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# Digital cellular telecommunications system (Phase 2+); Mobile radio interface signalling layer 3; General aspects (GSM 04.07 version 5.2.1)

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## Foreword

This second edition European Telecommunication Standard (ETS) has been produced by the Special Mobile Group (SMG) of the European Telecommunications Standards Institute (ETSI).

This ETS defines the architecture of layer 3 and its sublayers on the GSM Um interface, i.e. the interface between Mobile Station and network within the digital cellular telecommunications system (Phase 2+).

The specification from which this ETS has been derived was originally based on CEPT documentation, hence the presentation of this ETS may not be entirely in accordance with the ETSI drafting rules.

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# 1 Scope

This European Telecommunication Standard (ETS) defines the principal architecture of layer 3 and its sublayers on the GSM Um interface, i.e. the interface between Mobile Station (MS) and network; for the CM sublayer, the description is restricted to paradigmatic examples, call control, supplementary services, and short message services. It also defines the basic message format and error handling applied by the layer 3 protocols.

The corresponding protocols are defined in other Technical Specifications, see subclause 4.3.4.

The communication between sublayers and adjacent layers and the services provided by the sublayers are distributed by use of abstract service primitives. But only externally observable behaviour resulting from the description is normatively prescribed by this Technical Specification.

# 2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

[1] GSM 01.04 (ETR 350): "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 03.01: "Digital cellular telecommunications system (Phase 2+); Network functions".

[3] GSM 04.01: "Digital cellular telecommunications system; Mobile Station - Base Station System (MS - BSS) interface General aspects and principles".

[4] GSM 04.05 (ETS 300 937): "Digital cellular telecommunications system; Data Link (DL) layer General aspects".

[5] GSM 04.06 (ETS 300 938): "Digital cellular telecommunications system; Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[6] GSM 04.08 (ETS 300 940): "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[7] GSM 04.10 (ETS 300 941): "Digital cellular telecommunications system; Mobile radio interface layer 3 Supplementary services specification General aspects".

[8] GSM 04.11 (ETS 300 942): "Digital cellular telecommunications system (Phase 2+); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[9] GSM 04.80 (ETS 300 950): "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 supplementary services specification Formats and coding".

[10] GSM 04.81 (ETS 300 951): "Digital cellular telecommunications system; Line identification supplementary services - Stage 3".

[11] GSM 04.82 (ETS 300 952): "Digital cellular telecommunications system; Call Forwarding (CF) supplementary services - Stage 3".

[12] GSM 04.83 (ETS 300 953): "Digital cellular telecommunications system; Call Waiting (CW) and Call Hold (HOLD) supplementary services - Stage 3".

[13] GSM 04.84 (ETS 300 954): "Digital cellular telecommunications system; MultiParty (MPTY) supplementary services - Stage 3".

[14] GSM 04.85: "Digital cellular telecommunications system; Closed User Group (CUG) supplementary services - Stage 3".

[15] GSM 04.86 (ETS 300 955): "Digital cellular telecommunications system; Advice of Charge (AoC) supplementary services - Stage 3".

[16] GSM 04.88 (ETS 300 956): "Digital cellular telecommunications system; Call Barring (CB) supplementary services - Stage 3".

[17] GSM 04.90 (ETS 300 957): "Digital cellular telecommunications system; Unstructured supplementary services operation - Stage 3".

[18] CCITT Recommendation X.200: "Reference Model of Open systems interconnection for CCITT Applications".

# 3 Abbreviations

Abbreviations used in this ETS, are listed in GSM 01.04.

For the purposes of this ETS, the following abbreviations applies:

MNS Mobile Network Signalling

# 4 Introduction

## 4.1 General

The signalling layer 3 provides the functions necessary

- for Radio Resource (RR) management;
- for Mobility Management (MM); and
- for the Connection Management (CM) functions, i.e. functions for the control, provision, and support of services offered by the network; among which there are, e.g.:
    - the functions to establish, maintain and terminate circuit-switched connections across a GSM PLMN and other networks to which the GSM PLMN is connected;
    - supporting functions for supplementary services control;
    - supporting functions for short messages service control.

The signalling layer 3 is composed of three sublayers comprising:

- the Radio Resource Management (RR) functions;
- the Mobility Management (MM) functions; and
- the Connection Management (CM) functions.

The Connection Management (CM) sublayer is composed of functional blocks for:

- Call Control (CC);
- Short Message Service Support (SMS);
- Supplementary Services Support (SS);
- Group Call Control;
- Broadcast Call Control (BCC);
- Connection Management of Packet Data on Signalling channels.

This Technical Specification does not consider the distribution of signalling functions among the different network equipments. The signalling functions are described between two systems which represent the MS side and the network side of the radio interface of layer 3. Only the functions in the network for signalling communication with one MS is considered.

### 4.2 Applicability of functional blocks

Not for all functional blocks listed in subclause 4.1, support in the MS or in the network is mandatory:

- Support of Group Call Control is optional in the MS and in the network.
- Support of Broadcast Call Control is optional in the MS and in the network.
- Connection Management of Packet Data on Signalling channels. is optional in the MS and in the network.

Further conditions and constraints are defined in other Technical Specifications.

### 4.3 Technique of description

Signalling layer 3 and its sub-layers are specified by:

- their service specification, see subclause 4.3.1;
- their protocol specification, see subclause 4.3.3;
- the specification of functions, see clause 5.

#### 4.3.1 Service description

The services of signalling layer 3 and its sublayers are described in terms of:

- services provided to upper (sub-)layers at the service access points;
- services assumed from lower (sub-)layers at the service access points;

Layer 3 and its supporting lower layers provide the Mobile Network Signalling (MNS) Service to the upper layers.

The service provided/assumed at the service access points are described by means of abstract service primitives and parameters as recommended in CCITT Recommendation X.200.

#### 4.3.2 Abstract service primitives

The abstract service primitives consist of requests, responses, indications and confirmations. The general syntax of a primitive is specified in GSM 04.01.

#### 4.3.3 Protocols and peer-to-peer communication

By use of the services provided by lower (sub-)layers, peer entities in a (sub-)layer in the MS and the network exchange information. Exchange of information between two peer entities is performed according to the corresponding (sub-)layer protocols. A protocol is a set of rules and formats by which the information (control information and user data) is exchanged between the two peers. The information is exchanged by use of messages which are defined in the protocol. (Therefore, the messages are also called Protocol Data Units, PDUs).

There is a protocol of the RR sublayer, a protocol of the MM sublayer, and several protocols of the CM sublayer: for each functional block of the CM sublayer as defined in subclause 4.1 there is one protocol. The CM protocols are specified in the Technical Specifications identified in subclause 4.3.4.

In the model used in this ETS, there is:

- one RR sub-layer entity in the MS and one RR sub-layer entity in the network;

- one MM sub-layer entity in the MS and one MM sub-layer entity in the network;

- for each functional block of the CM sublayer as defined in subclause 4.1 which is supported in the MS (in the network), there are, depending on the protocol, one or more entities in the MS (in the network). Two different entities of the same functional block in the MS (in the network) are called parallel entities. The entities of the same functional block in the MS correspond in a one-to-one relation to the entities of the functional block in the network. The corresponding entities are called peer entities.

As each sub-layer entity is specified by one and only one protocol, it is also called a protocol entity or protocol control entity.

When two peer protocol entities exchange PDUs, a transaction is said to be established (or: to be active; or: to exist). It depends from the protocol when exactly a protocol entity considers the transaction to be active, normally this is the case.

- from the moment when it has passed the first suitable message to lower (sub-) layers or received the first suitable message from its peer entity.

up to the moment when it has released the transaction.

#### 4.3.4 Contents of signalling layer 3 related Technical Specifications

The Radio Resource (RR) management protocol is defined in GSM 04.08:
- the Mobility Management (MM) protocol is defined in GSM 04.08;
- the Call Control (CC) protocol is defined in GSM 04.08;
- the Supplementary Services (SS) protocol is defined in GSM 04.10, GSM 04.8x and GSM 04.9x;
- the Short Message Service (SMS) protocol is defined in GSM 04.11;
- the Group Call Control (GCC) protocol is defined in GSM 04.68;
- the protocols for Packet Data on Signalling channels (PDS), PDSS1 and PDSS2, are defined in GSM 04.63.

## 5 Structure of signalling layer 3 functions

### 5.1 Basic groups of functions

Most functions of signalling layer 3 and its sub-layers are described by the service specifications and protocol specifications of the (sub-)layers.

These functions are in the model realized by protocol control entities, see subclause 4.3.3.

In addition, routing functions are contained in layer 3 which are related to the transport of messages, e.g. multiplexing and splitting. These routing functions are defined in the Radio Resource Management and Mobility Management sub-layers.

1) They have the task to pass the messages from upper (sub-)layers to lower (sub-)layers.

2) They also have the task to pass messages provided by lower (sub-layers) to the appropriate sub-layer and, if applicable, entity.

The routing functions with task 2 make use of the protocol discriminator (PD) which is part of the message header.

A CM sublayer protocol may also define a transaction identifier (TI) as a part of the message header. This is at least the case if there are parallel entities of the same functional block, see subclause 4.3.3. If it is a part of a message, the TI is also used by the routing functions.

- The MM routing function passes the messages of the CM entities as well as of the MM entity of its own sublayer to the service access point of RR and multiplexes them in case of parallel transactions.

