

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

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Technical Report

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

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# Content

Intellectual Property Rights .....	9
Foreword.....	9
1 Scope .....	10
2 References .....	10
2.1 Normative references .....	11
2.2 Informative references.....	11
3 Definitions, symbols and abbreviations .....	12
3.1 Definitions.....	12
3.2 Symbols.....	14
3.3 Abbreviations .....	15
4 What is direct mode and why do we need it? .....	16
4.1 General .....	16
4.2 Frequency of operation.....	17
4.3 Managed Direct Mode.....	18
5 Direct mode services and facilities.....	19
5.1 Service definitions .....	19
5.1.1 Teleservice.....	19
5.1.2 Bearer service .....	19
5.1.3 Intrinsic service.....	19
5.1.4 Summary of tele/bearer services offered in TETRA DMO .....	20
5.1.5 Service Access .....	20
5.2 Direct mode teleservices .....	21
5.2.1 Individual call .....	21
5.2.2 Group call .....	21
5.2.3 SDS based teleservices .....	21
5.3 Direct mode bearer services .....	21
5.3.1 Circuit mode unprotected bearer services.....	22
5.3.2 Circuit mode protected bearer services.....	22
5.3.3 Short Data Service (SDS) .....	22
5.3.4 SDS-TL service .....	23
5.4 Intrinsic services.....	23
5.4.1 DM late entry.....	23
5.4.2 Transmitting party identification .....	24
5.4.3 Emergency calls.....	24
6 Description of direct mode equipment types.....	24
6.1 General .....	24
6.2 Direct mode mobile station (DM-MS) .....	25
6.3 Dual watch mobile station (DW-MS).....	26
6.4 Direct mode repeater (DM-REP).....	27
6.5 Direct mode gateway (DM-GATE).....	27
6.6 Direct mode repeater/gateway combination (DM-REP/GATE).....	28
6.7 Direct mode power classes .....	28
6.8 Limitations imposed by the physical layer for direct mode type equipment.....	29
7 Direct mode operational examples .....	29
7.1 General .....	29
7.2 MS to MS communication with full Dual Watching.....	30
7.3 DMO communication via a repeater with full Dual Watching.....	31
7.4 Gateway operation.....	31
7.5 Direct mode repeater/gateway operation.....	33
8 Outline of direct mode protocols.....	34
8.1 OSI reference model.....	34
8.2 TDMA frame and slot structure for direct mode operation.....	34

8.2.1	Frame structure .....	35
8.2.2	Timeslots and bursts .....	35
8.3	Physical layer functionality .....	36
8.4	Single call protocols .....	37
8.4.1	MS-MS Normal Mode .....	37
8.4.2	Repeater type 1A .....	37
8.4.3	Repeater type 1B .....	38
8.4.4	Gateway .....	38
8.4.5	Repeater/Gateway types 1A and 1B .....	38
8.5	Two call protocols .....	39
8.5.1	MS-MS frequency efficient mode .....	39
8.5.2	Repeater type 2 .....	40
8.6	Choosing the repeater type .....	40
8.6.1	Background .....	40
8.6.2	Mobile trunked mode base station .....	40
8.6.2.1	Advantages of using a stand-alone mobile trunked mode base station for repeater operation .....	41
8.6.2.2	Disadvantages of using a stand-alone mobile trunked mode base station for repeater operation .....	41
8.7	Co-existence with trunked mode .....	41
8.7.1	General .....	41
8.7.2	Type 1A DM-REP in TM-BS transmit band .....	42
8.7.3	Type 1A DM-REP in TM-BS receive band .....	43
8.7.4	Type 1B or type 2 DM-REP transmitter in TM-BS transmit band .....	44
8.7.5	Type 1B or type 2 DM-REP transmitter in TM-BS receive band .....	45
8.7.6	DM-REP and DM-MSs far from TM-BS and TM-MSs .....	46
8.7.7	DM-REP and DM-MSs far from TM-BS, close to TM-MSs .....	46
8.7.8	DM-REP and DM-MSs close to TM-BS, far from TM-MSs .....	47
8.7.9	DM-REP and DM-MSs close to TM-BS and TM-MSs .....	47
8.8	Co-existence with direct mode MS-MS operation .....	48
8.8.1	General .....	48
8.8.2	MS-MS call in type 1B DM-REP uplink band .....	48
8.8.3	MS-MS call in type 1B DM-REP downlink band .....	49
8.9	Direct mode frequency re-use .....	50
8.9.1	General .....	50
8.9.2	MS-MS call on type 1B DM-REP uplink frequency .....	51
8.9.3	MS-MS call on type 1B DM-REP downlink frequency .....	52
8.10	Implementation and operation issues affecting dual watch .....	53
8.10.1	General .....	53
8.10.2	Basis for dual watch operation .....	53
8.10.3	Implementation of dual watch operation .....	53
8.10.3.1	Switching from idle to active .....	54
8.10.3.2	Switching from active to active .....	55
8.11	Channel surveillance .....	56
8.12	Battery economy .....	56
8.13	Testable boundaries .....	56
9	Security features .....	57
9.1	General .....	57
9.2	Authentication .....	57
9.2.1	Mobile to mobile operation .....	57
9.2.2	Dual Watch Operation .....	57
9.2.3	Gateway mode operation .....	57
9.3	Confidentiality .....	57
9.3.1	Air Interface (AI) encryption .....	57
9.3.1.1	Cipher Key .....	58
9.3.1.2	The Time Variant Parameter (TVP) .....	59
9.3.2	End-to-end encryption .....	59
9.4	Key Management .....	59
9.4.1	Air Interface Encryption keys .....	59
9.4.2	End to End Encryption keys .....	59
10	Radio Aspects .....	59
10.1	DMO deployment constraints .....	59

