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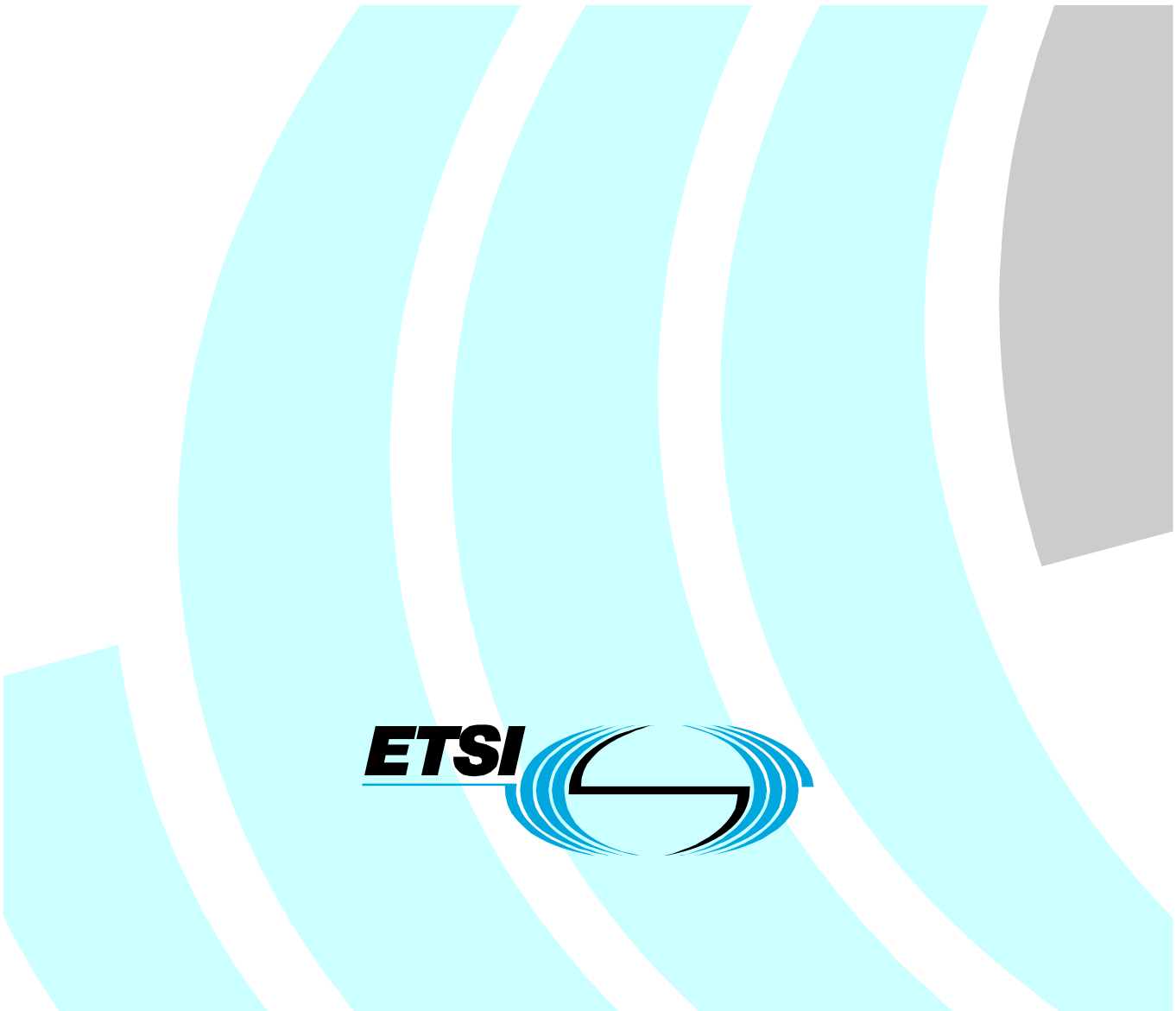
Technical Specification

Terrestrial Trunked Radio (TETRA);
Voice plus Data (V+D) and Direct Mode Operation (DMO);
Part 18: Air interface optimized applications;
Sub-part 3: Direct mode Over
The Air Management protocol (DOTAM)



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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Terrestrial Trunked Radio (TETRA).

The present document is part 18, sub-part 3 of a multi-part deliverable covering the Terrestrial Trunked Radio (TETRA); the Voice plus Data (V+D), as identified below:

EN 300 392-1: "General network design";

EN 300 392-2: "Air Interface (AI)";

EN 300 392-3: "Interworking at the Inter-System Interface (ISI)";

ETS 300 392-4: "Gateways basic operation";

TS 100 392-5: "Peripheral Equipment Interface (PEI)";

TS 100 392-7: "Security";

EN 300 392-9: "General requirements for supplementary services";

EN 300 392-10: "Supplementary services stage 1";

TS 100 392-11: "Supplementary services stage 2";

TS 100 392-12: "Supplementary services stage 3";

ETS 300 392-13: "SDL model of the Air Interface (AI)";

ETS 300 392-14: "Protocol Implementation Conformance Statement (PICS) proforma specification";

TS 100 392-15: "TETRA frequency bands, duplex spacings and channel numbering";

TS 100 392-16: "Network Performance Metrics";

TR 100 392-17: "TETRA V+D and DMO specifications";

TS 100 392-18: "Air interface optimized applications".

Sub-part 1: "Location Information Protocol (LIP)";

Sub-part 2: "Net Assist Protocol (NAP)".

Sub-part 3: "Direct mode Over The Air Management protocol (DOTAM)".

NOTE: Part 3, sub-parts 6 and 7 (Speech format implementation), part 4, sub-part 3 (Data networks gateway), part 10, sub-part 15 (Transfer of control), part 13 (SDL) and part 14 (PICS) of this multi-part deliverable are in status "historical" and are not maintained.

1 Scope

The present document defines the Direct mode operation Over The Air Management protocol for the TETRA V+D air interface. It defines the following services:

- Direct Mode Operation over the air management service.
- Interrogation of Direct Mode Operation groups and their status.

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.

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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.

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

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

[3] ETSI EN 300 392-9: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 9: General requirements for supplementary services".

[4] ETSI TS 100 392-15: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 15: TETRA frequency bands, duplex spacings and channel numbering".

[5] 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".

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

[7] ETSI EN 300 392-7: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 7: Security".

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.

Not applicable.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in EN 300 392-2 [2] and EN 300 396-3 [5] and the following apply:

assign: addition of group definition

assigned DMO group: DMO group with a valid parameter set

NOTE: DMO groups are assigned by a network operator.

deassign: permanent removal of DMO group definition

default DMO group: DMO group which is automatically selected when a mobile station switches from V+D to DMO

NOTE: There can be only a single default DMO group at any time.**DMO channel:** Radio Frequency (RF) carrier for DMO usage

DMO group: DMO group defined by the parameter set: a TETRA group address, a mnemonic group name, a DMO channel, and a mnemonic DMO channel name

NOTE: DMO group identifiers contain some additional parameters to the above list that is seen on the user's point of view.

management server: entity that manages DMO equipment

management source: originator of DMO management commands

preferred DMO group: DMO group which has been assigned to a specific organisation for preferred usage

NOTE: There can be multiple preferred DMO groups defined at the same time.

selected DMO group: DMO group that MS user has selected

NOTE: A selected DMO group can be a default, a preferred or an assigned DMO group.

Switching And Management Infrastructure (SwMI): all of the TETRA equipment for a Voice plus Data (V+D) network except for subscriber terminals

TETRA domain: all entities that are addressed using TETRA defined addresses

NOTE: TETRA domain, as defined, may contain entities that are not controlled by TETRA security features.

3.2 Symbols

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

ra	relationship between management server entity and managed DMO entity
rb	relationship between management source entity and management server entity
rc	relationship between management source entity and managed DMO entity
rd	relationship between communication management entity and management server entity
re	relationship between authentication entity and management server entity
rf	relationship between group number and radio resource management entity and management server entity
rg	relationship between communication management entity and authentication entity

3.3 Abbreviations

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

C	Conditional
DGNA	Dynamic Group Number Assignment
DMO	Direct Mode Operation
DOTAM	Direct mode operation Over The Air Management
FE	Functional Entity
GTSI	Group TETRA Subscriber Identity
ISDN	Integrated Services Digital Network
ISSI	Individual Short Subscriber Identity
ITSI	Individual TETRA Subscriber Identity
M	Mandatory
MNI	Mobile Network Identity
MS	Mobile Station
MS-ISDN	Mobile Station ISDN number
OTAK	Over The Air Keying
OTAR	Over The Air Re-keying
PDU	Protocol Data Unit
RF	Radio Frequency
SAP	Service Access Point
SCK	Static Cipher Key
SDS-TL	Short Data Service - Transport Layer
SS-DGNA	Supplementary Service Dynamic Group Number Assignment
SwMI	Switching And Management Infrastructure
V+D	Voice plus Data system

4 Direct mode operation over the air management protocol

4.1 General

The Direct mode operation Over The Air Management (DOTAM) is a TETRA air interface management protocol that could utilize various transport mechanisms.

The present document defines "control messages" to set and modify MS behaviour in DMO.

The management protocol can be used in various system configurations including:

- SwMI to MS communication.
- Management server to MS communication.
- MS to management server communication.

NOTE 1: Although DOTAM protocol can support direct MS to individual MS communication; the use of it may be limited to specific situations and is outside the scope of the present document.

NOTE 2: DMO groups are normally assigned by a network operator.

NOTE 3: DOTAM does not preclude the usage of pre-configured group and/or frequency settings. It is outside the scope of the present document how DOTAM and pre-configured group and/or frequency settings may interact, but a basic assumption is that the DOTAM protocol cannot modify or remove pre-configured DMO groups.

NOTE 4: It is outside the scope of the present document whether or how MS user may select between usage of the DOTAM DMO groups and pre-configured groups.

The DOTAM protocol may be a member of various other MS over the air management services such as:

- DGNA - V+D group management.
- Phonebook management - ISSI & MS-ISDN management.
- Remote programming of Status message mnemonics.
- Remote programming of technical parameters (timers, etc.).
- Remote software upgrade.
- OTAR/OTAK.

The first on the list is covered by SS-DGNA. The second is in relation to the first one and to the present document, but is outside the scope of the present document.

4.2 DOTAM protocol system architecture

The DOTAM protocol is used between various entities of the TETRA network. Physical entities identified for the purpose of the present document are:

- Mobile Station (MS).
- Management server.
- SwMI.
- Management source.

The management server details are outside the scope of the present document.

The management information exchange contains scenarios:

- Management server to managed MS in the TETRA V+D domain.
- Management source equipment to Management server.
- Management source MS to managed MS in DMO without any action in any other entities.

For the purposes of the present document, the TETRA domain consists of entities that are addressable using TETRA addressing and understand the binary format of the DOTAM protocol.