- The routing function of Radio Resource Management distributes the messages to be sent according to their protocol discriminator (PD), to the actual channel configuration, and, if applicable, to further information received from upper sub-layers to the appropriate service access point of layer 2 (identified by SAPI and logical channel).

- The messages provided at the different service access points of layer 2 are distributed by the RR routing function according to their protocol discriminator (PD). Messages with a PD equal to RR are passed to the RR entity of the own sublayer, all other messages are passed to the MM sublayer at the service access point RR-SAP.

- The routing function of MM passes the messages according to the protocol discriminator (PD) and, if applicable, the transaction identifier (TI) towards the MM entity or towards the CM entities via the various MM-SAP's.

The message (message header or other parts of the message) are neither changed nor removed by the RR routing function or MM routing function before passing it to the appropriate service access point.

Figure 5.1 shows the protocol architecture, restricting the representation of CM sublayer protocols to three paradigmatic examples, CC, SS, and SMS.

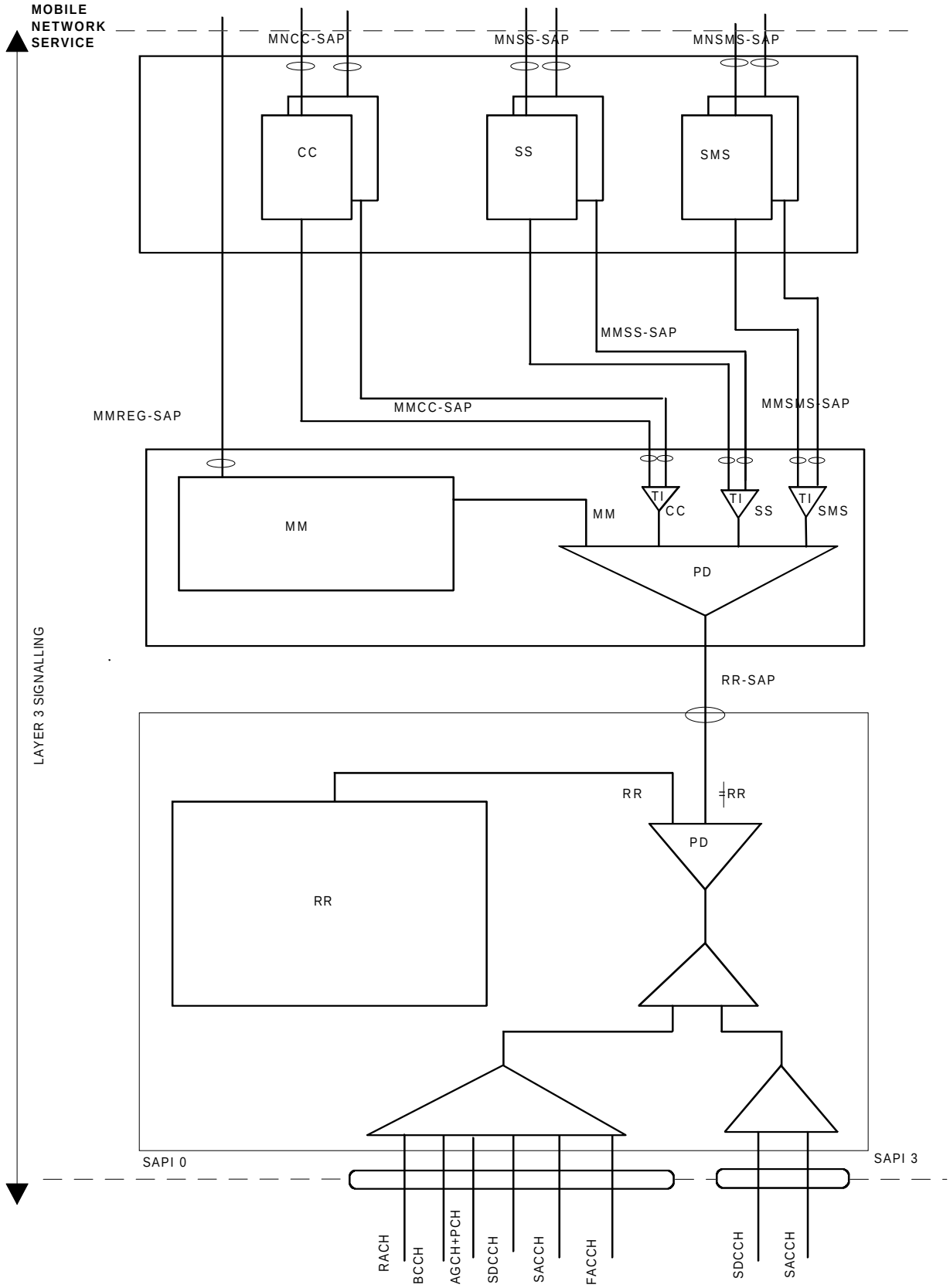



**Figure 5.1: Protocol Architecture of Signalling Layer 3 - MS side**

### 5.2 Protocol architecture

As shown in figure 5.1 a hierarchy of 3 sublayers is defined:

- the RR sublayer provides services to the MM sublayer and utilizes the services of signalling layer 2;
- the MM sublayer provides common services to the entities of the Connection Management (CM) sublayer;
- the CM sublayer includes, among others, the CC, SS, and SMS entities, which are independent entities.

## 6 Services provided by signalling layer 3 at the MS side

The different classes of services provided by signalling layer 3 at the MS side are accessible at the following service access points:

- registration services at the MMREG-SAP;
- Call Control services for normal and emergency calls including call related Supplementary Services Support services at the MNCC-SAP;
- Short Message Services Support services at the MNSMS-SAP;
- Call independent Supplementary Services Support services at the MNSS-SAP;
- other services corresponding to further functional blocks of the CM sublayer at the appropriate service access points. These services are not further described in this clause.

### 6.1 Registration services

The registration services (location updating, IMSI attach/detach) are provided at the service access point MMREG-SAP. As opposed to all other MN-Services, these services are provided by and can be directly accessed at the Mobility Management sublayer.

#### 6.1.1 Service state diagram

The registration services provided at the service access point MMREG-SAP are illustrated in the state of figure 6.1 below.

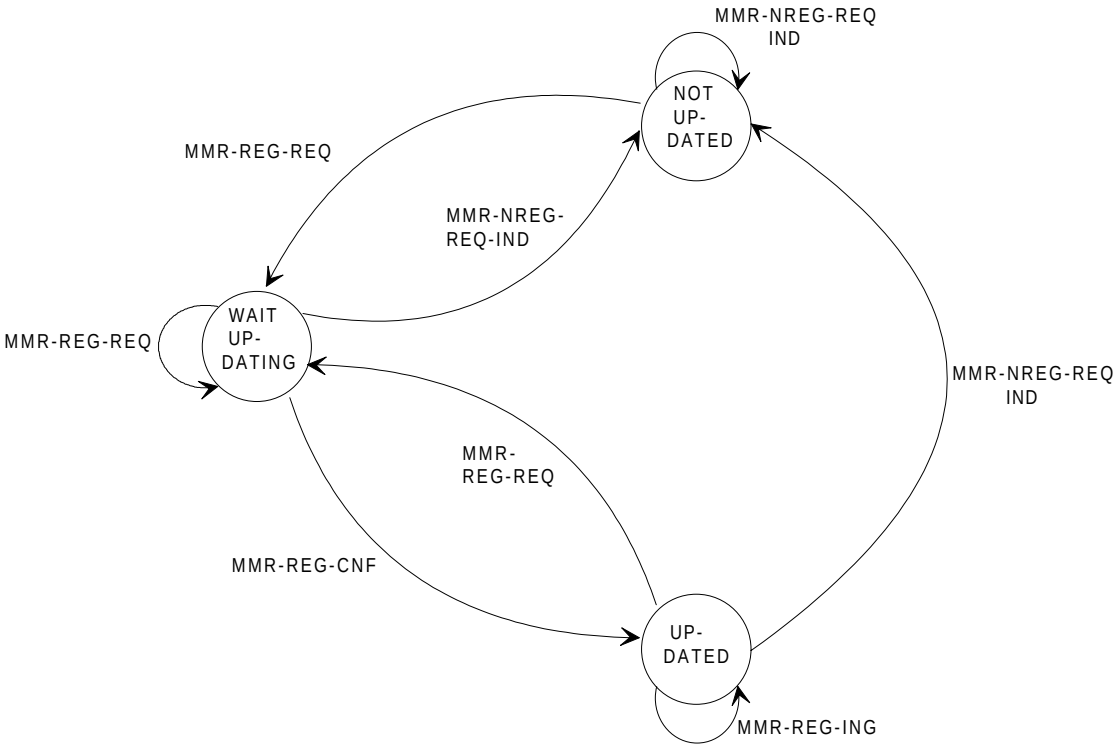



**Figure 6.1: Registration services provided at MMREG-SAP - MS side**

### 6.1.2 Service primitives

**Table 6.1: Primitives and Parameters at the MMREG-SAP - MS side**

| PRIMITIVE | PARAMETER | REFERENCE |
|---|---|---|
| MMR_REG_REQ | IMSI | 6.1.2.1 |
| MMR_REG_CNF | - | 6.1.2.2 |
| MMR_NREG_REQ | - | 6.1.2.4 |
| MMR_NREG_IND | cause | 6.1.2.5 |

#### 6.1.2.1 MMR_REG_REQ

Registration request, triggered by activation of the IMSI, e.g., by activation of the MS with inserted SIM, insertion of the SIM into the activated MS, pressing of a reset button.

