ETSI TR 102 300-3 V1.3.3 (2009-06)

Technical Report

Terrestrial Trunked Radio (TETRA);
Voice plus Data (V+D);
Designers' guide;
Part 3: Direct Mode Operation (DMO)

Reference
RTR/TETRA-01187-3

Keywords
MS, radio, TETRA

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
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, please send your comment to one of the following services:
http://portal.etsi.org/chaircor/ETSI_support.asp

Content

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

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

The present document is part 3 of a multi-part deliverable covering Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Designers' Guide, as identified below:

ETR 300-1: "Overview, technical description and radio aspects";

ETR 300-2: "Radio channels, network protocols and service performance";

TR 102 300-3: "Direct Mode Operation (DMO)";

ETR 300-4: "Network management";

TR 102 300-5: "Guidance on Numbering and addressing".

1 Scope

The present document is written as a "Read-me-first" manual or "Getting started with TETRA DMO". It is not intended to be a guide to the TETRA DMO standard nor an authoritative interpretation of the standard. If any conflict is found between the present document and the corresponding clauses in the TETRA standard then the standard takes precedence.

The aims of the present document are:

- to provide the reader with sufficient knowledge to engage in qualified discussions with the equipment and service suppliers;
- to expose the reader to the specific language and technical terminology used in the standard;
- to enable the reader to understand the flexibility in system design, system network topography, system availability, various modes of operation and security features;
- in clause 10, sufficiently detailed design information is given to allow link budget calculations to be carried out and outline radio coverage planning to be performed. Some preliminary calculations are also given for co-existence between trunked and direct mode terminals and also for the number of direct mode talk groups (Nets) that can operate simultaneously at the same location.

The scope of the present document of the DMO Designers' Guide adds detailed consideration of repeaters and gateways to the detailed consideration of mobile station to mobile station direct mode operation which was covered in the first edition.

It should be understood that, as in all standardization activities, there is an inherent conflict between the users' wish to have as broad a standard as possible and at the same time wanting to have as much as possible of that broad standard available and implemented right from the beginning of service. Potential equipment 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 standard to develop and implement equipment in various ways, and still be conforming to the standard. This broad availability of equipment, each optimized around certain features and functionalities, needs to be carefully analysed by network operators and system users to find the supplier with equipment suited best for their needs.

2 References

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.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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 indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Not applicable,

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] ETSI ETS 300 396-1: "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 1: General network design".

[i.2] ETSI EN 300 396-2: "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 2: Radio aspects".

[i.3] ETSI EN 300 396-3: "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 3: Mobile Station to Mobile Station (MS-MS) Air Interface (AI) protocol".

[i.4] ETSI EN 300 396-4: "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 4: Type 1 repeater air interface".

[i.5] ETSI EN 300 396-5: "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 5: Gateway air interface".

[i.6] ETSI EN 300 396-6: "Terrestrial Trunked Radio (TETRA); Direct Mode Operation (DMO); Part 6: Security".

[i.7] ETSI EN 300 396-7: "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 7: Type 2 repeater air interface". (Historical).

[i.8] ETSI EN 300 396-10: "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 10: Managed Direct Mode Operation (M-DMO)". (Historical).

[i.9] ETSI EN 300 392-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 1: General network design".

[i.10] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

[i.11] ETSI EN 300 392-5: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 5: Peripheral Equipment Interface (PEI)".

[i.12] ETSI EN 300 395-2: "Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel; Part 2: TETRA codec".

[i.13] ETSI ETR 300-1 (1996): "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Designers' guide; Part 1: Overview, technical description and radio aspects". (Historical).

[i.14] ETSI TR 102 300-5: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Designers' guide; Part 5: Guidance on numbering and addressing".

[i.15] ITU-R Recommendation SM.329-6: "Spurious emissions".

[i.16] EPT/DMO PTG 010 (January 2001): "Suggestions on propagation models for TETRA scenarios".

[i.17] UK Home Office Study No. 95/27/256/4/CS201: "TETRA RF Co-Existence Study Final Report June 1996 Telecom Consultants International (TCI)".

[i.18] ERC Decision ERC/DEC(01)19 of 12 March 2001 on the harmonised frequency bands to be designated for the Direct Mode Operation (DMO) of Digital Land Mobile Systems for the Emergency Services.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

call: complete sequence of related call transactions between DM-MSs

NOTE 1: There are two types of call, individual call or group call. These are slightly different for each type of direct mode but follow the same basic principles. An individual call is a complete sequence of related call transactions between two user MSs. A group call is a complete sequence of related call transactions involving two or more user MSs. The number of participants in a group call is not fixed. Participants may join (late entry) and leave an ongoing group call.