For the purposes of the present document protocol Functional Entities (FE) are used in some clauses instead of physical entities:

FE1: Managed entity.

FE2: Management server entity.

FE3: Management source entity.

The following relationships exit between these FEs:

ra: Relationship between management server entity and managed entity.

rb: Relationship between management source entity and management server entity.

rc: Relationship between management source entity and managed entity.

In figure 4.1 the management server FE2 acts as the source entity of management information and manages the FE1 entity.

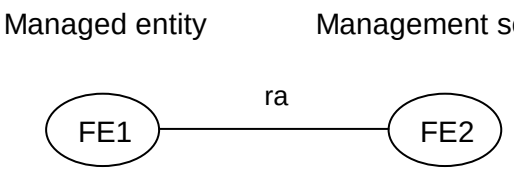


Figure 4.1: Management server and managed entity relationship

In figure 4.2 the management source FE3 defines DMO groups and DMO frequencies for the managed entity FE1.

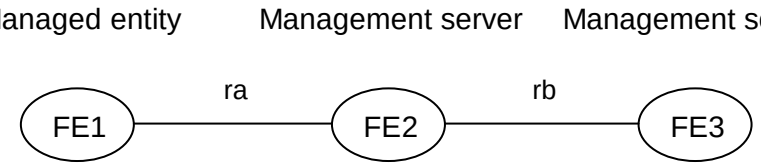


Figure 4.2: Management source, management server, and managed entity relationship

In figure 4.3 a management source FE3 controls the managed entity FE1 without involvement of a management server.

NOTE: This optional arrangement may be used in special cases where a controlled end to end communication is arranged and the management source is authorised. This usage is outside the scope of the present document.

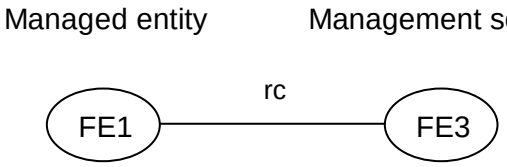


Figure 4.3: Management source and managed entity direct relationship

The management server entity can be sub-divided into sub-entities:

FE21: Communication management entity.

FE22: Management server entity.

FE23: Authentication entity.

FE24: Group number and radio resource management entity.

The following relationships exit between these FEs:

rd: Relationship between communication management entity and management server entity.

re: Relationship between authentication entity and management server entity.

rf: Relationship between group number and radio resource management entity and management server entity.

rg: Relationship between communication management entity and authentication entity.

Functional entity FE2 and its sub-entities FE21, FE22, FE23 and FE24 are presented in figure 4.4.

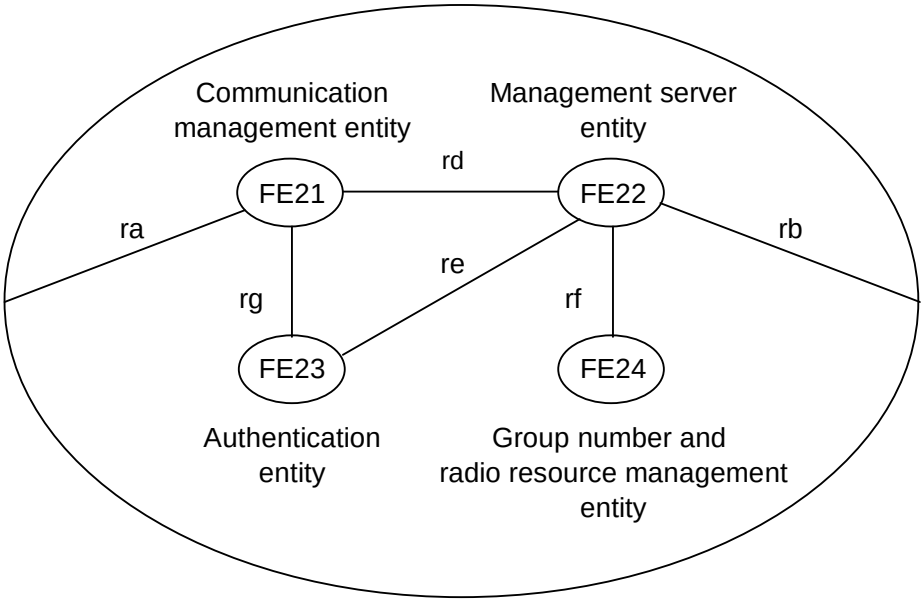


Figure 4.4: Management server sub-entities relationships

4.3 DOTAM protocol service description

4.3.1 General on DOTAM services

The DOTAM protocol can support multiple services. Typical services are:

- Assignment of DMO group definition (addition of a DMO group and/or DMO frequency).
- Deassignment of DMO group definition (removal of a group).
- Allocation or status change of a DMO group.
- Interrogation of DMO group definitions.

4.3.2 Services available at the DOTAM-SAP

DOTAM-SAP at the management server offers services to the DOTAM manager entity and is accessible to the human users. The man machine interface is outside the scope of the present document.

DOTAM-SAP at the MS is a conceptual service access point and is not intended to be accessible by human users.

4.3.3 Service primitives at the DOTAM-SAP

Service primitives at the DOTAM-SAP define service access at management source:

DOTAM-Assign request: this primitive is used to send DMO group and frequency definition requests.

DOTAM-Assign indication: this primitive is used to receive assignments.

DOTAM-Assign response: this primitive is used to acknowledge assignments.

DOTAM-Assign confirmation: this primitive is used to receive acknowledgements to the DMO group and frequency definition requests.

DOTAM-Change status request: this primitive is used to send DMO group status change requests.

DOTAM-Change status indication: this primitive is used to receive DMO group status change requests.

DOTAM-Change status response: this primitive is used to send response to the DMO group status change requests.

DOTAM-Change status confirmation: this primitive is used to receive response to the DMO group status change requests.

DOTAM-Deassign request: this primitive is used to send DMO group removal requests.

DOTAM-Deassign indication: this primitive is used to receive DMO group removal requests.

DOTAM-Deassign response: this primitive is used to acknowledge DMO group removal requests.

DOTAM-Deassign confirmation: this primitive is used to receive acknowledgements to the DMO group removal requests.

DOTAM-Group provide request: this primitive is used to send DMO control group definition and removal requests.

DOTAM-Group provide indication: this primitive is used to receive DMO control group definition and removal requests.

DOTAM-Group provide response: this primitive is used to acknowledge DMO control group definition and removal requests.

DOTAM-Group provide confirmation: this primitive is used to receive acknowledgements to the DMO control group definition and removal requests.

DOTAM-Interrogate request: this primitive is used to send DMO group interrogation requests.

DOTAM-Interrogate indication: this primitive is used to receive DMO group interrogation requests.

DOTAM-Interrogate response: this primitive is used to send DMO group interrogation results.

DOTAM-Interrogate confirmation: this primitive is used to receive DMO group interrogation results.

DOTAM-Interrogate control group request: this primitive is used to send DMO control group group interrogation requests.

DOTAM-Interrogate control group indication: this primitive is used to receive DMO control group group interrogation requests.

DOTAM-Interrogate control group response: this primitive is used to send DMO control group group interrogation results.

DOTAM-Interrogate control group confirmation: this primitive is used to receive DMO control group group interrogation results.

4.3.4 Service primitive parameters at the DOTAM-SAP

As the present document does not define a physical access to the DOTAM-SAP, the description of the conceptual service primitives is minimized and the service primitive parameters are implied by the information elements in the PDUs, refer to clause 6.2.

4.3.5 State description

The DOTAM protocol uses a single state at the FEs that does not link request and response together. At that state DOTAM sends and receives all the service primitives and PDUs.

5 DOTAM protocol description

5.1 Description of information elements

5.1.1 Acknowledgement request

Acknowledgement request shall define whether a confirmation is expected for the message.

NOTE 1: Acknowledgement request in a "request" control message means that confirmation of receipt is requested using the corresponding "response" control message.

NOTE 2: Behaviour on failure to receive a requested confirmation is not defined.

5.1.2 Air interface encryption state

The Air interface encryption state defines security level of DMO communication, refer to EN 300 396-6 [6], clause 4.1.

5.1.3 DMO frequency

The DMO frequency shall comprise DMO carrier frequency (12 bits), Frequency band (4 bits) and Offset (2 bits).

5.1.4 DMO frequency mnemonic name

The DMO frequency mnemonic name is an optional information element that can be used at man machine interface to identify the DMO frequency.

5.1.5 DMO group status

The DMO group status defines the purpose of a DMO group:

- Assigned DMO group, a DMO group with a valid parameter set.
- Preferred DMO group, one or more DMO groups that should be used in normal operations.
- Default DMO group, a DMO group that is selected when a mobile station moves from V+D to DMO.

A DMO group can be in one status at a time and a DMO controlling entity can set the status either at the DMO group assignment or change it later.

NOTE 1: Normally a DMO controlling entity uses one of the preferred DMO groups as the default DMO group. As only a single group can be a default DMO group, an assigment or changing another DMO group to default DMO group changes the previous default DMO group to a preferred DMO group, see clauses 5.5.3 and 5.5.5.

At the same time DMO group can be:

- selected DMO group, a DMO group selected for use; or
- not selected DMO group, any other than the selected DMO group.

NOTE 2: While in DMO mode the selection of a DMO group overrides the other DMO group settings, it does not modify the status of any DMO group.

The support of default and preferred DMO groups is optional.

NOTE 3: The DOTAM control groups are outside the assigned, preferred and default DMO groups, refer to clause 5.5.7.

5.1.6 DMO group mnemonic name

The DMO group mnemonic name is an optional information element that can be used at man machine interface to identify the DMO group.

5.1.7 Encryption key number

The Encryption key number defines the SCK that is used in encrypted DMO communication.

5.1.8 Group number

The Group number shall comprise Country code (10 bits), Network code (14 bits) and Group Short Subscriber Identity (24 bits) as defined in EN 300 392-1 [1], clause 7. Group number is a part of the Unique DMO group identity and is not used as a separate information element in the PDUs.

5.1.9 Interrogate range

The Interrogate range defines which DMO groups are interrogated. MS shall allocate interrogate range numbers to all DMO groups normally commencing from 1 using consecutive interrogation numbers. Also other interrogation range number allocations may be applied and definitions of those are outside the scope of the present document. When a DMO group is deassigned MS may reallocate interrogate range numbers.

5.1.10 Selected group

The selected group is the group that is used in DMO either due to default or selected DMO group action or DMO user selection. It is outside the scope of the present document whether DMO user may select any assigned DMO group or only any of the preferred DMO groups or default DMO group. See note 4 in clause 4.1 about other than DOTAM groups.

5.1.11 Unique DMO group identifier

Parameters for identification of a DMO group contain:

- GTSI or GSSI.
- Group mnemonic name.
- DMO frequency.
- DMO channel mnemonic name.
- DMO group status.
- Encryption level.