10.2	Transmitter noise.....	60
10.3	Blocking.....	61
10.4	Effects of transmitter noise and blocking.....	62
10.5	Methodology.....	62
10.5.1	Assumptions.....	63
10.5.2	Calculating the effect of transmitter noise.....	63
10.5.3	Calculating the effect of blocking.....	64
10.5.4	Allowing for a noise floor uplift.....	64
10.5.5	Translating path losses into distances.....	64
10.6	Example 1 - wanted signal at extremity of range, unwanted interferer close by.....	65
10.6.1	Step 1 - Calculate allowable noise.....	65
10.6.2	Step 2 - Translate allowable noise into path loss and stay-away distance.....	66
10.6.3	Step 3 - Calculate path loss and stay-away distance for blocking.....	66
10.7	Example 2 - wanted signal at close range, unwanted interferer close by.....	66
10.7.1	Step 1 - Calculate noise floor uplift.....	66
10.7.2	Step 2 - Calculate allowable noise.....	67
10.7.3	Step 3 - Translate allowable noise into path loss and stay-away distance.....	67
10.7.4	Step 4 - Calculate path loss and stay-away distance for blocking.....	67
10.8	Unwanted transmission noise versus blocking.....	67
10.9	Variation of stay-away distance with transmitter power and frequency separation.....	68
10.10	Effect of assumptions.....	69
10.11	Implementation issues.....	70
10.12	Recommended frequency separation for DMO MS-MSs.....	73
11	Operational scenarios.....	73
11.1	Range extension scenario using type 1A repeater.....	73
11.2	Range extension scenarios using a gateway.....	75
11.3	DMO range extension scenario with link into TMO Dispatcher using a type 1B repeater/gateway.....	76
11.4	DMO range extension scenario with link into TMO Dispatcher using a gateway.....	78
11.5	Range extension inside buildings using a type 2 repeater.....	79
<b>Annex A:</b>	<b>Teleservices, bearer and supplementary services supported by TMO/DMO.....</b>	<b>81</b>
<b>Annex B:</b>	<b>Short range propagation models used in the co-existence studies.....</b>	<b>82</b>
B.1	Introduction.....	82
B.2	Free space propagation.....	82
B.3	Bacon model.....	83
B.4	CEPT SE21 model.....	84
B.5	Discussion.....	86
<b>Annex C:</b>	<b>Trial results for short range propagation model and comparison between theoretical and measured stay-away distances.....</b>	<b>89</b>
C.1	Introduction.....	89
C.2	Results of the trials.....	89
C.3	Assumptions of the theoretical calculations.....	90
C.4	Propagation model.....	92
C.5	Losses between receiver and transmitters.....	92
C.6	Reduction in voice quality.....	94
C.7	Measured transmitter losses at the Newbury Racecourse trials and the decreased margin.....	95
C.8	The assumption of linearity.....	96
C.9	Conclusions and discussion.....	98
C.10	Quantitative assessment.....	99