#### 6.1.2.2 MMR_REG_CNF

Registration confirmation. Indicates to the user that the MS is ready to start a transaction.

#### 6.1.2.3 [reserved]

#### 6.1.2.4 MMR_NREG_REQ

Request to cancel the registration, stimulated either by removing the SIM or automatically in the power off phase.

#### 6.1.2.5 MMR_NREG_IND

Indication that registration has been cancelled or that registration was not possible. Only emergency services are available to the user.

## 6.2 Call Control services

The Call Control services are provided by multiple CC entities at the service access point MNCC-SAP.

The Call Control service class consists of the following services:

- Mobile originated and Mobile terminated call establishment for normal calls;
- Mobile originated call establishment for emergency calls;
- call maintaining;
- call termination;
- call related Supplementary Services Support.

### 6.2.1 Service state diagram

The Call Control services provided at the service access point MNCC-SAP are illustrated in the state diagram of figure 6.2.

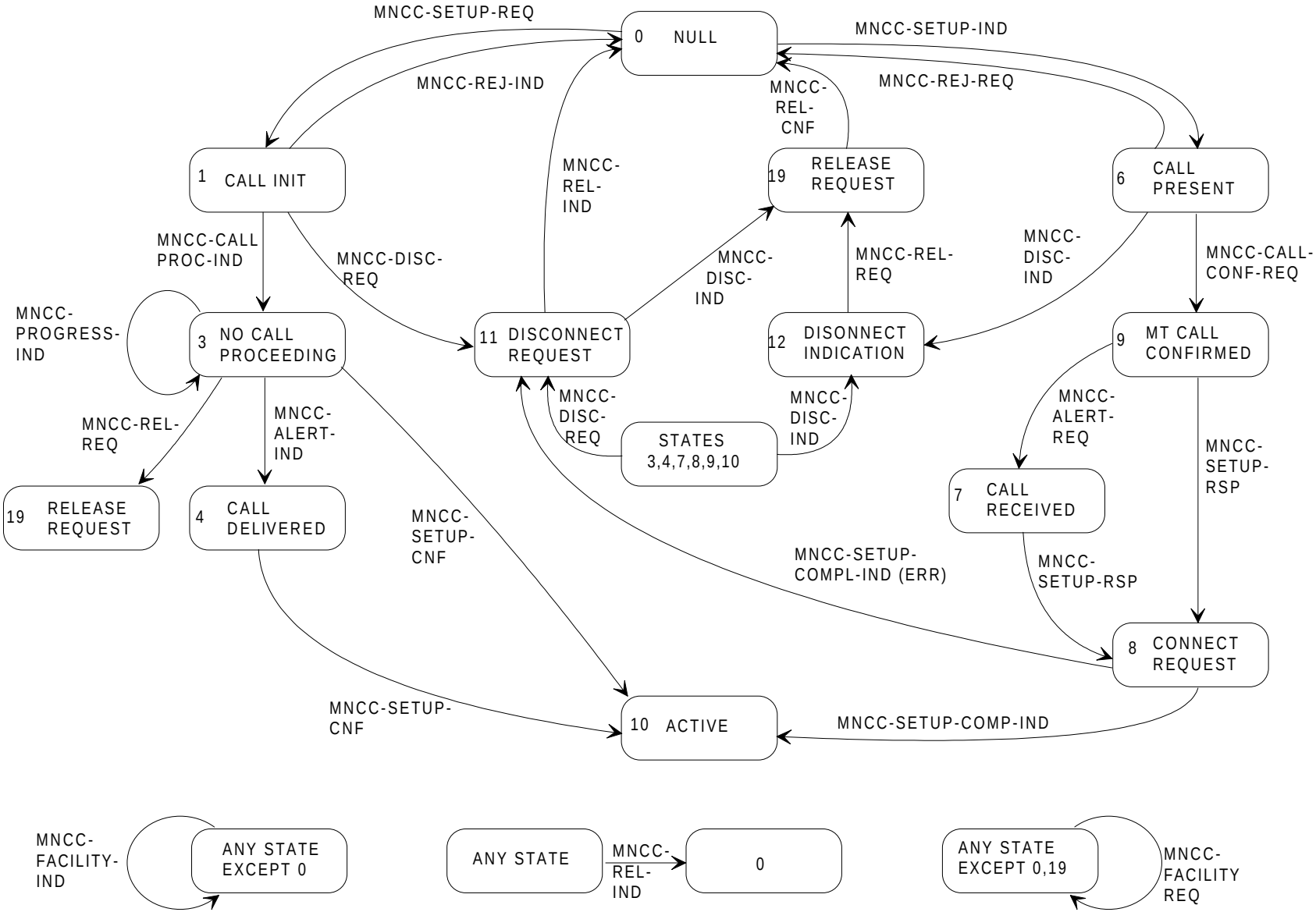



**Figure 6.2: Service graph of Call Control entity - MS side (page 1 of 2)**

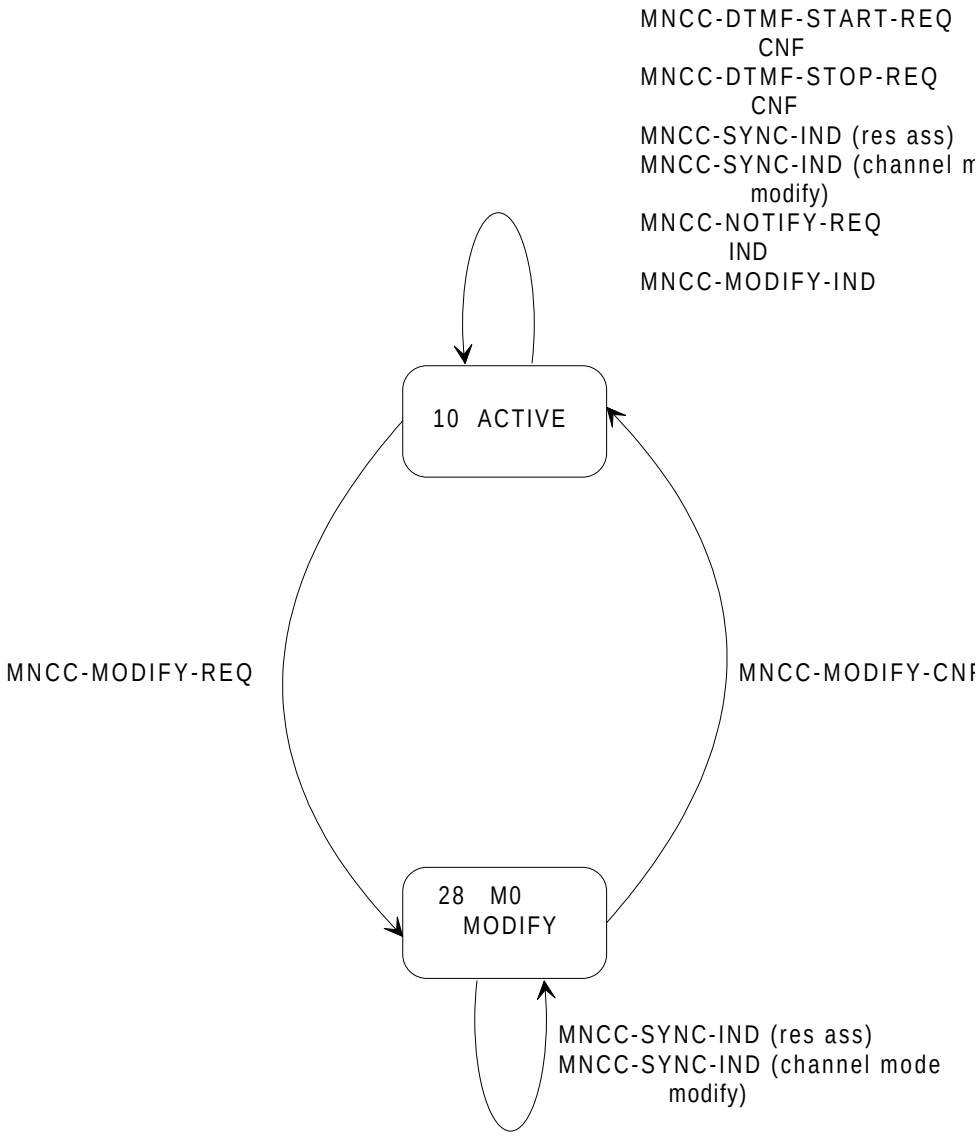



**Figure 6.2: Service graph of Call Control entity - MS side Active state (page 2 of 2)**

### 6.2.2 Service primitives

**Table 6.2: Primitives and parameters at MNCC-SAP - MS side**

| PRIMITIVE | PARAMETER (message, info elements of message, other parameters) | REFERENCE |
|---|---|---|
| MNCC_SETUP_REQ | SETUP or EMERGENCY SETUP | 6.2.2.1 |
| MNCC_SETUP_IND | SETUP | 6.2.2.2 |
| MNCC_SETUP_RSP | CONNECT | 6.2.2.3 |
| MNCC_SETUP_CNF | CONNECT | 6.2.2.4 |
| MNCC_SETUP_COMPLETE_REQ | - | 6.2.2.5 |
| MNCC_SETUP_COMPLETE_IND | - | 6.2.2.6 |
| MNCC_REJ_REQ | RELEASE COMPLETE | 6.2.2.7 |
| MNCC_REJ_IND | cause | 6.2.2.8 |
| MNCC_CALL_CONF_REQ | CALL CONFIRMED | 6.2.2.9 |
| MNCC_CALL PROC_IND | CALL PROCEEDING | 6.2.2.10 |
| MNCC_PROGRESS_IND | PROGRESS | 6.2.2.11 |
| MNCC_ALERT_REQ | ALERTING | 6.2.2.12 |
| MNCC_ALERT_IND | ALERTING | 6.2.2.13 |
| MNCC_NOTIFY_REQ | NOTIFY | 6.2.2.14 |
| MNCC_NOTIFY_IND | NOTIFY | 6.2.2.15 |
| MNCC_DISC_REQ | DISCONNECT | 6.2.2.16 |
| MNCC_DISC_IND | DISCONNECT | 6.2.2.17 |
| MNCC_REL_REQ | RELEASE | 6.2.2.18 |
| MNCC_REL_IND | RELEASE | 6.2.2.19 |
| MNCC_REL_CNF | RELEASE or RELEASE COMPLETE | 6.2.2.20 |
| MNCC_FACILITY_REQ | facility | 6.2.2.21 |
| MNCC_FACILITY_IND | facility | 6.2.2.22 |
| MNCC_START_DTMF_REQ | START DTMF | 6.2.2.23 |
| MNCC_START_DTMF_CNF | START DTMF ACK or START DTMF REJ | 6.2.2.24 |
| MNCC_STOP_DTMF_REQ | STOP DTMF | 6.2.2.25 |
| MNCC_STOP_DTMF_CNF | STOP DTMF ACK | 6.2.2.26 |
| MNCC_MODIFY_REQ | MODIFY | 6.2.2.27 |
| MNCC_MODIFY_IND | MODIFY | 6.2.2.28 |
| MNCC_MODIFY_RES | MODIFY COMPLETE | 6.2.2.29 |
| MNCC_MODIFY_CNF | MODIFY COMPLETE | 6.2.2.30 |
| MNCC_SYNC_IND | cause (res. ass., channel mode modify) | 6.2.2.31 |

#### 6.2.2.1 MNCC_SETUP_REQ

Request to send a SETUP or EMERGENCY SETUP message to initiate Mobile originating establishment of either a normal or an emergency call.

#### 6.2.2.2 MNCC_SETUP_IND

Receipt of a SETUP message, the Mobile terminated call establishment has been initiated.

#### 6.2.2.3 MNCC_SETUP_RES

Response to send a CONNECT message to indicate call acceptance by the Mobile terminated user; call control is requested to attach the user connection (if it is not yet attached).

#### 6.2.2.4 MNCC_SETUP_CNF

Receipt of a CONNECT message, the Mobile originated call has been accepted by the remote called user.

#### 6.2.2.5 MNCC_SETUP_COMPL_REQ

Request to send a CONNECT ACKNOWLEDGE message, the mobile originating call has been accepted.

#### 6.2.2.6 MNCC_SETUP_COMPL_IND

Receipt of a CONNECT ACKNOWLEDGE message, the Mobile terminated call establishment has been completed; for a data call, the user is informed that the user connection is attached.

#### 6.2.2.7 MNCC_REJ_REQ

Request to reject a Mobile terminated call if the call is refused or if the call cannot be accepted, e.g., because of missing compatibility.

#### 6.2.2.8 MNCC_REJ_IND

Indication that the Mobile originated call has been rejected, e.g. if the MM connection cannot be provided or if the call establishment initiation has been rejected by the network.

#### 6.2.2.9 MNCC_CALL_CONF_REQ

Request to confirm a Mobile terminated call by sending a CALL CONFIRMED message. A bearer capability different from that given in MNCC_SETUP_IND may be offered to the remote calling user.

#### 6.2.2.10 MNCC_CALL_PROC_IND

Indication to the Mobile originating user that call establishment has been initiated in the Network and no more call establishment information will be accepted by the Network.