DOTAM protocol uses as the unique DMO group identifier a GTSI and DMO frequency combination and some additional bits.

NOTE: The MNI of the GTSI part of the Unique DMO group identifier may be implied in the PDU construction.

The Unique DMO group identifier is a label to a set of DMO group parameters and it supports any combination of those parameters so that the whole set can be identified and managed using only it. E.g. there can be a DMO group that uses the same GTSI and DMO frequency, but has two different security levels. On the users point of view those may be separated by their group name, but on the DOTAM protocol point of view they are separated by their Unique DMO group identifier.

5.2 Information flows

5.2.1 General on information flows

The information flows in clauses 5.2.2 to 5.2.5 present typical implementations of DOTAM protocol services. The service primitives are defined in clause 4.3.3. The information flows use the PDU names as defined in clause 5.7 or descriptive names, if no PDU is defined in the present protocol.

Information flows inside FE2 are outside the scope of the present document.

5.2.2 MS receiving DMO group assignment without an acknowledgement

DMO capable MS may receive DMO group assignment without an acknowledgement request as presented in figures 5.1 and 5.2. DOTAM entity in FE1 stores the parameters.

Information flows for change status and deassignment are the same as for the assignment.

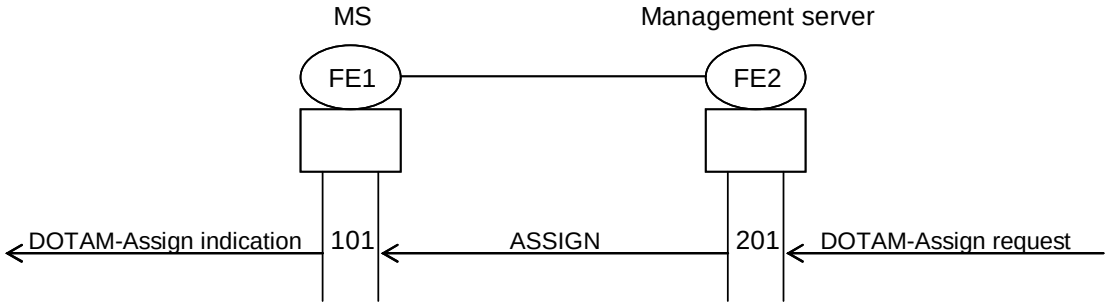


Figure 5.1: MS receiving DMO assignment

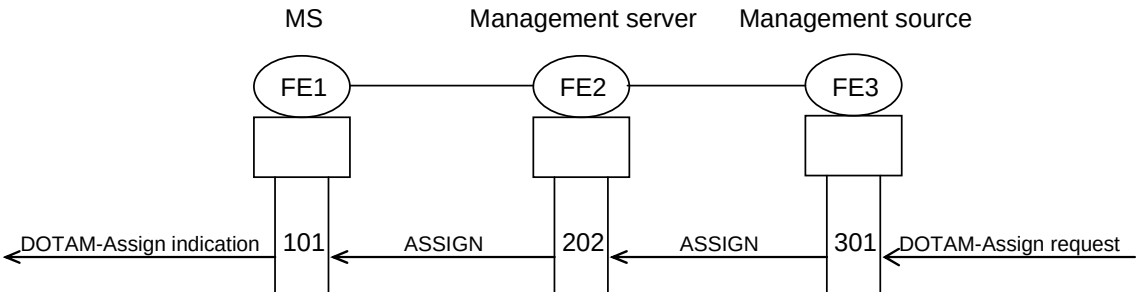
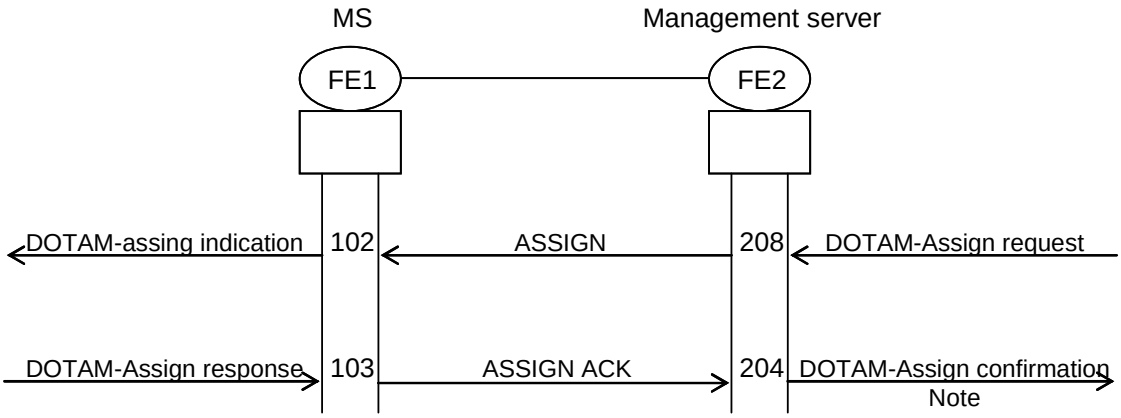


Figure 5.2: MS receiving DMO assignment, separate management source

5.2.3 MS receiving DMO group assignment with an acknowledgement

DMO capable MS may receive a DMO group assignment and send an acknowledgement as presented in figures 5.3 to 5.5. The DOTAM entity stores the parameters.

Information flows for change status and deassignment are the same as for the assignment.



NOTE: DOTAM-Assign confirmation is optional.

Figure 5.3: MS receiving DMO assignment and sending response to it

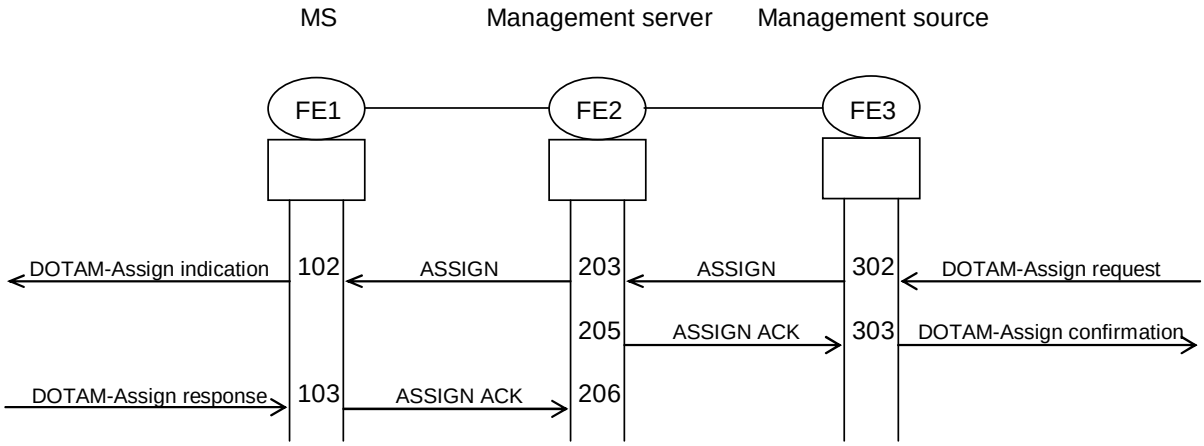


Figure 5.4: MS receiving DMO assignment and sending response to it - management source receiving acknowledgement from the management server

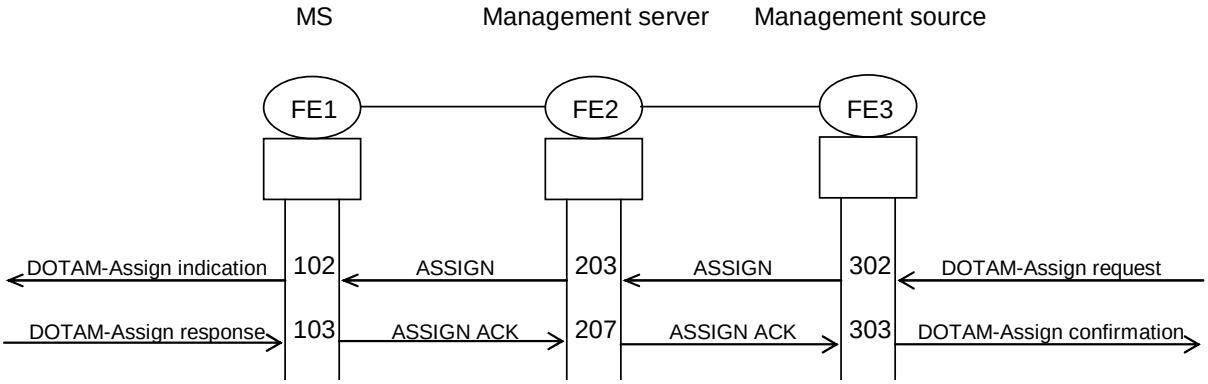


Figure 5.5: MS receiving DMO assignment and sending response to it - management source receiving acknowledgement from the MS

The service primitives and information flows presented in figures 5.3 to 5.5 for ASSIGN are also applicable for DEASSIGN and CHANGE STATUS service primitives and information flows.

5.2.4 Deassignment of DMO group definitions

DMO group can be deleted by DEASSIGN information flow as presented in figures 5.1 and 5.2 without acknowledgements and in figures 5.3 to 5.5 with acknowledgements where ASSIGN information flows and service primitives are replaced by the corresponding DEASSIGN information flows and service primitives.

5.2.5 Change of status of DMO group definitions

DMO group status can be modified by CHANGE STATUS information flow as presented in figures 5.1 and 5.2 without acknowledgements and in figures 5.3 to 5.5 with acknowledgements where ASSIGN information flows and service primitives are replaced by the corresponding CHANGE STATUS information flows and service primitives.

5.2.6 Interrogation of DMO group definitions

Optionally, an MS may receive a request to report DMO group definitions at any time and may respond to it with an INTERROGATE ACK information flow as presented in figures 5.6 and 5.7.