NOTE 2: For calls without presence check there is no guaranty that anyone is listening.

call transaction: all of the functions associated with a complete unidirectional transmission of information during a call

NOTE: A call is made up of one or more call transactions.

called user application: user application which receives an incoming call

calling user application: user application which initiates an outgoing call

carrier: See RF carrier.

changeover: within a call, 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 Call Control (DMCC): layer 3 entity responsible for setting up and maintaining a call in DMO

DM 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 or a type 1B DM-REP/GATE

NOTE: 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 DM-MS(s) and the TETRA V+D network

NOTE: The gateway provides the interface between TETRA DMO and TETRA V+D mode. A gateway may provide only the gateway function (DM-GATE) or may provide the functions of both a DM repeater and a DM gateway during a call (DM-REP/GATE).

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

NOTE: A DM-MS may have one of three roles:

- **Master:** if the DM-MS is either active in a call transaction transmitting traffic or control data, or is reserving the channel by means of channel reservation signalling.
- **Slave:** if the DM-MS is receiving traffic and/or signalling in a call.
- **Idle:** if the DM-MS is not in a call.

Direct Mode Operation (DMO): 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

NOTE: Direct Mode Operation is performed without intervention of any base station.

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

NOTE: It may be either a type 1 DM-REP, capable of supporting only a single call on the air interface, or a type 2 DM-REP, capable of supporting two calls on the air interface. A type 1 DM-REP may operate on either a single RF carrier (type 1A DM-REP) or a pair of duplex spaced RF carriers (type 1B DM-REP). A type 2 DM-REP operates on a pair of duplex spaced RF carriers.

Direct Mode REPeater/GATEway (DM-REP/GATE): device that combines the functions of a DM repeater and a DM gateway in a single implementation and is capable of providing both functions simultaneously (so that, during a call transaction initiated by a DM-MS, the DM-REP/GATE provides gateway connectivity to the TETRA V+D network and also provides a repeater function on the DM channel)

NOTE: The repeater part of the combined implementation may be either a type 1A repeater, operating on a single DM RF carrier, or a type 1B repeater, operating on a pair of duplex spaced DM RF carriers.

DUal Mode switchable Mobile Station (DU-MS): MS that is capable to operate in TETRA DMO or in TETRA V+D one mode at a time

NOTE: Only one mode can be selected at any given time and the MS is not capable of monitoring a DM RF carrier while in V+D or a V+D channel while in DMO.

Dual Watch Mobile Station (DW-MS): MS that is capable of both TETRA DMO and TETRA V+D operation

NOTE: In full dual watch a DW-MS is capable of periodically monitoring the V+D control channel while in a DM call, a DM RF carrier while in a V+D call and, when idle, of periodically monitoring both the DM RF carrier and the V+D control channel. In idle dual watch a DW-MS is not capable of monitoring the other channel while involved in an activity (e.g. a call), but, when idle, is still capable of periodically monitoring both the DM RF carrier and the V+D control channel.

frequency efficient mode: mode of operation where two independent DM communications are supported on a single RF carrier (or pair of duplex-spaced RF carriers for operation with a type 2 DM-REP)

NOTE: In frequency efficient mode the two DM channels are identified as channel A and channel B.

gateway: generic term used to describe either a pure DM-GATE or a combined implementation with a repeater (DM-REP/GATE)

logical channel: generic term for any distinct data path

NOTE: Logical channels are considered to operate between logical endpoints.

managed DMO: form of direct mode operation that requires authorization from the V+D infrastructure or a M-DMO authorizing unit in order for the DM-MS to be permitted to transmit

master link: communication link used for transmissions between master DM-MS and DM-REP or DM-REP/GATE

mobile trunked mode base station: trunked mode base station isolated from the SwMI but capable of single site trunking

NOTE: Such a BS can be rapidly located at an event or incident.

net: traditional name for a group call

normal mode: mode of operation where only one DM communication is supported on an RF carrier (or pair of duplex-spaced RF carriers for operation with a type 1B DM-REP or type 1B DM-REP/GATE)

pre-emption: transfer of the master role to the requested DM-MS

NOTE: This process may occur within a call during occupation or to set-up a new call during either occupation or reservation.