#### 6.2.2.11 MNCC_PROGRESS_IND

Indication to the Mobile user that a PROGRESS message or a message containing a *progress* IE has been received, e.g., because the call is progressing in the PLMN/ISDN environment, or because the call has left the PLMN/ISDN environment, or because in-band tones/announcement are available.

#### 6.2.2.12 MNCC_ALERT_REQ

Request to send an ALERTING message from the called Mobile user to the remote calling user to indicate that user alerting has been initiated.

#### 6.2.2.13 MNCC_ALERT_IND

Indication of the receipt of an ALERTING message, alerting to the remote called user has been initiated.

#### 6.2.2.14 MNCC_NOTIFY_REQ

Request to send information pertaining to a call, such as user suspended, to the Network by the Mobile user.

#### 6.2.2.15 MNCC_NOTIFY_IND

Indication to the Mobile user that information pertaining to a call, such as remote user suspended, has been received from the Network.

#### 6.2.2.16 MNCC_DISC_REQ

Request to send a DISCONNECT message to the Network in order to clear the end-to-end connection.

#### 6.2.2.17 MNCC_DISC_IND

Indication of reception of a DISCONNECT message, by which the Network indicates that the end-to-end connection is cleared.

#### 6.2.2.18 MNCC_REL_REQ

Request of the Mobile user to send a RELEASE message to inform the Network that the user intends to release the call reference and the corresponding MM connection so that the Network can release its MM connection and the correspondent call reference.

#### 6.2.2.19 MNCC_REL_IND

Indication to the Mobile originating or terminated user that a RELEASE message has been received and the Network intends to release its MM connection. The Mobile user is requested to release the call reference and the corresponding MM connection.

#### 6.2.2.20 MNCC_REL_CNF

Confirmation of the Mobile user's request to release the MM connection and call reference in the Network. The Mobile user may release the call reference and the corresponding MM connection.

#### 6.2.2.21 MNCC_FACILITY_REQ

Request to transport a *facility* IE for a call related supplementary service invocation.

#### 6.2.2.22 MNCC_FACILITY_IND

Indication that a *facility* IE for a call related supplementary service invocation has been received.

#### 6.2.2.23 MNCC_START_DTMF_REQ

Request to send a START DTMF message in order to start a DTMF control operation.

#### 6.2.2.24 MNCC_START_DTMF_CNF

Confirmation of the receipt of a START DTMF ACKNOWLEDGE or START DTMF REJECT message that the start of a DTMF control operation has been acknowledged or rejected.

#### 6.2.2.25 MNCC_STOP_DTMF_REQ

Request to send a STOP DTMF message in order to stop a DTMF control operation.

#### 6.2.2.26 MNCC_STOP_DTMF_CNF

Confirmation of the receipt of STOP DTMF ACKNOWLEDGE message, the DTMF control operation has been stopped.

#### 6.2.2.27 MNCC_MODIFY_REQ

Request to start Mobile originating in-call modification by sending a MODIFY message.

#### 6.2.2.28 MNCC_MODIFY_IND

RECEIPT OF A MODIFY message, a Mobile terminating in-call modification has been initiated.

#### 6.2.2.29 MNCC_MODIFY_RES

Response to send a MODIFY COMPLETE message to indicate Mobile terminating in-call modification completion by the Mobile user.

#### 6.2.2.30 MNCC_MODIFY_CNF

Receipt of a MODIFY COMPLETE message, the Mobile originating in-call modification has been completed.

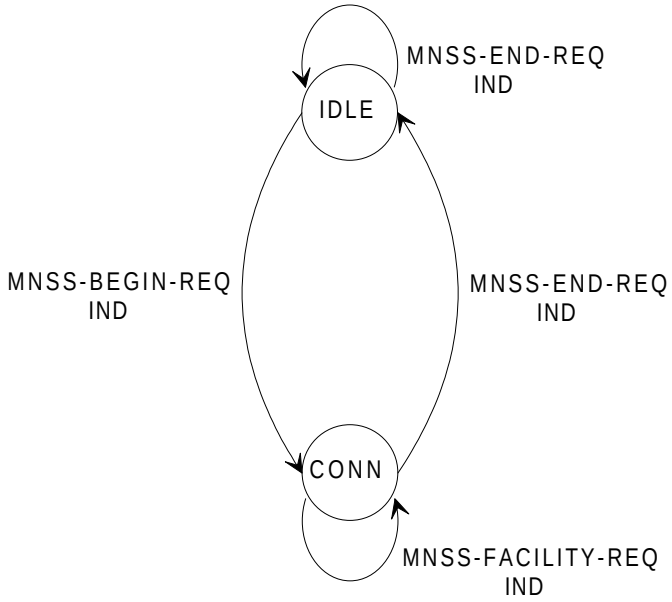
#### 6.2.2.31 MNCC_SYNC_IND

Indication that a dedicated channel assignment has been performed (res. ass. = "resource assigned") and/or the channel mode has been changed.

### 6.3 Call independent Supplementary Services Support

#### 6.3.1 Service state diagram

The primitives provided by the call independent Supplementary Services Support entity and the transitions between permitted states are shown in figure 6.3.




STATES:

IDLE - No SS signalling transaction pending
CONN - SS signalling transaction established

**Figure 6.3: Service graph of the call independent Supplementary Services Support entity - MS side**

#### 6.3.2 Service primitives

**Table 6.3: Primitives and Parameters at MNSS-SAP - MS side**

| PRIMITIVES | PARAMETERS (Info elements of message) | REFERENCE |
|---|---|---|
| MNSS_BEGIN_REQ | REGISTER | 6.3.2.1 |
| MNSS_BEGIN_IND | REGISTER | 6.3.2.2 |
| MNSS_FACILITY_REQ | FACILITY | 6.3.2.3 |
| MNSS_FACILITY_IND | FACILITY | 6.3.2.4 |
| MNSS_END_REQ | REL COMPLETE | 6.3.2.5 |
| MNSS_END_IND | REL COMPLETE | 6.3.2.6 |

#### 6.3.2.1 MNSS_BEGIN_REQ

Request to send a REGISTER message in order to establish a signalling transaction for the provision of call independent supplementary services. The request for a call independent supplementary service invocation may be included.