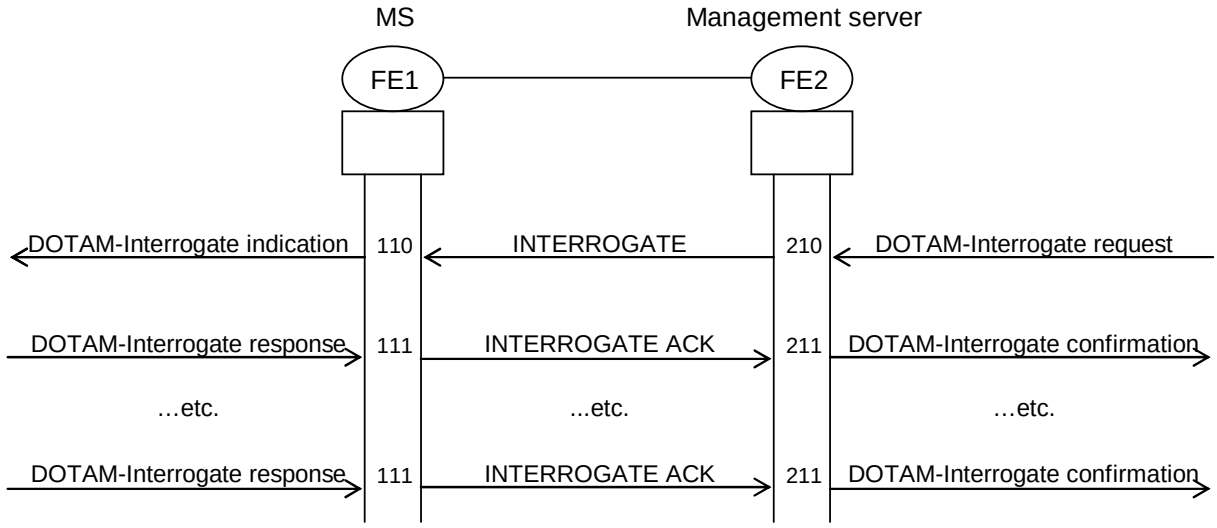


Figure 5.6: Management server interrogates DMO groups

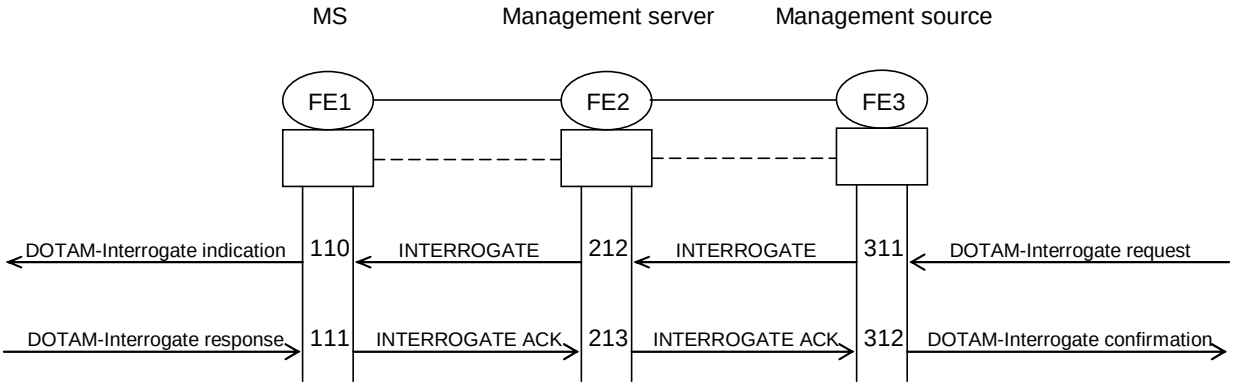


Figure 5.7: Management source interrogates DMO groups

Optionally, an MS may receive a request to report DOTAM control group definitions at any time and may respond to it with an INTERROGATE CONTROL GROUP ACK information flow as presented in figures 5.6 and 5.7, when the INTERROGATE ACK information flow is replaced by INTERROGATE CONTROL GROUP ACK information flows and the service primitives with the corresponding service primitives for DOTAM-Interrogate control group.NOTE:
The INTERROGATE information flow is also used to interrogate DOTAM control groups.

5.2.7 MS receiving DMO control group with an acknowledgement

DMO capable MS may receive a DMO control group assignment and send an acknowledgement as presented in figures 5.8 to 5.9. The DOTAM entity stores the control group.

Support of DMO control groups is optional.

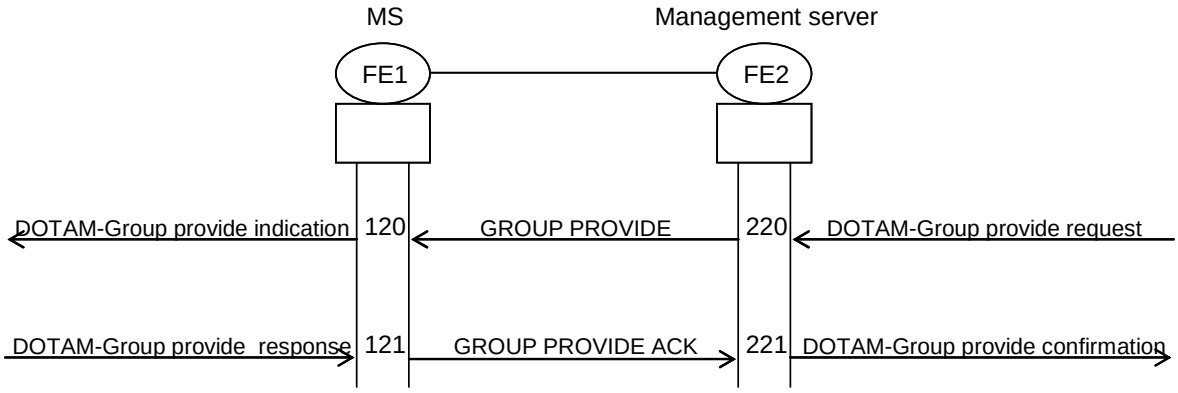


Figure 5.8: MS receiving DMO control group and sending response to it

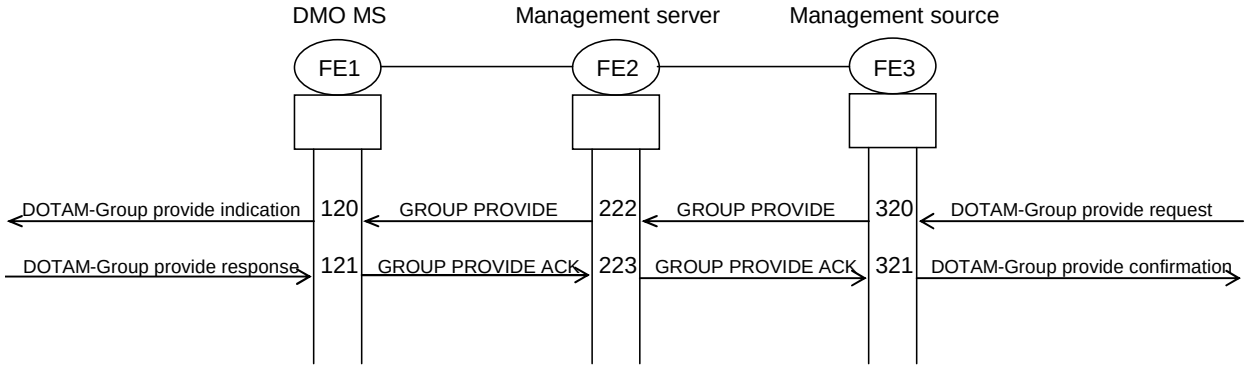


Figure 5.9: MS receiving DMO control group and sending response to it - management source receiving acknowledgement from the MS

5.3 Functional entity actions

5.3.1 FE1 actions

101: Upon reception of an assignment, FE1 shall store the DMO group definition for usage. If the DMO group definition already exists then the new definition shall replace the old one.

Upon reception of a deassignment, FE1 shall remove the DMO group definition. FE1 may refuse to remove DMO group assignment; the reasons for the refusal are outside the scope of the present document.

If the DMO group definition storage or deassignment fails, FE1 shall take no further action.

Upon reception of a DMO status, FE1 shall store the new status for usage. If the DMO group does not exist, then FE1 shall ignore the DMO status definition.

If the DMO status value is not allowed in the FE1, then FE1 shall not change the status of the group and shall take no further action.

102: Upon reception of an assignment, FE1 shall store the DMO group definition for usage and send an acknowledgement (103). If the DMO group definition already exists, then the new definition shall replace the old one.

Upon reception of a deassignment, FE1 shall remove the DMO group definition and send an acknowledgement (103) as requested. FE1 may refuse to remove DMO group assignment; the reasons for the refusal are outside the scope of the present document.

If the DMO group definition storage or removal fails, FE1 shall send acknowledgement with the corresponding reason value (103).

Upon reception of a DMO change status, FE1 shall store the new status for usage and send an acknowledgement (103). If the DMO group does not exist, then FE1 shall send an acknowledgement indicating rejection reason (103).

If the DMO change status value is not allowed in the FE1, then FE1 shall not change the status of the group and shall send an acknowledgement indicating rejection reason (103).

103: See action 102.

110: Upon reception of an INTERROGATION information flow, FE1 shall send corresponding results (111).

120: Upon reception of GROUP PROVIDE information flow, FE1 shall store/replace or remove, as requested, the control group address and shall store the related Maximum response time value.

121: If FE1 accepts the control group action FE1 shall send GROUP PROVIDE ACK information flow.

If the control group related action fails, FE1 shall send GROUP PROVIDE ACK information flow with the corresponding reason value.

5.3.2 FE2 actions

Functional entity FE2 may be divided into multiple functional entities responsible of specific actions, but for the purposes of the present document that sub-division is not defined nor any information flows between those functional entities.

201: Upon reception of a DOTAM-Assign request, FE2 may check that the DMO group number and frequency are in allowed ranges (FE24) and the FE1 is eligible for the definition. If definition is allowed, then FE2 shall send corresponding assignment.

Upon reception of a DOTAM-Change status request, FE2 may check that the DMO status is allowed for the FE1 and send the DMO Status to it.

Upon reception of a DOTAM-Deassign request, FE2 may check that removal of the DMO group is allowed from the FE1 and send the DEASSIGN information flow to FE1.

In addition, FE2 may record the DMO group allocation and its status. The recording is outside the scope of the present document.

202: Upon reception of an ASSIGN information flow, FE2 may check that the DMO group number and frequency are in allowed ranges (FE24) and the FE1 is eligible for the definition. If definition is allowed, then FE2 shall send corresponding assignment.

Upon reception of a CHANGE STATUS information flow, FE2 may check that the DMO status is allowed for the FE1 and send the DMO Status to it.

Upon reception of a DEASSIGN information flow, FE2 may check that removal of the DMO group is allowed from the FE1 and send the DEASSIGN information flow to FE1.

In addition, FE2 may record the DMO group allocation and its status. The recording is outside the scope of the present document.

203: In addition to the actions 202, FE2 requests acknowledgement from FE1.

204: Upon reception of an Acknowledgement from FE1, FE2 passes it to the user as a corresponding DOTAM service primitive.

205: In addition to action 203, FE2 responses to the request with corresponding result to FE3 without waiting for acknowledgement information flow from FE1.

206: Upon reception of the acknowledgement information flow, FE2 notes the result and stops any further transmission actions to FE1 due to the corresponding action 203.

NOTE 1: In the scenario corresponding to the actions 205 and 206, FE2 may be responsible of retries, if FE1 is not reachable.

207: Upon reception of the acknowledgement information flow, FE2 sends the result to FE3.

NOTE 2: In the scenario corresponding to the actions 204 and 207, the service user or FE3 may be responsible of retries, if FE1 is not reachable.

208: In addition to the actions 201, FE2 requests acknowledgement from FE1.