<b>Annex D:</b>	<b>RF channel selection, numbering and addressing</b> .....	<b>100</b>
D.1	Background .....	100
D.2	Numbering.....	100
D.3	Addressing in repeater and gateway direct mode operation.....	101
D.4	Summary .....	101
<b>Annex E:</b>	<b>Detailed direct mode protocols</b> .....	<b>102</b>
E.1	General .....	102
E.2	MS-MS direct mode normal operation.....	102
E.2.1	DM protocol layering .....	102
E.2.2	MS-MS direct mode functionality.....	103
E.2.3	MS-MS physical resources .....	103
E.2.4	Slot timing diagrams .....	103
E.2.4.1	Constraints on the frame structure (including synchronization) .....	104
E.2.4.2	Direct mode operation .....	104
E.2.5	MS-MS call set-up protocol .....	105
E.2.5.1	MS-MS call set-up without presence check.....	105
E.2.5.2	MS-MS call set-up time (fundamental constraints) .....	106
E.2.5.3	MS-MS call set-up with presence check.....	106
E.2.6	Late entry.....	106
E.2.7	Channel reservation and changeover in a call .....	107
E.2.8	Pre-emption of a DM call .....	108
E.2.9	Terminating a call.....	109
E.2.10	DM short data call .....	109
E.2.10.1	Unacknowledged short data message .....	109
E.2.10.2	Acknowledged short data message .....	109
E.2.11	Implementation issues .....	110
E.2.11.1	Configuration.....	110
E.2.11.2	Calling/dialling procedures.....	110
E.3	Repeater Type 1A.....	111
E.3.1	DM protocol layering .....	111
E.3.2	Direct mode functionality.....	111
E.3.3	Physical resources .....	111
E.3.4	Slot timing diagrams .....	111
E.3.4.1	Constraints on the frame structure (including synchronization) .....	111
E.3.4.2	Direct mode operation .....	111
E.3.5	Call set-up protocol .....	112
E.3.5.1	Call set-up without presence check.....	112
E.3.5.2	Call set-up time (fundamental constraints) .....	113
E.3.5.3	Call set-up with presence check.....	113
E.3.6	Late entry.....	114
E.3.7	Channel reservation and changeover in a call .....	114
E.3.8	Pre-emption of a DM call .....	115
E.3.9	Terminating a call.....	116
E.3.10	DM short data call .....	116
E.3.10.1	Unacknowledged short data message .....	116
E.3.10.2	Acknowledged short data message .....	117
E.3.11	Implementation Issues .....	118
E.3.11.1	Configuration.....	118
E.3.11.2	Calling/dialling procedures.....	119
E.3.11.3	Operational procedures .....	119
E.3.11.4	Constraints .....	119
E.4	Repeater Type 1B.....	120
E.4.1	DM protocol layering .....	120
E.4.2	Direct mode functionality.....	120
E.4.3	Physical resources .....	120
E.4.4	Slot timing diagrams .....	120