#### 6.3.2.2 MNSS_BEGIN_IND

Receipt of a REGISTER message, a signalling transaction is established for the provision of call independent supplementary services after receipt of a REGISTER message. The indication of a supplementary service invocation may be included.

#### 6.3.2.3 MNSS_FACILITY_REQ

Request to send a FACILITY message for the provision of a call independent supplementary service invocation.

#### 6.3.2.4 MNSS_FACILITY_IND

Receipt of a FACILITY message for a call independent supplementary service invocation.

#### 6.3.2.5 MNSS_END_REQ

Request to send a RELEASE COMPLETE message in order to release the signalling transaction. The request for transfer of a supplementary service facility may be included.

#### 6.3.2.6 MNSS_END_IND

Receipt of a RELEASE COMPLETE message, the signalling transaction has been released. The indication of a supplementary service facility may be included.

### 6.4 Short Message Services Support

The service provided by the CM sublayer to support the short message service are defined in GSM 04.11.

## 7 Services provided by signalling layer 3 on the Network side

In this clause, the services provided by signalling layer 3 on the network side are described which belong to the CM sub-layer functional blocks of CC, SMS, and SS. The services corresponding to further functional blocks of the CM sublayer are not further described in this clause.

### 7.1 Call control services

The Call Control services are provided by multiple CC entities at the service access point MNCC-SAP.

The Call Control service class consists of the following services:

- call establishment;
- call maintaining;
- call termination;
- call related Supplementary Services Support.

#### 7.1.1 Service state diagram

The Call Control services provided at the service access point MNCC-SAP are illustrated in figure 7.1.