210: Upon reception of a DOTAM-Interrogate or a DOTAM-Interrogate control group request service primitive, FE2 sends the corresponding INTERROGATE information flow to FE1.

211: Upon reception of an INTERROGATION ACK or INTERROGATE CONTROL GROUP ACK information flow, FE2 passes it to the user as the corresponding DOTAM-Interrogate or DOTAM-Interrogate control group confirm service primitive.

212: Upon reception of an INTERROGATION or INTERROGATE CONTROL GROUP information flow, FE2 passes it to FE1.

213: Upon reception of an INTERROGATION ACK or INTERROGATE CONTROL GROUP ACK information flow, FE2 passes it to FE3.

In addition to the above actions, FE2 may record the DMO group allocation and its status. The recording is outside the scope of the present document.

220: Upon reception of a DOTAM-Group provide request, FE2 may check that the DMO control group number is in allowed range (FE24) and the FE1 is eligible for the control group. If the control group is allowed, then FE2 shall send corresponding GROUP PROVIDE information flow to FE1.

In addition, FE2 may record the DMO control group allocation and its status. The recording is outside the scope of the present document.

221: Upon reception of a GROUP PROVIDE information flow from FE1, FE2 passes it to the user as a DOTAM-Group provide confirmation service primitive.

222: Upon reception of a GROUP PROVIDE information flow, FE2 may check that the DMO control group number is in allowed range (FE24) and the FE1 is eligible for the control group. If the control group is allowed, then FE2 shall send corresponding GROUP PROVIDE information flow to FE1.

223: Upon reception of the acknowledgement information flow, FE2 sends the result to FE3.

NOTE 3: In the scenario corresponding to the actions 221 and 223, the service user or FE3 may be responsible of retries, if FE1 is not reachable.

NOTE 4: In addition in actions 220 to 223, FE2 may record the DMO control group allocation and its status. The recording is outside the scope of the present document.

5.3.3 FE3 actions

301: Upon reception of a DOTAM-Assign, DOTAM-Change status, or DOTAM-Deassign service primitive, FE3 sends a corresponding ASSIGN, CHANGE STATUS, or DEASSIGN information flow to FE2 without requesting an acknowledgement.

302: Upon reception of a DOTAM-Assign, DOTAM-Change status, DOTAM-Deassign or DOTAM-Group provide request service primitive, FE3 sends corresponding ASSIGN, CHANGE STATUS DEASSIGN or GROUP PROVIDE information flow to FE2 with requesting an acknowledgement. The acknowledgement request is implicit in the GROUP PROVIDE information flow.

303: Upon reception of an ASSIGN ACK, CHANGE STATUS ACK, DEASSIGN ACK or GROUP PROVIDE ACK information flow from FE2, FE3 passes the corresponding DOTAM service primitive to the user.

311: Upon reception of a DOTAM-Interrogate or DOTAM-Interrogate control group request service primitive, FE3 sends an INTERROGATE information flow to FE2.

312: Upon reception of an INTERROGATE ACK or INTERROGATE CONTROL GROUP ACK information flow from FE2, FE3 passed the corresponding DOTAM-Interrogate or DOTAM-Interrogate control group confirm service primitive to the user.

320: Upon reception of a DOTAM-Group provide request FE3 sends a GROUP PROVIDE information flow to FE2.

321: Upon reception of a GROUP PROVIDE ACK information flow from FE2, FE3 passes the DOTAM-Group provide confirm service primitive to the user.

5.4 Allocation of entities

Management server FE2 and its sub-entities FE21, FE22, and FE23 may be a part of SwMI or independent entities that are connected to SwMI in a secure manner and are as such part of TETRA domain. The number of sub-entities inside FE2 is outside the scope of the present document.

Management source FE3 is typically a system management device or a dispatcher station.

In the flow charts in figures 5.1 to 5.7, "MS" is used as a physical allocation to FE1.

In a system, there may be any number of any entities allocated to any number of physical entities.

5.5 Procedures

5.5.1 Relations to flow charts

The procedures refer to the flow chart action numbers as needed. Some of the actions in the flow charts are not described as those should be self-evident and do not contain any requirements.

The present document defines procedures for MS. No procedures are defined for SwMI or any management entity.

5.5.2 Moving from V+D to DMO and Powering on in DMO

If an MS supports DMO group status, then it shall select the defined default DMO group, when the MS moves from V+D service to DMO service. If a default DMO group is not defined and if an MS moves from V+D service to DMO service, then the MS may select the last selected DMO group as the implied DMO group.

Although outside the scope of the present document, there can also be a linkage between the selected V+D group and a DMO group implying the DMO group that may be used instead of a defined default DMO group, if any.

It is outside the scope of the present document which DMO group will be used, if there are conflicting implied and defined default DMO groups.

NOTE: Once in DMO, the user may select another DMO group than the default one.

Although outside the scope of the present document, when an MS powers on in DMO, a typical requirement is that the last selected DMO group shall be used. If a default DMO group is defined and if an MS powers on in DMO, then the default DMO group may or may not override the last selected DMO group.

5.5.3 MS receiving DMO group assignment

MS may receive an ASSIGN PDU at any time as shown in action 101 in figure 5.1 and action 102 in figure 5.3. The assignment functions both as an addition and as a modification. The MS shall:

- if MS accepts the assignment and the DMO group definition does not exist as defined by the unique group identifier, then MS shall store assignment;
- if MS accepts the assignment and the DMO group definition exists as defined by the unique group identifier, then MS shall replace the existing assignment with the new one;
- if MS accepts the assignment of a new default DMO group and if a previous default DMO group exists and the assignment does not modify the previous DMO group to an assigned DMO group, then the previous default DMO group shall be changed to a preferred DMO group;
- if MS does not accept the assignment at all, then MS shall not modify any of the existing assignments;
- if MS does not accept one or more of the assignments, then MS shall not modify related existing assignments;
- if the encryption key as indicated by the Encryption key number information element does not exist or MS does not support settings of air interface encryption, then MS shall store the assignment, if otherwise acceptable, and shall indicate reason "Warning, encryption key not present and/or air interface encryption setting not supported", if an acknowledgement is requested; and

NOTE 1: As the encryption key management is performed by another protocol, it is considered that the usage order of the protocols is irrelevant.

- if an acknowledgement is requested, then MS shall prepare and send an ASSIGN ACK PDU indicating the result of the assignment. If the result is common to the all assignments, then the DMO group by DMO group acknowledgement should not be included into the ASSIGN ACK PDU.

NOTE 2: The ASSIGN ACK PDU supports also construction, where in addition to a general failure DMO group specific failures are presented.

NOTE 3: DMO group assignment command does not support a DMO group selection, refer to clauses 5.1.5 and 5.5.5.

If the Unique DMO group identifier does not contain an MNI, then the MS shall assume that the DMO group MNI is the same as the MNI of the sending entity.

5.5.4 MS receiving DMO group deassignment

MS may receive a DEASSIGN PDU at any time in the same manner as shown for ASSIGN PDU in action 101 in figure 5.1 and action 102 in figure 5.3. The MS shall:

- if MS accepts the deassignment and the specific DMO group definition does exist as defined by the unique group identifier, then MS shall delete that DMO group;
- if the DMO group definition does not exist as defined by the unique group identifier, then shall not perform any action on that DMO group;
- if MS does not accept the deassignment at all, then MS shall not delete any of the existing assignments; and
- if an acknowledgement is requested in the DEASSIGN PDU, then MS shall prepare and send a DEASSIGN ACK PDU indicating the result of the deassignment.

If the Unique DMO group identifier does not contain an MNI, then the MS shall assume that the DMO group MNI is the same as the MNI of the sending entity.

NOTE: The DEASSIGN PDU is never group addressed and MS will not react to a group addressed DEASSIGN PDU.

5.5.5 MS receiving DMO group status change

MS may receive a CHANGE STATUS PDU at any time as shown in action 101 in figure 5.1 and action 102 in figure 5.3. The MS shall:

- if the DMO group status change type information element defines actions and MS accepts those actions, then MS shall first perform those;
- if MS does not accept the actions defined in the DMO group status change type information element, then MS may either:
  - continue with individually defined DMO status changes;
  - if an acknowledgement is requested, send one as defined below; or
  - if no acknowledgement is requested, perform no action.
- if MS accepts the DMO status and the DMO group definition exists as defined by the unique group identifier, then MS shall store the DMO status; if a DMO group has been changed to the default DMO group and if a default DMO group had already been defined, then the previous DMO group shall become a preferred DMO group;

NOTE 1: If a new default DMO group is defined and accepted, then the status change of the old one by the DMO group status change type information element cannot fail.

NOTE 2: A DMO group selection does not change the status of the DMO group, refer to clause 5.1.5.

- if the DMO group definition does not exist as defined by the unique group identifier, then MS shall not modify any DMO group;
- if MS does not accept the DMO status, then MS shall not modify the corresponding group definition; and
- if an acknowledgement is requested, then MS shall prepare and send CHANGE STATUS ACK PDU indicating the result of the status change.

If a Unique DMO group identifier does not contain an MNI, then the MS shall assume that the DMO group MNI is the same as the MNI of the sending entity.

NOTE 3: A DMO group status change does not delete (deassign) any DMO group assignment.

NOTE 4: A DMO group selection does not change the status of the group, refer to clause 5.1.5.

5.5.6 MS receiving DMO interrogation request

Optionally MS may receive an INTERROGATE PDU at any time as shown in action 110 in figures 5.6 and 5.7.

- If MS supports DMO groups interrogation, the MS shall prepare and send a corresponding INTERROGATE ACK PDU. MS shall include only those DMO groups to the INTERROGATE ACK PDU that were requested, if any. MS may send multiple INTERROGATE ACK PDUs as a response to a single INTERROGATE PDU, if the size of an individual PDU will exceed acceptable size. The sizes of individual PDUs are outside the scope of the present document. When multiple INTERROGATE ACK PDUs belong together, then the other than the last INTERROGATE ACK PDU shall contain Result code "Success, more information to follow" and the Number of remaining DMO group definitions information element shall indicate the number of DMO group assignments that are not yet reported, if any, in this set of INTERROGATE ACK PDUs. The additional INTERROGATE ACK PDUs should not repeat already sent DMO group information. The non-presence of some DMO group status in an INTERROGATE ACK PDU shall not indicate that DMO groups with those status values are not assigned.
- If MS supports DOTAM control groups interrogation, the MS shall prepare and send an INTERROGATE CONTROL GROUP ACK. MS may send multiple INTERROGATE CONTROL GROUP ACK PDUs in the same manner as INTERROGATE ACK PDUs defined above.

- If MS does not support DMO or DOTAM control groups interrogation, but recognizes the INTERROGATE PDU, the MS shall prepare and send a corresponding INTERROGATE ACK PDU or INTERROGATE DOTAM GROUP ACK with reason "Action not supported".