E.4.4.1	Constraints on the frame structure (including synchronization)	120
E.4.4.2	Direct mode operation	120
E.4.5	Call set-up protocol	120
E.4.5.1	Call set-up without presence check	120
E.4.5.2	Call set-up time (fundamental constraints)	120
E.4.5.3	Call set-up with presence check	121
E.4.6	Late entry	121
E.4.7	Channel reservation and changeover in a call	121
E.4.8	Pre-emption of a DM call	121
E.4.9	Terminating a call	121
E.4.10	DM short data call	121
E.4.10.1	Unacknowledged short data message	121
E.4.10.2	Acknowledged short data message	121
E.4.11	Implementation Issues	121
E.4.11.1	Configuration	121
E.4.11.2	Calling/dialling procedures	121
E.4.11.3	Operational procedures	121
E.4.11.4	Constraints	121
E.5	Gateway	122
E.5.1	DM protocol layering	122
E.5.2	Direct mode functionality	122
E.5.3	Physical resources	122
E.5.4	Slot timing diagrams	122
E.5.4.1	Constraints on the frame structure (including synchronization)	124
E.5.4.2	Direct mode operation	124
E.5.5	Call set-up protocol	124
E.5.5.1	Group call from V+D to DM-MS via a DM-GATE	124
E.5.5.2	Group call from DM-MS via a DM-GATE	126
E.5.5.3	Call set-up time (fundamental constraints)	128
E.5.5.4	Individual call from V+D MS to DM-MS via a DM-GATE	129
E.5.5.5	Individual call from DM-MS to V+D MS via a DM-GATE	131
E.5.6	Late entry	132
E.5.7	Channel reservation and changeover in a call	132
E.5.8	Pre-emption of a DM call	134
E.5.9	Terminating a DM-GATE call	136
E.5.10	DM short data call	136
E.5.11	Implementation Issues	137
E.5.11.1	Configuration	137
E.5.11.2	Calling/dialling procedures	137
E.5.11.3	Operational procedures	138
E.5.11.4	Constraints	138
E.6	Repeater/Gateway Type 1A	138
E.6.1	DM protocol layering	138
E.6.2	Direct mode functionality	138
E.6.3	Physical resources	139
E.6.4	Slot timing diagrams	139
E.6.4.1	Constraints on the frame structure (including synchronization)	139
E.6.4.2	Direct mode operation	139
E.6.5	Group call from DM-MS via DM-REP/GATE	139
E.6.6	Implementation Issues	140
E.6.6.1	Configuration	140
E.6.6.2	Calling/dialling procedures	141
E.6.6.3	Operational procedures	142
E.6.6.4	Constraints	142
E.7	Repeater/Gateway Type 1B	142
E.7.1	DM protocol layering	142
E.7.2	Direct mode functionality	142
E.7.3	Physical resources	142
E.7.4	Implementation Issues	142
E.7.4.1	Configuration	142

E.7.4.2	Calling/dialling procedures .....	143
E.7.4.3	Operational procedures .....	143
E.7.4.4	Constraints .....	143
E.8	MS-MS frequency efficient operation .....	143
E.8.1	DM protocol layering .....	143
E.8.2	Direct mode functionality .....	143
E.8.3	Physical resources .....	143
E.8.4	Slot timing diagrams .....	143
E.8.4.1	Constraints on the frame structure (including synchronization) .....	143
E.8.4.2	Direct mode operation .....	143
E.8.5	Call set-up protocol .....	144
E.8.5.1	Call set-up without presence check .....	144
E.8.5.2	Call set-up time (fundamental constraints) .....	144
E.8.5.3	Call set-up with presence check .....	144
E.8.6	Late entry .....	144
E.8.7	Channel reservation and changeover in a call .....	145
E.8.8	Pre-emption of a DM call .....	145
E.8.9	Terminating a call .....	145
E.8.10	DM short data call .....	145
E.8.10.1	Unacknowledged short data message .....	145
E.8.10.2	Acknowledged short data message .....	145
E.8.11	Implementation Issues .....	145
E.8.11.1	Configuration .....	145
E.8.11.2	Calling/dialling procedures .....	145
E.9	Repeater Type 2 .....	145
E.9.1	DM protocol layering .....	145
E.9.2	Direct mode functionality .....	145
E.9.3	Physical resources .....	146
E.9.4	Slot timing diagrams .....	146
E.9.4.1	Constraints on the frame structure (including synchronization) .....	146
E.9.4.2	Direct mode operation .....	146
E.9.5	Call set-up protocol .....	146
E.9.5.1	Call set-up without presence check .....	147
E.9.5.2	Call set-up time (fundamental constraints) .....	148
E.9.5.3	Call set-up with presence check .....	148
E.9.6	Late entry .....	149
E.9.7	Channel reservation and changeover in a call .....	149
E.9.8	Pre-emption of a DM call .....	150
E.9.9	Terminating a call .....	151
E.9.10	DM short data call .....	151
E.9.10.1	Unacknowledged short data message .....	151
E.9.10.2	Acknowledged short data message .....	152
E.9.11	Implementation Issues .....	153
E.9.11.1	Configuration .....	153
E.9.11.2	Calling/dialling procedures .....	153
E.9.11.3	Operational procedures .....	153
E.9.11.4	Constraints .....	153
<b>Annex F:</b>	<b>Support of security features .....</b>	<b>154</b>
F.1	Time Variant Parameter .....	154
F.2	Synchronization of end-to-end encryption .....	154
History	.....	155



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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 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".

Full standard:  
https://standards.iteh.ai/catalog/standards/sist/295d043b-f792-4a3d-ab6c-f974bf6b4666/etsi-tr-102-300-3-v1.3.3-2009-06

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# 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.

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# 2 References

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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.