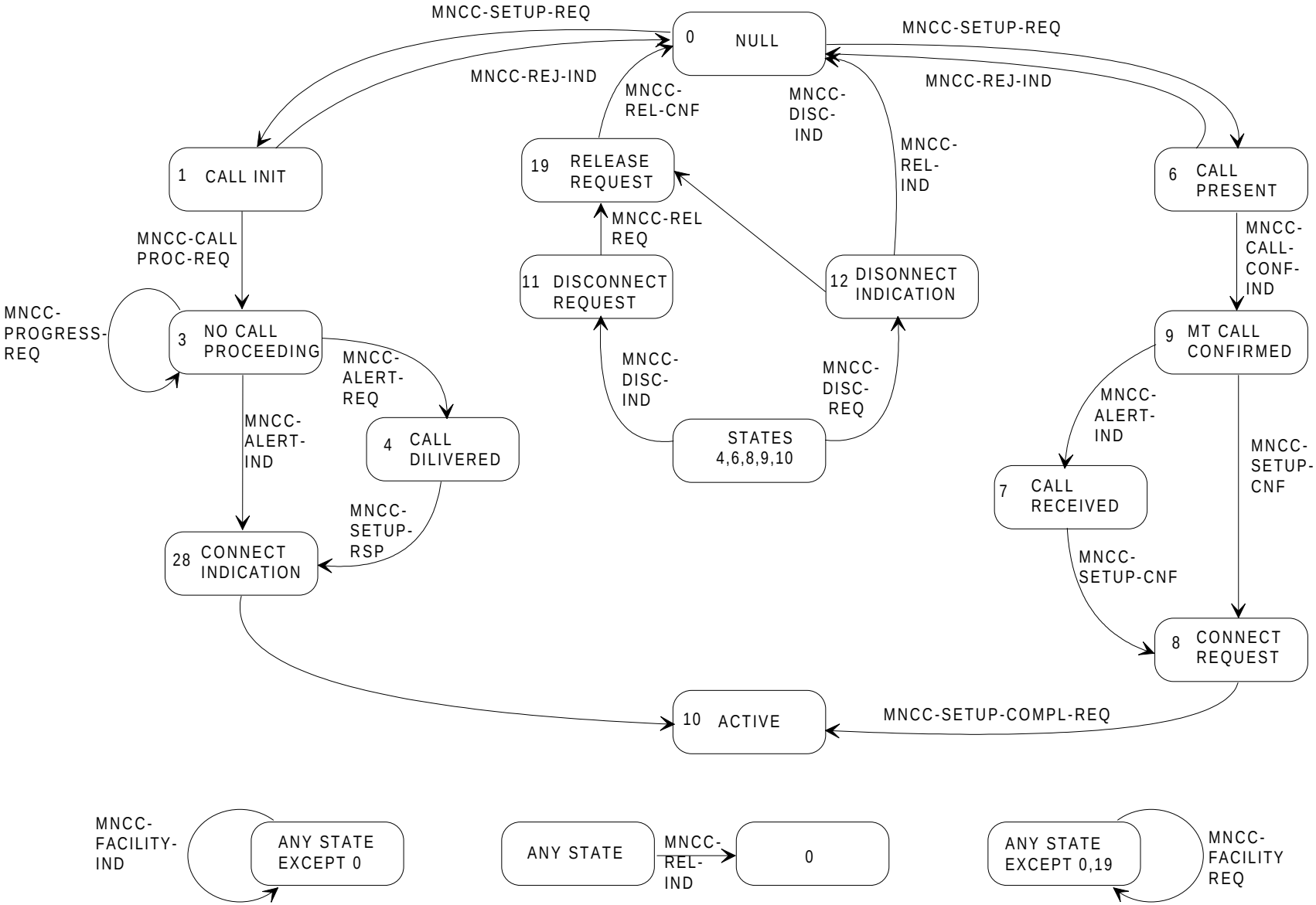



**Figure 7.1: (page 1 of 2) Service graph of Call Control entity - Network side**

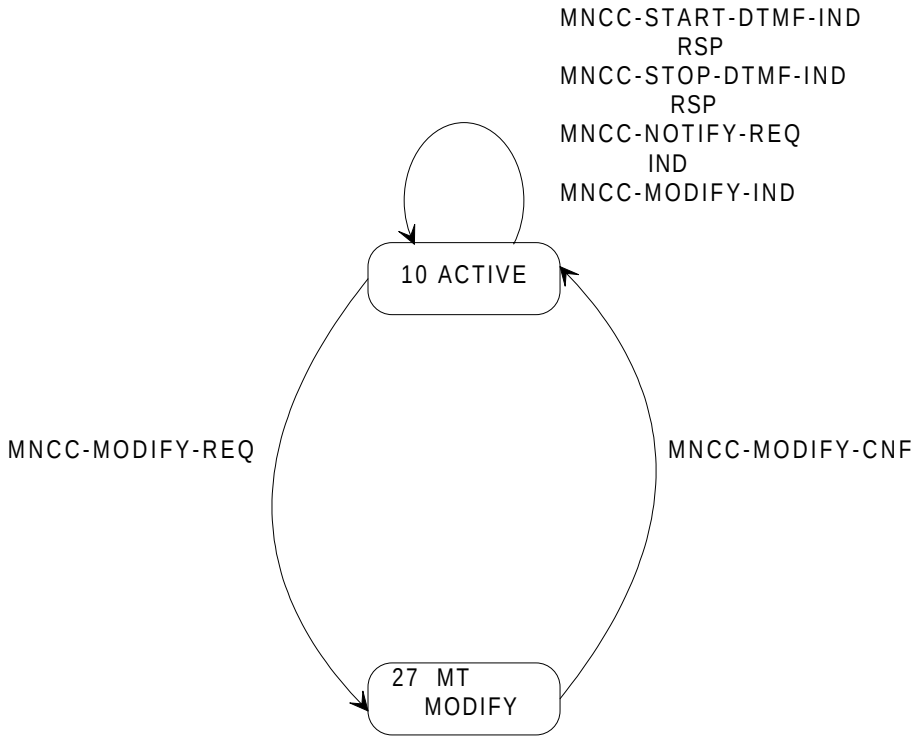



**Figure 7.1: (page 2 of 2) Service graph of Call Control entity - Network side**

### 7.1.2 Service primitives

**Table 7.1: Primitives and Parameters at MNCC-SAP - Network side**

| PRIMITIVE | PARAMETER (message, info elements of message, other parameters) | REFERENCE |
|---|---|---|
| MNCC_SETUP_REQ | SETUP incl. Mobile ID or EMERGENCY SETUP | 7.1.2.1 |
| MNCC_SETUP_IND | SETUP | 7.1.2.2 |
| MNCC_SETUP_RSP | CONNECT | 7.1.2.3 |
| MNCC_SETUP_CNF | CONNECT | 7.1.2.4 |
| MNCC_SETUP_COMPL_REQ | CONNECT ACKNOWLEDGE | 7.1.2.5 |
| MNCC_SETUP_COMPL_IND | CONNECT ACKNOWLEDGE | 7.1.2.6 |
| MNCC_REJ_REQ | RELEASE COMPLETE | 7.1.2.7 |
| MNCC_REJ_IND | cause | 7.1.2.8 |
| MNCC_CALL_CONF_IND | CALL CONFIRMED | 7.1.2.9 |
| MNCC_CALL PROC_REQ | CALL PROCEEDING | 7.1.2.10 |
| MNCC_PROGRESS_REQ | PROGRESS | 7.1.2.11 |
| MNCC_ALERT_REQ | ALERTING | 7.1.2.12 |
| MNCC_ALERT_IND | ALERTING | 7.1.2.13 |
| MNCC_NOTIFY_REQ | NOTIFY | 7.1.2.14 |
| MNCC_NOTIFY_IND | NOTIFY | 7.1.2.15 |
| MNCC_DISC_REQ | DISCONNECT | 7.1.2.16 |
| MNCC_DISC_IND | DISCONNECT | 7.1.2.17 |
| MNCC_REL_REQ | RELEASE or DISCONNECT | 7.1.2.18 |
| MNCC_REL_IND | RELEASE | 7.1.2.19 |
| MNCC_REL_CNF | RELEASE or RELEASE COMPLETE | 7.1.2.20 |
| MNCC_FACILITY_REQ | facility | 7.1.2.21 |
| MNCC_FACILITY_IND | facility | 7.1.2.22 |
| MNCC_START_DTMF_IND | START DTMF | 7.1.2.23 |
| MNCC_START_DTMF_RSP | START DTMF ACK or START DTMF REJ | 7.1.2.24 |
| MNCC_STOP_DTMF_IND | STOP DTMF | 7.1.2.25 |
| MNCC_STOP_DTMF_RSP | STOP DTMF ACK | 7.1.2.26 |
| MNCC_MODIFY_REQ | MODIFY or BC-parameter | 7.1.2.27 |
| MNCC_MODIFY_IND | BC-parameter | 7.1.2.28 |
| MNCC_MODIFY RES | MODIFY COMPLETE | 7.1.2.29 |
| MNCC_MODIFY_CNF | BC-parameter | 7.1.2.30 |

#### 7.1.2.1 MNCC_SETUP_REQ

Request to send a SETUP message to initiate Mobile terminated establishment.

#### 7.1.2.2 MNCC_SETUP_IND

Receipt of a SETUP or EMERGENCY SETUP message, the Mobile originating call establishment has been initiated.

#### 7.1.2.3 MNCC_SETUP_RSP

Response to send a CONNECT message to indicate call acceptance by the remote user.

#### 7.1.2.4 MNCC_SETUP_CNF

Receipt of a CONNECT message, the Mobile terminated call has been accepted.

#### 7.1.2.5 MNCC_SETUP_COMPL_REQ

Request to send a CONNECT ACKNOWLEDGE message, the Mobile terminated call establishment has been completed.

#### 7.1.2.6 MNCC_SETUP_COMPL_IND

Indication of the receipt of a CONNECT ACKNOWLEDGE message, the Mobile originating call establishment has been completed.

#### 7.1.2.7 MNCC_REJ_REQ

Reject the Mobile originated call establishment if the call cannot be accepted.

#### 7.1.2.8 MNCC_REJ_IND

A Mobile terminated call was rejected by the MS, e.g. because of missing compatibility.

#### 7.1.2.9 MNCC_CALL_CONF_IND

Receipt of a CALL CONFIRMED message, the Mobile terminated call has been confirmed. A bearer capability different from that given in MNCC_SETUP_REQ may be offered to the remote calling user.

#### 7.1.2.10 MNCC_CALL_PROC_REQ

Request to send a CALL PROCEEDING message to indicate to the Mobile originating user that call establishment has been initiated in the Network and no more call establishment information will be accepted.

#### 7.1.2.11 MNCC_PROGRESS_REQ

Request to send a PROGRESS message or to piggy-back a progress IE in a suitable CC message in order to give the Mobile user information about the call , e.g., that the call is progressing in the PLMN/ISDN environment, or that the call has left the PLMN/ISDN environment, or that in-band tones/announcement are available.

#### 7.1.2.12 MNCC_ALERT_REQ

Request to send an ALERTING message to indicate to the Mobile originating user that remote called user alerting has been initiated.

#### 7.1.2.13 MNCC_ALERT_IND

Receipt of an ALERTING message from the Mobile terminated user to be sent to the remote calling user to indicate that user alerting has been initiated.

#### 7.1.2.14 MNCC_NOTIFY_REQ

Request to send information pertaining to a call, such as user suspended, to the Mobile originating or the Mobile terminated user.

#### 7.1.2.15 MNCC_NOTIFY_IND

Indication from the Mobile originating or Mobile terminated user of information pertaining to a call, such as remote user suspended.

#### 7.1.2.16 MNCC_DISC_REQ

Request to send a DISCONNECT message to the MS in order to clear the end-to-end connection.

#### 7.1.2.17 MNCC_DISC_IND

Receipt of a DISCONNECT message, the MS indicates that the end-to-end connection is cleared.

#### 7.1.2.18 MNCC_REL_REQ

Request to send a RELEASE message to inform the MS that the network intends to release the MM connection and the correspondent call reference.

#### 7.1.2.19 MNCC_REL_IND

Receipt of a RELEASE message, the MS intends to release its MM connection and call reference. The Network is requested to release its call reference and MM connection.

#### 7.1.2.20 MNCC_REL_CNF

The RELEASE COMPLETE message has been received, the MM connection in the MS has been released, the Network itself shall release its MM connection and the corresponding call reference.

#### 7.1.2.21 MNCC_FACILITY_REQ

Request to transport a *facility* IE for call related supplementary service invocations.

#### 7.1.2.22 MNCC_FACILITY_IND

Indication that a *facility* IE for call related supplementary service invocations has been received.

#### 7.1.2.23 MNCC_START_DTMF_IND

Indicate the receipt of a START DTMF message in order to start a DTMF control operation.

#### 7.1.2.24 MNCC_START_DTMF_RSP

Request to send a START DTMF ACKNOWLEDGE or START DTMF REJECT message in order to acknowledge or reject the start of a DTMF control operation.

#### 7.1.2.25 MNCC_STOP_DTMF_IND

Indicate the receipt of a STOP DTMF message in order to stop a DTMF control operation.

#### 7.1.2.26 MNCC_STOP_DTMF_RSP

Request to send a STOP DTMF ACKNOWLEDGE message in order to acknowledge the completion of a DTMF control operation.

#### 7.1.2.27 MNCC_MODIFY_REQ

Request to start the Mobile terminating in-call modification.

#### 7.1.2.28 MNCC_MODIFY_IND

Receipt of a MODIFY message, the Mobile originating in-call modification has been initiated.

#### 7.1.2.29 MNCC_MODIFY_RES

Response to send a MODIFY COMPLETE to indicate to the Mobile user that the mobile originating in-call modification procedure has been completed.

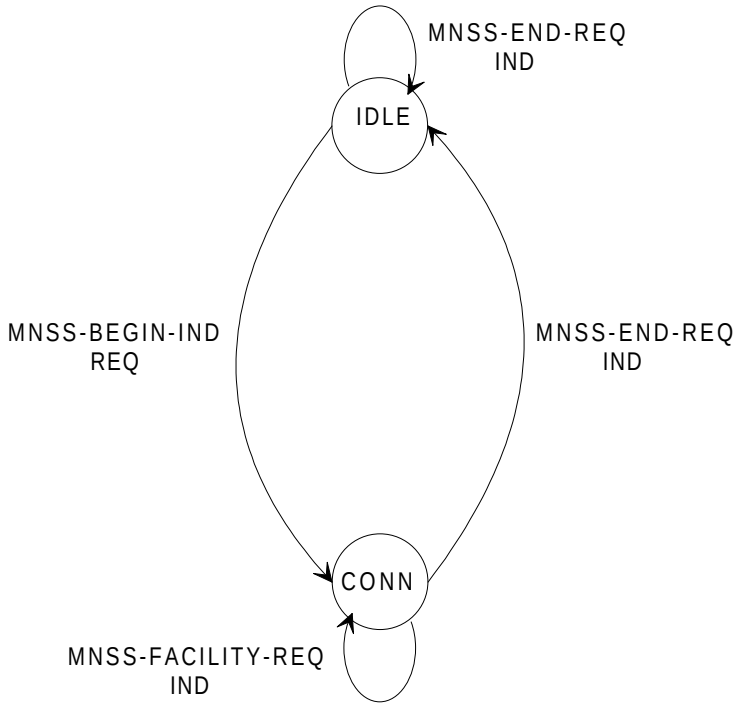
#### 7.1.2.30 MNCC_MODIFY_CNF

Confirmation that the Mobile terminating in-call modification has been completed.

## 7.2 Call independent Supplementary Services Support

### 7.2.1 Service state diagram

The primitives provided by the call independent Supplementary Services Support entity and the transitions between permitted states are shown in the service graph of figure 7.2 below.




STATES:

IDLE - No SS signalling transaction pending
CONN - SS signalling transaction established

**Figure 7.2: Service graph of the call independent Supplementary Services Support entity - Network side**

### 7.2.2 Service primitives

**Table 7.2: Primitives and Parameters at MNSS-SAP - Network side**

| PRIMITIVES | PARAMETERS (Info elements of message) | REFERENCE |
|---|---|---|
| MNSS_BEGIN_REQ | REGISTER | 7.2.2.1 |
| MNSS_BEGIN_IND | REGISTER | 7.2.2.2 |
| MNSS_FACILITY_REQ | FACILITY | 7.2.2.3 |
| MNSS_FACILITY_IND | FACILITY | 7.2.2.4 |
| MNSS_END_REQ | RELEASE COMPLETE | 7.2.2.5 |
| MNSS_END_IND | RELEASE COMPLETE | 7.2.2.6 |

#### 7.2.2.1 MNSS_BEGIN_REQ

Request to send a REGISTER message in order to establish a signalling transaction for the provision of call independent supplementary services. The request for a supplementary service invocation may be included.