If a DMO group MNI is the same as the MNI of the sending MS ITSI then the Unique DMO group identifier does not need to contain the MNI. The entity receiving the INTERROGATE ACK PDU shall assume that the MNI of the DMO group number is the same as the MNI of the sending MS ITSI.

5.5.7 MS receiving DOTAM control group address

Optionally MS may receive a GROUP PROVIDE PDU individually addressed as shown action 120 in figures 5.8 and 5.9.

- If MS supports DOTAM control group address, it shall store/replace or remove, as requested, the control group address as a special group address that will be active for reception of DOTAM messages and shall store the related Maximum response time value. MS shall send a GROUP PROVIDE ACK PDU with result code information element set to "Success, action completed".

- If MS supports DOTAM control group address, but does not support the requested action it shall send a GROUP PROVIDE ACK PDU with result code information element set to "Not supported information element value" or "Control address already defined" as appropriate.

- If MS does not support DOTAM control group address it may either send a GROUP PROVIDE ACK PDU with result code information element set to "Not supported action" or an Action not supported PDU, refer to annexes A or B as appropriate.

NOTE: It is outside the present document whether MS supports more than one DOTAM control group address.

5.5.8 MS receiving PDU using DOTAM control group address

MS may receive any DOTAM PDU addressed to a DOTAM control group address. Upon reception of the DOTAM PDU MS shall set timer T1 to a random value up to the Maximum response time defined for that DOTAM control group address. The MS shall then determine whether to respond to the group addressed DOTAM PDU as follows:

- if the PDU explicitly requires MSs to respond, each MS shall respond to inform the success (or failure) of the transaction following expiry of timer T1;

- optionally, if the transmission does not explicitly require MSs to respond, an MS may respond following the expiry of T1 only if the transmission provides that MS with an assignment that the MS does not have stored;

- if the transmission does not explicitly require MSs to respond, and the transmission does not provide an MS with an assignment that the MS does not have stored, that MS shall not respond.

If an MS is required to respond for one of the reasons given above, but needs to leave the SwMI by sending ITSI-Detach signalling the MS shall consider T1 to have terminated at this point, and should send the response to the DOTAM signalling before detaching from the SwMI.

NOTE 1: If the MS is unable to send the response there is no requirement to store the response.

NOTE 2: The use of group addressing should be carefully considered as the responses from multiple MSs may generate excessive traffic. For that reason e.g. group addressed interrogation may not be allowed.

MS shall not try to attach that DOTAM control group address as a part of any registration or group attachment action.

5.6 Operational requirements

5.6.1 DMO capable MS

The DMO capable MS shall comply with the requirements in clause 14 of EN 300 392-2 [2] which apply to the call unrelated signalling. In addition, it shall comply with the relevant requirements in clauses 7 and 11 of EN 300 392-9 [3].

5.6.2 DMO capable MS home SwMI

If the DMO capable MS is registered in the home SwMI, that SwMI shall support this MS complying with the requirements for call unrelated signalling set in clause 14 of EN 300 392-2 [2]. This SwMI shall also comply with the relevant requirements in clauses 7 to 11 of EN 300 392-9 [3].

If the DMO capable MS is not all registered in the home SwMI that SwMI shall comply with the ISI requirements necessary to support call unrelated signalling set. It shall also comply with the relevant requirements in clauses 9 to 11 of EN 300 392-9 [3].

6 DOTAM protocol coding requirements

6.1 General on coding requirements

Option 1

The DOTAM PDUs are transported using D-FACILITY and U-FACILITY PDUs as defined in EN 300 392-9 [3], clauses 7.3 and 8 and EN 300 392-2 [2] while MS is connected to V+D service.

SS type value shall be as defined in EN 300 392-9 [3], clause 8.1.

NOTE: The maximum total length of an SS PDU is 256 octets.

Option 2

The DOTAM PDUs are transported using SDS-TL as defined in EN 300 392-2 [2], clause 29 while MS is connected to V+D service.

SDS-TL PID values shall be as defined in EN 300 392-2 [2], clause 29.4.3.9 (no SDS-TL transport service supported).

MS may check that the original source address of the SDS-TL message is one of those who is authorised to send DOTAM commands to the MS.

End of options

The DOTAM protocol sets strict requirements on the PDU encoding so that the maximum amount of information can be fitted into short messages. As a result, mandatory information elements are used in cases where it is expected that the information is not needed by all applications that receive the PDU. In order to let DOTAM generating entity use such PDUs when they do not have data for all the mandatory information elements, some information element values are used to indicate that situation.

The DOTAM protocol uses optional information elements in its PDUs. Those are implemented either by conditional or type 5 information elements. The use of those types remove use of type 2 and so no O-bit or M-bit shall be used in the PDU encoding. Refer to clause 6.4.

In clauses 6.2 and 6.3 PDU encoding and information element encoding tables use the following key:

- Length: length of the element in bits;
- Type: element type (1 or 5) as defined above;
- C/M: conditional/optional/mandatory information in the PDU;

- Value: value of the information element;
- Remark: comment.

6.2 DOTAM protocol PDU description tables

6.2.1 ASSIGN PDU

The ASSIGN PDU shall be encoded as defined in table 6.1.

Table 6.1: ASSIGN PDU contents

Information element	Length	Type	C/M	Value	Remark
PDU type	5	1	M		ASSIGN
Number of assignments	4	1	M		
DMO group definition	varies		C		See note 1
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 2 and 3
NOTE: This information element shall be repeated as many times as indicated by the Number of assignments information element. NOTE 2: This information element shall be present as indicated by the Reserved information element present information element. NOTE 3: The reserved information element is a place holder and is presented for PDU encoding purpose.					

6.2.2 ASSIGN ACK PDU

The ASSIGN ACK PDU shall be encoded as defined in table 6.2.

Table 6.2: ASSIGN ACK PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		ASSIGN ACK
Result code	5	1	M		See note 1
Number of assignments present	1	1	M	0	Number of assignments not present
				1	Number of assignments present
Number of assignments	4		C		See note 2
Unique DMO group identifier	varies		C		See note 3
Result code	5		C		See note 3
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 4 and 5
NOTE 1: General assignment result code. NOTE 2: This information element shall be present as indicated by the Number of assignments present information element. NOTE 3: These information elements shall be repeated as a set as many times as indicated by the Number of assignments information element. NOTE 4: This information element shall be present as indicated by the Reserved information element present information element. NOTE 5: The reserved information element is a place holder and is presented for PDU encoding purpose.					

6.2.3 CHANGE STATUS PDU

The CHANGE STATUS PDU shall be encoded as defined in table 6.3.

Table 6.3: CHANGE STATUS PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		CHANGE STATUS
DMO group status change type	4	1	M		
Number of changed groups present	1	1	M	0	Number of changed groups not present
				1	Number of changed groups present
Number of changed groups	4		C		See note 1
Unique DMO group identifier	varies		C		See note 2
Acknowledgement request	1		C		See note 2
DMO group status	3		C		See note 2
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 3 and 4

NOTE 1: This information element shall be present as indicated by the Number of changed groups present information element.
NOTE 2: These information elements shall be repeated as a set as many times as indicated by the Number of changed groups information element.
NOTE 3: This information element shall be present as indicated by the Reserved information element present information element.
NOTE 4: The reserved information element is a place holder and is presented for PDU encoding purpose.

6.2.4 CHANGE STATUS ACK PDU

The CHANGE STATUS ACK PDU shall be encoded as defined in table 6.4.

Table 6.4: CHANGE STATUS ACK PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		CHANGE STATUS ACK
Result code	5	1	M		See note 1
Number of changed groups present	1	1	M	0	Number of changed groups not present
				1	Number of changed groups present
Number of changed groups	4		C		See note 2
Unique DMO group identifier	varies		C		See note 3
Result code	5		C		See note 3
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 4 and 5

NOTE 1: General status change result code.
NOTE 2: This information element shall be present as indicated by the Number of changed groups present information element.
NOTE 3: These information elements shall be repeated as a set as many times as indicated by the Number of changed groups information element.
NOTE 4: This information element shall be present as indicated by the Reserved information element present information element.
NOTE 5: The reserved information element is a place holder and is presented for PDU encoding purpose.

6.2.5 DEASSIGN PDU

The DEASSIGN PDU shall be encoded as defined in table 6.5.

Table 6.5: DMO DEASSIGN PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		DEASSIGN
DMO group deassign type	2	1	M	0	Deassign DMO groups as defined by the Number deassignments information element
Number of deassignments present	1	1	M	0	Number of deassignments not present
				1	Number of deassignments present
Number of deassignments	4		C		See note 1
Unique DMO group identifier	varies		C		See note 2
Acknowledgement request	1		C		See note 2
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 3 and 4
NOTE 1: This information element shall be present as indicated by the Number of deassignments present information element. NOTE 2: These information elements shall be repeated as a set as many times as defined by the Number of deassignments information element. NOTE 3: This information element shall be present as indicated by the Reserved information element present information element. NOTE 4: The reserved information element is a place holder and is presented for PDU encoding purpose.					

NOTE: The DMO group deassign type information element defines the structure of the current DMO DEASSIGN PDU. A later version of the present document may define different structures as identified by the DMO group deassign type information element.

6.2.6 DEASSIGN ACK PDU

The DEASSIGN ACK PDU shall be encoded as defined in table 6.6.

Table 6.6: DEASSIGN ACK PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		DEASSIGN ACK
Result code	5	1	M		See note 1
Number of deassignments present	1	1	M	0	Number of deassignments not present
				1	Number of deassignments present
Number of deassignments	4		C		See note 2
Unique DMO group identifier	varies		C		See note 3
Result code	5		C		See note 3
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 4 and 5
NOTE 1: General deassignment result code. NOTE 2: This information element shall be present as indicated by the Number of deassignments present information element. NOTE 3: These information elements shall be repeated as a set as many times as indicated by the Number of deassignments information element. NOTE 4: This information element shall be present as indicated by the Reserved information element present information element. NOTE 5: The reserved information element is a place holder and is presented for PDU encoding purpose.					

6.2.7 GROUP PROVIDE PDU

The GROUP PROVIDE PDU shall be encoded as defined in table 6.7.

Table 6.7: GROUP PROVIDE PDU contents

Information element	Length	Type	C/M	Value	Remark
PDU type	5	1	M		GROUP PROVIDE
Group Short Subscriber Identity	24	1	M		See EN 300 392-1 [1], clause 7
Mobile Network Identity	24	1	M		
Maximum response time	8	1	M		
DOTAM control group action	2	1	M	0	Add/replace the indicated DOTAM control group
				1	Remove the indicated DOTAM control group
				2	Reserved
				3	Reserved
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 1 and 2
NOTE 1: This information element shall be present as indicated by the Reserved information element present information element. NOTE 2: The reserved information element is a place holder and is presented for PDU encoding purpose.					

