in frequency efficient mode as an example, there are two DM channels, identified by the letters A and B

Direct Mode GATEway (DM-GATE): device which provides gateway connectivity between a DM-MS and the TETRA V+D network. The gateway provides the interface between TETRA DMO and TETRA V+D mode

Direct Mode Mobility Management (DMMM): Layer 3 entity responsible for registration to a gateway in DMO

Direct Mode Mobile Station (DM-MS): physical grouping that contains all of the mobile equipment that is used to obtain TETRA DM services

Direct Mode REPeater (DM-REP): device that operates in TETRA DMO and provides a repeater function to enable two or more DM-MSs to extend their coverage range. It may be either a DM-REP type 1, supporting a single call on the air interface, or a DM-REP type 2, supporting two calls on the air interface. A DM-REP type 1 may operate on either a single RF carrier (DM-REP type 1A) or a pair of duplex-spaced RF carriers (DM-REP type 1B). A DM-REP type 2 operates on a pair of duplex-spaced RF carriers

DM-REP presence signal: message transmitted by a DM-REP in order to indicate its presence on an RF carrier

DM-REP type 1: DMO Repeater that supports a single call on the air interface. There are two varieties of type 1 DM-REP:

- **DM-REP type 1A:** which operates on a single RF carrier;
- **DM-REP type 1B:** which operates on a pair of duplex-spaced RF carriers, one used as the "uplink" from DM-MSs to the DM-REP and the other used as the "downlink" from the DM-REP to DM-MSs

DM-REP type 2: DMO Repeater that is capable of supporting two simultaneous type 2 calls on the air interface. A type 2 DM-REP operates on a pair of duplex-spaced RF carriers, one used as the "uplink" from DM-MSs to the DM-REP and the other used as the "downlink" from the DM-REP to DM-MSs. The protocol for type 2 calls through a type 2 DM-REP is based on the protocol for frequency efficient mode in ETS 300 396-3 [23]. (A DM-REP type 2 may also optionally offer type 1B calls using the protocol defined in ETSI TS 100 396-4 [24])

environmental profile: range of environmental conditions under which equipment within the scope of the present document is required to comply with the provisions of the present document

Individual TETRA Subscriber Identity (ITSI): identity used to specify an individual TETRA user. An ITSI cannot be shared by multiple users

Linearization CHannel (LCH): channel, which may be used by the equipment to linearize its transmitter. The linearization burst contains no useful bits

logical channel: generic term for any distinct data path. Logical channels are considered to operate between logical endpoints

Managed DMO (M-DMO): direct interworking between two DMO Mobile Stations under control of a network by a management mechanism to avoid interference

master: Direct Mode equipment that is either active in a call transaction transmitting traffic or control data, or is reserving the channel by means of channel reservation signalling and hence is providing synchronization information to the channel

presence signal: message transmitted by a DM-REP or a gateway in order to indicate its presence on an RF carrier

Random Challenge (RAND1, RAND2): random value generated by the infrastructure to authenticate a user or in an MS to authenticate the infrastructure, respectively

Random Seed (RS): random value used to derive a session authentication key from the authentication key

Response (RES1, RES2): value calculated in the MS from RAND1 and a session key to prove the authenticity of a user to the infrastructure or by the infrastructure from RAND2 and a session key to prove its authenticity to a user, respectively

slave: Direct Mode equipment that is receiving traffic and/or signalling and hence is deriving synchronization information from the channel

solicited registration: registration request which is made by a DM-MS during a registration phase initiated by a gateway

surveillance: process of determining the current state of the DM RF carrier for DMO

TETRA Equipment Identity (TED): electronic serial number that is permanently embedded in the TETRA equipment

unacknowledged data transfer: service provided by the layer below which does not give any acknowledgement back to over the air interface from the lower layer peer entity

useful part of the burst: modulation symbol times SN0 to SNmax of a burst

unsolicited registration: registration request, which is made by a DM-MS at any time other than within a registration phase