#### 7.2.2.2 MNSS_BEGIN_IND

Receipt of a REGISTER message, a signalling transaction is established for the provision of call independent supplementary services. The indication of a supplementary service invocation may be included.

#### 7.2.2.3 MNSS_FACILITY_REQ

Request to send a FACILITY message for the provision of a call independent supplementary service facility.

#### 7.2.2.4 MNSS_FACILITY_IND

Receipt of a FACILITY message, a supplementary service facility has been requested.

#### 7.2.2.5 MNSS_END_REQ

Request to send a RELEASE COMPLETE message in order to release the signalling transaction by sending a RELEASE COMPLETE message. The request for transfer of a supplementary service facility may be included.

#### 7.2.2.6 MNSS_END_IND

Indication that the signalling transaction has been released after receipt of a RELEASE COMPLETE message. The indication of a supplementary service facility may be included.

### 7.3 Short Message Services Support

The service provided by the CM sublayer to support the short message service are defined in GSM 04.11.

## 8 Services assumed from signalling layers 1 and 2

The services provided by layer 2 are defined in detail in GSM 04.05. A short summary is given below.

In addition, layer 1 communicates directly with layer 3 for information transfer related to channel management and to measurement control. See section 8.5 below.

### 8.1 Priority

Messages from layer 3 can be sent with:

- no priority,
  i.e. the messages are sent in first-in-first-out order;
- priority,
  i.e. a message with this indication is sent as early as possible by layer 2.

### 8.2 Unacknowledged information transfer

Transfer of unacknowledged information using the primitives DL_UNIT_DATA_ REQUEST/INDICATION.

### 8.3 Acknowledged information transfer

Transfer of information in multiframe acknowledged mode including:

- establishment of data link connection between L3 entities;
- transfer of information in acknowledged mode;
- release of the data link connection.

The primitives associated with acknowledged information transfer are:

- DL_ESTABLISH_REQUEST/INDICATION/CONFIRM for establishment of acknowledged mode;

- DL_DATA_REQUEST/INDICATION for requesting the transmission of a message unit and for indicating the reception of a message unit;
- DL_SUSPEND_REQUEST/DL_RELEASE_CONFIRM for requesting and confirming the suspension of the acknowledged information transfer in the MS upon channel change;
- DL_RESUME_REQUEST/DL_ESTABLISH_CONFIRM for requesting and confirming the resumption of the acknowledged information transfer in the MS after suspension at channel change;
- DL_RELEASE_REQUEST/INDICATION/CONFIRM for the termination of acknowledged mode operation;
- DL_RECONNECT_REQUEST for requesting the re-establishment of acknowledged information transfer in the MS on the old channel after channel change failure.

### 8.4 Random access

The transmission/reception of a random access burst is controlled by the primitives DL_RANDOM_ACCESS_REQUEST/INDICATION/CONFIRM.

### 8.5 Channel management and measurements

The management of channels, i.e. their activation, deactivation, configuration, deconfiguration, through-connection and disconnection is controlled by the RR sublayer in layer 3. The measurements performed by the physical layer are also controlled by the RR sublayer of layer 3 and they are reported to layer 3.

These functions use the primitives MPH_INFORMATION_REQUEST/INDICATION/CONFIRMATION.

## 9 Interlayer service interfaces on the MS side

In addition to the services described in this clause, the RR entity and MM entity also provide services to CM entities which don't belong to the functional blocks of CC, SMS, and SS. (For example, the RR entity provides service to Group Call and Broadcast Call entities.) These services are not further described in this clause.

### 9.1 Services provided by the Radio Resource Management entity

The Radio Resource Management (RR) sublayer provides a service to the Mobility Management entity (MM).

The RR services are used for:

- establishing control channel connections;
- releasing control channel connections;
- control-data transfer.

The Radio Resource Management services are represented by the RR-service primitives.

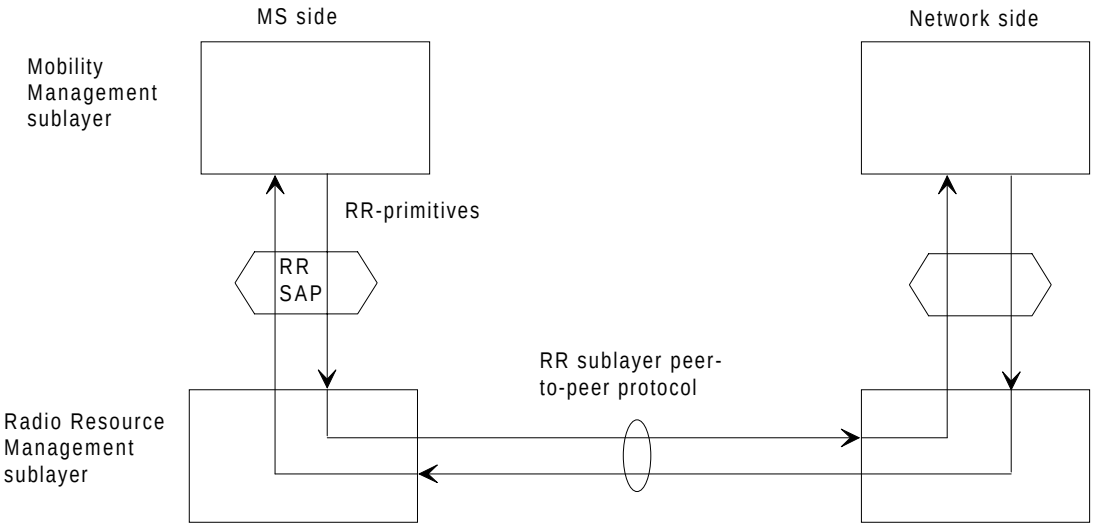



**Figure 9.1: Services provided at RR-SAP - MS side**

### 9.1.1 Service state diagram

The primitives provided by the Radio Resource Management entity and the transition between permitted states are shown in figure 9.2.

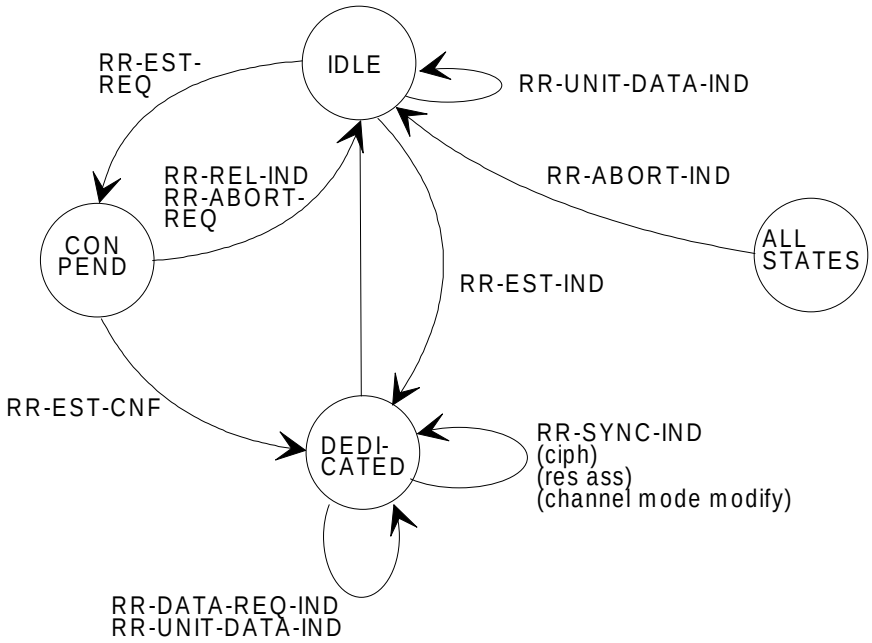



**Figure 9.2: Service graph of the Radio Resource Management - MS side**

### 9.1.2 Service primitives

**Table 9.1: Primitives and parameters at the RR-SAP - MS side**

| PRIMITIVES | PARAMETERS | REFERENCE |
|---|---|---|
| RR_EST_REQ | Layer 3 message transferred in the SABM frame | 9.1.2.1 |
| RR_EST_IND | - | 9.1.2.2 |
| RR_EST_CNF | - | 9.1.2.3 |
| RR_REL_IND | cause | 9.1.2.4 |
| RR_SYNC_IND | cause (ciphering, res. ass., channel mode modify) | 9.1.2.5 |
| RR_DATA_REQ | Layer 3 message | 9.1.2.6 |
| RR_DATA_IND | Layer 3 message | 9.1.2.7 |
| RR_UNIT DATA_IND | Layer 3 message | 9.1.2.8 |
| RR_ABORT_REQ | cause | 9.1.2.9 |
| RR_ABORT_IND | cause | 9.1.2.10 |
| RR_ACT_REQ | reselection mode | 9.1.2.11 |

#### 9.1.2.1 RR_EST_REQ

Is used by the Mobility Management entity to request establishment of a Mobile originated RR connection. The request shall be given only in the IDLE state when the MS listens to the CCCH and the previously selected BCCH.

#### 9.1.2.2 RR_EST_IND

Indicates to the Mobility Management entity the establishment of a Mobile terminated RR connection. By this indication MM is informed that a transparent connection exists and RR is in the dedicated mode.

#### 9.1.2.3 RR_EST_CNF

Is used by RR to indicate the successful completion of a Mobile originated RR connection establishment. RR connection exists and RR is in the dedicated mode.