6.2.8 GROUP PROVIDE ACK PDU

The GROUP PROVIDE ACK PDU shall be encoded as defined in table 6.8.

Table 6.8: GROUP PROVIDE ACK PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		GROUP PROVIDE ACK
Result code	5	1	M		
Group Short Subscriber Identity	24	1	M		See EN 300 392-1 [1], clause 7
Mobile Network Identity	24	1	M		
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 1 and 2
NOTE 1: This information element shall be present as indicated by the Reserved information element present information element. NOTE 2: The reserved information element is a place holder and is presented for PDU encoding purpose.					

6.2.9 INTERROGATE PDU

The INTERROGATE PDU shall be encoded as defined in table 6.9.

Table 6.9: INTERROGATE PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		INTERROGATE
Interrogate type	4	1	M		See note 1
Interrogation range included	1	1	M	0	Interrogation range is included
				1	Interrogation range is not included
Interrogation range start number	10		C		See note 2
Interrogation range end number	10		C		See note 2
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 3 and 4
NOTE 1: If a range is included, then this information element has no meaning and shall be set to zero. NOTE 2: Shall be present as defined by the Interrogation range included information element. NOTE 3: This information element shall be present as indicated by the Reserved information element present information element. NOTE 4: The reserved information element is a place holder and is presented for PDU encoding purpose.					

6.2.10 INTERROGATE ACK PDU

The INTERROGATE ACK PDU shall be encoded as defined in table 6.10.

Table 6.10: INTERROGATE ACK PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		INTERROGATE ACK
Result code	5	1	M		
Unique DMO group identifier of the default DMO group present	1	1	M	0	Default DMO group information not present
				1	Default DMO group information present
Unique DMO group identifier of the default DMO group	varies		C		Shall be present as defined by the Unique DMO group identifier of the default DMO group present information element
Preferred DMO groups present	1	1	M	0	No preferred DMO group information present
				1	Preferred DMO group information present
Number of preferred DMO groups	5		C		Shall be present as defined by the Preferred DMO groups present
Unique DMO group identifier of a preferred DMO group	varies		C		Shall be present and repeated as many times as defined by the Number of preferred DMO groups information element
Assigned DMO groups present	1	1	M	0	No assigned DMO group information present
				1	Assigned DMO group information present
Number of assigned DMO groups	5		C		Shall be present as defined by the Assigned DMO groups present information element
Unique DMO group identifier of an assigned DMO group	varies		C		Shall be present and repeated as many times as defined by the Number of assigned DMO groups information element
Number of remaining DMO group definitions present	1	1	M	0	Number of remaining DMO group definitions is not present
				1	Number of remaining DMO group definitions is present
Number of remaining DMO group definitions	10		C		Shall be present as defined by the Number of remaining DMO group definitions present information element
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 1 and 2
NOTE 1: This information element shall be present as indicated by the Reserved information element present information element. NOTE 2: The reserved information element is a place holder and is presented for PDU encoding purpose.					

6.2.11 INTERROGATE CONTROL GROUPS ACK PDU

The INTERROGATE CONTROL GROUPS ACK PDU shall be encoded as defined in table 6.11.

Table 6.11: INTERROGATE CONTROL GROUPS ACK PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	5	1	M		INTERROGATE CONTROL GROUPS ACK
Result code	5	1	M		
Number of DOTAM control groups	5	1	M		
Group Short Subscriber Identity	24		C		See notes 1 and 2
Mobile Network Identity	24		C		See notes 1 and 2
Number of remaining DOTAM control groups	10	1	M		
Reserved information element present	1	1	M	0	Refer to clause 6.3.17
Reserved	24		C		See notes 3 and 4
NOTE 1: Shall be present as many times as defined by the Number of DOTAM control groups information element. NOTE 2: These information elements shall be present together as a set. NOTE 3: This information element shall be present as indicated by the Reserved information element present information element. NOTE 4: The reserved information element is a place holder and is presented for PDU encoding purpose.					

6.3 PDU information elements

6.3.1 Acknowledgement request

The Acknowledgement request information element shall be encoded as defined in table 6.12.

Table 6.12: Acknowledgement request information element contents

Information element	Length	Type	C/O/M	Value	Remark
Acknowledgement request	1	1	M	0	No acknowledgement requested
				1	Acknowledgement requested

6.3.2 Air Interface encryption state

The Air Interface encryption state information element shall be encoded as defined in EN 300 396-6 [6], clause 4.1 and presented in table 6.13.

Table 6.13: AI encryption state element encoding

Information element	Length	Type	Value	Class
Air Interface encryption state	2	1	00_2	DM-1
			10_2	DM-2-A
			11_2	DM-2-B
			01_2	DM-2-C

6.3.3 DMO channel mnemonic name

The DMO channel mnemonic name information element shall be encoded as presented in table 6.14.

Table 6.14: DMO channel mnemonic name information element contents

Information element	Length	Type	C/O/M	Remark
Text encoding scheme	7	1	M	See note 1
Length of DMO channel mnemonic name	8	1	M	See note 2
Character string	Variable		C	See note 3
NOTE 1: The definition of the text encoding scheme information element shall be as given in EN 300 392-2 [2], clause 29.5.4.1. NOTE 2: The length of character string information element shall indicate the total number of bits in the character string information element. NOTE 3: The mnemonic name information element shall be a string of characters, the length and the meaning of each character being defined by the value of the text coding scheme information element. There shall be at least two characters and maximum 20 characters in the mnemonic name. The receiving entity needs to know at least the size of characters in order to properly decode this information element.				

6.3.4 DMO frequency

The DMO frequency information element shall be encoded as presented in table 6.15.

Table 6.15: DMO frequency information element contents

Information element	Length	Type	C/M	Value	Remark
DMO carrier	12	1	M		Frequency of the DMO channel, note 1
Frequency band	4	1	M		Frequency band of the DMO channel, note 2
Offset	2	1	M	00_2	0 kHz offset
				01_2	+6,25 kHz offset
				10_2	-6,25 kHz offset
				11_2	+12,5 kHz offset
NOTE 1: The DMO carrier frequency = base frequency + (DMO carrier × 25 kHz) + offset kHz. NOTE 2: The Frequency band shall define the base frequency as presented in TS 100 392-15 [4].					

6.3.5 DMO group deassign type

The DMO group deassign type information element shall be encoded as defined in table 6.16.

Table 6.16: DMO group deassign type information element contents

Information element	Length	Type	Value	Remark
DMO group deassign type	2	1	0	Deassign DMO groups as defined by the Number deassignments information element
			1	Reserved
			2	Reserved
			3	Reserved

6.3.6 DMO group definition

The DMO group definition information element shall be encoded as defined in table 6.17.

Table 6.17: DMO group definition information element contents

Information element	Length	Type	C/M	Value	Remark
Unique DMO group identifier	varies	1	M		See note 1
Acknowledgement request	1	1	M		
DMO group status	3	1	M		
Air interface encryption state	2	1	M		
Encryption key number	5	1	M		See note 2
DMO group mnemonic name present	1	1	M	0	Name is not present
				1	Name is present
DMO group mnemonic name	varies		C		
DMO channel mnemonic name present	1	1	M	0	Name is not present
				1	Name is present
DMO channel mnemonic name	varies		C		
NOTE 1: That information element contains both DMO group number and DMO carrier frequency. NOTE 2: If the Air interface encryption state is DM-1, then the Encryption key number has no meaning and shall be set to zero.					

6.3.7 DMO group mnemonic name

The DMO group mnemonic name information element shall be encoded as presented in table 6.18.

Table 6.18: DMO group mnemonic name information element contents

Information element	Length	Type	C/O/M	Remark
Text encoding scheme	7	1	M	See note 1
Length of DMO group mnemonic name	8	1	M	See note 2
Character string	Variable		C	See note 3
NOTE 1: The definition of the text encoding scheme information element shall be as given in EN 300 392-2 [2], clause 29.5.4.1. NOTE 2: The length of character string information element shall indicate the total number of bits in the character string information element. NOTE 3: The mnemonic name information element shall be a string of characters, the length and the meaning of each character being defined by the value of the text coding scheme information element. There shall be at least two characters and maximum 20 characters in the mnemonic name. The receiving entity needs to know at least the size of characters in order to properly decode this information element.				

6.3.8 DMO group status

The DMO group status information element shall be encoded as defined in table 6.19.

Table 6.19: DMO group status information element contents

Information element	Length	Type	Value	Remark
DMO group status	3	1	0	Assigned DMO group
			1	Default DMO group
			2	Preferred DMO group
			3	Selected DMO group, see note
			4	Reserved
			5	Reserved
			6	Reserved
			7	Reserved
NOTE: This value is applicable only for a status change to force a selection of a DMO group and it does not change the DMO group status, refer to 5.1.5.				

6.3.9 DMO group status change type

The DMO group status change type information element shall be encoded as defined in table 6.20.

Table 6.20: DMO group status change type information element contents

Information element	Length	Type	Value	Remark
DMO group status change type	4	1	0	No change defined by this information element
			1	Change default DMO group to a preferred DMO group
			2	Change default DMO group to an assigned DMO group
			3	Change default and preferred DMO groups to assigned DMO groups
			4	Reserved
			etc.	etc.
			15	Reserved

6.3.10 Encryption key number

The Encryption key number information element shall be encoded as defined in table 6.21.

Table 6.21: Encryption key number information element contents

Information element	Length	Type	Value	Remark
Encryption key number	5	1	0	SCKN = 1
			1	SCKN = 2
			etc.	etc.
			31	SCKN = 32

6.3.11 Group Short Subscriber Identity

The Group Short Subscriber Identity information element shall be encoded as defined in table 6.22.

Table 6.22: Group Short Subscriber Identity information element contents

Information element	Length	Value	Remark
Group Short Subscriber Identity	24		See EN 300 392-1 [1], clause 7

6.3.12 Interrogate range

The Interrogate range start number and Interrogate range stop number information elements shall be encoded as defined in table 6.23.

Table 6.23: Interrogate type information element contents

Information element	Length	Type	Value	Remark
Interrogate range start/stop number	10	M	0	Reserved
			1	Group 1
			etc.	etc.
			1023	Group 1 023

6.3.13 Interrogate type

The Interrogate type information element shall be encoded as defined in table 6.24.

Table 6.24: Interrogate type information element contents

Information element	Length	Type	Value	Remark
Interrogate type	4	M	0	Range of DMO groups
			1	Default DMO group
			2	Preferred DMO groups
			3	Default DMO group and preferred DMO groups
			4	Assigned DMO groups
			5	Default DMO group and assigned DMO groups
			6	Preferred DMO groups and assigned DMO groups
			7	All DMO groups, see note
			8	DOTAM control groups
			9	Reserved
			etc.	etc.
			15	Reserved
NOTE: "All groups" means DMO groups with status values "default DMO group", "preferred DMO group" and "assigned DMO group". It does not contain DOTAM control groups nor any groups that are defined by other means than DOTAM.				

6.3.14 Maximum response time

The Maximum response time information element shall be encoded as defined in table 6.25.

Table 6.25: Maximum response time information element contents

Information element	Length	Type	Value	Remark
Maximum response time	8	M	0	No response time set
			1	1 min
			2	2 min
			etc.	etc. steps of 1 min
			60	1 h
			61	2 h
			etc.	etc. steps of 1 h
			83	24 h
			85	Reserved
			etc.	etc.
			255	Reserved

6.3.15 Mobile Network Identity

Mobile Network Identity information element shall be encoded as defined in table 6.26.

Table 6.26: Mobile Network Identity information element contents

Information element	Length	Value	Remark
Country code	10		See EN 300 392-1 [1], clause 7
Network code	14		See EN 300 392-1 [1], clause 7

6.3.16 PDU type

The PDU type information element shall be encoded as presented in table 6.27.

Table 6.27: PDU type information element contents

Information element	Length	Value	Remark
PDU type	5	0	Reserved (Supplementary service not supported), see note
		1	Action not supported, see note
		2	Reserved (ISI problem), see note
		3	Reserved, see note
		4	Reserved, see note
		5	ASSIGN
		6	ASSIGN ACK
		7	INTERROGATE
		8	INTERROGATE ACK
		9	CHANGE STATUS
		10	CHANGE STATUS ACK
		11	DEASSIGN
		12	DEASSIGN ACK
		13	DOTAM GROUP PROVIDE
		14	DOTAM GROUP PROVIDE ACK
		15	INTERROGATE DOTAM CONTROL GROUP ACK
		16	Reserved
		etc.	etc.
		31	Reserved
NOTE: Values are aligned with supplementary services generic PDU contents, refer to EN 300 392-9 [3].			

6.3.17 Reserved information element present

The Reserved information element present information element shall be encoded as defined in table 6.28.

Table 6.28: Reserved information element present information element contents

Information element	Length	Type	C/O/M	Value	Remark
Reserved information element present	1	1	M	0	The reserved information element is not present, see note
				1	The reserved information element is present
NOTE: Only value "0" shall be used as the reserved information element is a place holder.					

6.3.18 Result code

The Result code information element shall be encoded as defined in table 6.29.

Table 6.29: Result code information element contents

Information element	Length	Value	Remark
Result code	5	0	Success, action completed
		1	Success, more information to follow
		2	Failure, memory full
		3	Failure, unknown DMO group
		4	Failure, MS prevented assignment, deassignment or status change
		5	Failure, status "preferred group" not allowed for that group
		6	Failure, status "default group" not allowed for that group
		7	Failure, syntax error
		8	Failure, requested frequency not allowed
		9	Failure, more information to follow
		10	Failure, range interrogation not supported
		11	Failure, range outside DMO group assignments in the MS
		12	Warning, encryption key not present and/or air interface encryption setting not supported
		13	Assignment successful, but status is set to assigned
		14	Not supported action
		15	Not supported information element value
		16	Reserved
		17	Reserved
		etc.	etc.
		31	Reserved
NOTE: When failure reasons are used as an overall reason, then those normally mean "One or more instance of the specified reason in the following list, if the list is included". The list may then contain both successful and failed items with various reasons.			

6.3.19 Type 5 element identifier (informative)

Type 5 element identifier information element shall define information contents of the information element as presented in table 6.30.

NOTE: The type 5 elements are currently not used in any of the PDUs of the present document.

Table 6.30: Type 5 element identifier information element contents

Information element	Length	Value	Remark
Type 5 element identifier	5	0	Reserved
		1	Reserved
		2	Reserved
		etc.	etc.
		30	Reserved
		31	Extended type 5 information element, see note
NOTE: Extension encoding is outside the scope of the present document. The extended type 5 information element shall be ignored, if the extension is not supported.			

6.3.20 Unique DMO group identifier

The Unique DMO group identifier information element shall be encoded as defined in table 6.31.

Table 6.31: Unique DMO group identifier information element contents

Information element	Length	Type	C/O/M	Value	Remark
Group short subscriber identity	24	1	M		
MNI extension indicator	1	1	M	0	Mobile Network Identifier is not present
				1	Mobile Network Identifier is present
Mobile Network Identifier	24		C		
Additional DMO group identifier	2	1	M		See note 1
Reserved	3	1	M		Reserved, note 2
DMO frequency	18	1	M		
NOTE 1: The Additional DMO group identifier information element can be used to separate DMO groups that use the same GTSI and DMO frequency, but have other parameters different. Default value is zero.					
NOTE 2: Reserved bits shall be set to zero.					

6.4 Type 5 information element description (informative)

NOTE: The type 5 elements are currently not used in any of the PDUs of the present document.

6.4.1 Type 5 information element definition

Type 5 information element coding modifies PDU encoding principles so that the type 5 information element replaces both type 2 and type 3/4 information elements. In a PDU using type 5 information elements there cannot be any type 2 or type 3/4 information elements and so no O-bit nor M-bit shall be used. PDU end is indicated by length information element.

Type 5 information element length can be from 1 bit to 63 bits in one bit steps and from 64 bits to 1 080 bits in 8 bits (octet) steps.

6.4.2 Type 5 element length

The type 5 element length information element shall be encoded as presented in table 6.32.

Table 6.32: Type 5 element length information element contents

Information element	Length	Value	Remark
Type 5 element length	6	000000_2	Type 5 length extension
		000001_2	Element data length is one bit
		000010_2	Element data length is two bits
		etc.	etc.
		111111_2	Element data length is 63 bits

6.4.3 Type 5 element length extension

The type 5 element length extension information element shall be encoded as presented in table 6.33.

Table 6.33: Type 5 element length extension information element contents

Information element	Length	Value	Remark
Type 5 element length extension	7	0000000_2	Reserved
		00000001_2	Element data length is eight octets
		0000010_2	Element data length is nine octets
		etc.	etc.
		1111111_2	Element data length is 135 octets

6.4.4 Type 5 information element

The type 5 information elements shall be encoded as presented in table 6.34.

Table 6.34: Type 5 information element

Information element	Length	Type	C/O/M	Remark
Type 5 element identifier	5	1	M	Shall be unique per SDS-TL Protocol ID
Type 5 element length	6	1	M	
Type 5 element length extension	7		C	Shall be present, if and only if type 5 element length has value "000000"
Extended type 5 information element	See note 1		C	Shall be present, if and only if type 5 element identifier value is "11111"
Element data	variable	1	M	See note 2
NOTE 1: The length of the Extended type 5 information element will be defined in a later version of the present document.				
NOTE 2: In the case the type 5 element length extension is used and the length of the actual element data is not octet bounded the element data shall contain fill bits at the end, the fill bits shall have value "1". Fill bit value one allows Binary Coded Decimal presentation of numbers as value "1111" is reserved in TETRA protocols.				

7 Interactions with other services

7.1 Direct mode

DOTAM protocol shall be performed in trunked mode i.e. in V+D mode. MS shall ignore any DOTAM messages received in Direct Mode Operation. This shall include messages received via a Direct Mode Operation gateway.

7.2 Direct mode dual watch

MS shall be considered to be in V+D mode while performing DOTAM protocol. When MS has accepted and stored a group definition in V+D mode, it will be in force on the next mode change to DMO mode.

It is outside of the present document whether MS changes to V+D mode, when it receives a DOTAM message in dual watch.

It is outside of the present document whether a change of group status affects to the listened DMO group in Dual Watch.

7.3 Intersystem interface

DOTAM services may be used via intersystem interface. Air interface security level shall be considered as defined for ISI services, refer to EN 300 392-7 [7].

Annex A (normative): Service or action not supported U/D FACILITY PDU option

If the DOTAM protocol or any DOTAM PDU indicated as a DOTAM DPU is not supported, then EN 300 392-9 [3] clause 8.2 shall apply.

EXAMPLE: If the DOTAM GROUP PROVIDE PDU is not supported, then the U-FACILITY PDU sent to the same SwMI will be encoded as defined in table A.1.

Table A.1: U-FACILITY PDU for action not supported contents

Information element	Length	Type	C/O/M	Value	Remarks
PDU type	5	1	M	16	U-FACILITY, see note 1
Routeing	2	1	M	0	See note 2
Number of SS PDUs	4	1	M	1	
Length indicator	11	1	C	17	See note 3
SS type	6	1	C	25	DOTAM, see note 4
SS PDU type	5	1	C	1	Action not supported
DOTAM PDU type	5	1	C	13	DOTAM GROUP PROVIDE
NOTE 1: Equal to the binary value 10000_2, as defined in clause 14.4.28 of EN 300 392-2 [2].					
NOTE 2: The meaning of the information element routeing shall be the following: - same SwMI, if its binary value is equal to 00_2.					
NOTE 3: The length defines the total length of the "SS type", "SS PDU type", "DOTAM PDU type" and SS PDU related O-bit, refer to clause E.1.2 of EN 300 392-2 [2].					
NOTE 4: The value is provisionally set to 25, refer to EN 300 392-9 [3], clause 7.3.					

Annex B (normative): Service or action not supported SDS-TL PDU option

If any DOTAM PDU is not supported, then MS should return an Action not supported PDU containing the DOTAM PDU type that is not supported.

EXAMPLE: If the DOTAM GROUP PROVIDE PDU is not supported, then the DOTAM PDU will be encoded as defined in table B.1.

Table B.1: Action not supported DOTAM PDU contents

Information element	Length	Type	C/O/M	Value	Remarks
PDU type	5	1	C	1	Action not supported
DOTAM PDU type	5	1	C	13	DOTAM GROUP PROVIDE

Annex C (informative): Change Requests

The Change Requests defined in the table C.1 have been included into the present version of the present document.

Table C.1: Change Requests

No	CR version	Standard Version	Clauses affected	Title	CR Status
001	11	V1.1.1	6.2.10	Error in INTERROGATE ACK PDU	WG3 approved 091217
002	11	V1.1.1	3.1, 4.1, 5.1.5, 5.1.9, 5.5.5, 6.2.10, 6.3.8, 6.3.9, 6.3.12	Clarification on the DMO group states	WG3 approved 100426
003	11	V1.1.1	2.2, 4.3.5, 5.1.9 (new), 5.2.7, 5.3.1, 5.3.2, 5.3.3, 5.5.7, 6.1, 6.3.12 (new)	Clarification on DOTAM protocol and editorial corrections	WG3 approved 100520
004	11	V1.1.1	4.3.3, 5.2.3, 5.2.6, 5.3.1, 5.3.2, 5.3.3, 5.5.6, 5.5.7, 6.2.11, 6.3.16	Addition of missing control group interrogation ack	WG3 approved 100901
005	11	V1.1.1	6.3.18 (ex. 6.3.17)	An inconsistency of in the GROUP PROVIDE PDU	WG3 approved 100901

History

Document history		
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V1.2.1	December 2010	Publication