#### 9.1.2.4 RR_REL_IND

Is used by RR to indicate to the Mobility Management entity the release of a RR connection when RR has received a CHANNEL RELEASE from the Network and has triggered a normal release of the data link layer. It is also used to indicate that a requested RR connection cannot be established. In both cases, RR returns to IDLE mode.

#### 9.1.2.5 RR_SYNC_IND

Is used for synchronizing RR and the Mobility Management entity after the establishment of a Mobile originated or Mobile terminated RR connection. This indication is provided to MM in the following cases:

- ciphering has been started (ciphering);
- a traffic channel has been assigned (res. ass. = "resource assigned");
- the channel mode has been modified (channel mode modify).

#### 9.1.2.6 RR_DATA_REQ

Is used by the Mobility Management entity to send control data to its peer entity on the Network side via an existing RR connection.

#### 9.1.2.7 RR_DATA_IND

Is used by RR to indicate control-data, which has been received from its peer entity on the Network side via an existing RR connection.

#### 9.1.2.8 RR_UNIT_DATA_IND

Is used by RR to provide MM with system info. The system info is received on the current BCCH if RR is in the IDLE state. If a RR connection has been established, the system info is received on the SACCH.

#### 9.1.2.9 RR_ABORT_REQ

Request to abort an existing RR connection or a RR connection in progress. The data link, if already established, shall be released by a normal release procedure (DISC/UA) initiated by the MS. This is the only way the MS can trigger the release of a RR connection in case of exceptional conditions. The RR returns to the IDLE state.

#### 9.1.2.10 RR_ABORT_IND

Indication that the RR connection has been aborted by a lower layer failure and RR has returned to the IDLE state.

### 9.2 Services provided by the Mobility Management entity

The Mobility Management (MM) sublayer provides services to the Call Control (CC) entity, the Supplementary Services Support (SS) entity and the Short Message Service Support (SMS) entity.

The Mobility Management services primitives are discriminated by the MMCC, MMSS and MMSMS prefix.

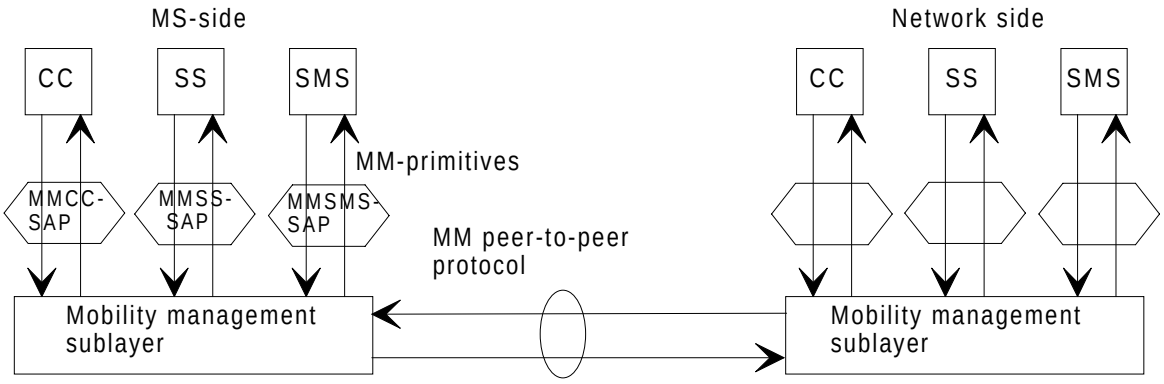
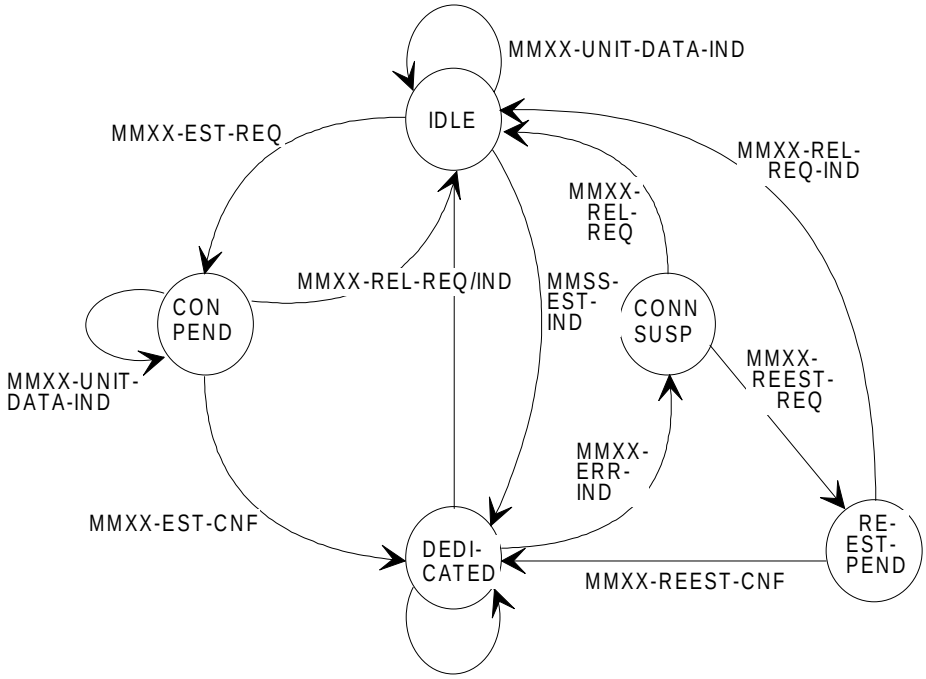



**Figure 9.3: Services provided at the MMCC-SAP, MMSS-SAP, MMSMS-SAP - MS side**

### 9.2.1 Service state diagram

The primitives provided by the Mobility Management entity towards Call Control, call independent Supplementary Service Support and towards Short Messages Service Support and the transition between permitted states are illustrated in figure 9.4.




NOTE 1: MMCC-primitives only at MMCC-SAP.

NOTE 2: The prefix MMXX is used for substitution of MMCC, MMSS or MMSMS.

**Figure 9.4: Service graph of the Mobility Management entity - MS side**

### 9.2.2 Service primitives

**Table 9.2: Primitives and Parameters at MMCC-SAP, MMSS-SAP or MMSMS-SAP - MS side**

| PRIMITIVES | PARAMETERS | REFERENCE |
|---|---|---|
| MMXX_EST_REQ (see note 1) | Parameters for the appropriate CM SERVICE REQUEST (if any) | 9.2.2.1 |
| MMXX_EST_IND (see note 1) | First CM message | 9.2.2.2 |
| MMXX_EST_CNF (see note 1) | - | 9.2.2.3 |
| MMXX_REL_REQ (see note 1) | cause | 9.2.2.4 |
| MMXX_REL_IND (see note 1) | cause | 9.2.2.5 |
| MMXX_DATA_REQ (see note 1) | Layer 3 message | 9.2.2.6 |
| MMXX_DATA_IND (see note 1) | Layer 3 message | 9.2.2.7 |
| MMXX_UNIT_DATA_REQ (see note 1) | Layer 3 message | 9.2.2.8 |
| MMXX_UNIT_DATA_IND (see note 1) | Layer 3 message | 9.2.2.9 |
| MMCC_SYNC_IND (see note 2) | cause: res.ass | 9.2.2.10 |
| MMXX_REEST_REQ (see note 1) | | 9.2.2.11 |
| MMXX_REEST_CNF (see note 1) | | 9.2.2.12 |
| MMXX_ERR_IND (see note 1) | cause | 9.2.2.13 |
| NOTE 1: MMXX is used as substitution for MMCC, MMSS or MMSMS<br>NOTE 2: Only at MMCC-SAP | | |

#### 9.2.2.1 MMXX_EST_REQ

Request used by CC, SS and SMS respectively, to request establishment of a MM connection. Several MM connections may be provided in parallel to the requesting entities. The primitive may contain parameters which are relevant for the CM SERVICE REQUEST message, e.g. to distinguish a basic call from an emergency call.

#### 9.2.2.2 MMXX_EST_IND

Indication to CC, SS or SMS that a Mobile terminated MM connection has been established and the first message has been received from the respective peer entity. Several MM connections may be provided in parallel. If a MM connection already exists, a new MM connection using the same RR connection is indicated by this primitive if MM detects a message with a new combination of Protocol Discriminator (PD) and Transaction Identifier (TI).

#### 9.2.2.3 MMXX_EST_CNF

Successful confirmation of the MM connection establishment by the MM sublayer to be given to the appropriate entity which has requested the service.

#### 9.2.2.4 MMXX_REL_REQ

Used by CC, SS or SMS respectively, to request release of the MM connection. The corresponding PD/TI will be released and may be used for a new MM connection.

#### 9.2.2.5 MMXX_REL_IND

Indication of the release of an existing MM connection or a MM connection in progress. This primitive is used in exceptional cases to indicate that the MM connection cannot be established or kept any longer and PD/TI have been released.

#### 9.2.2.6 MMXX_DATA_REQ

Request used by the CC, SS or SMS entities for acknowledged control-data transmission.

#### 9.2.2.7 MMXX_DATA_IND

Indication used by MM to transfer the received acknowledged control-data to the CC, SS or SMS entities.

#### 9.2.2.8 MMXX_UNIT_DATA_REQ

Request used by the CC, SS or SMS entities for unacknowledged control-data transmission.

#### 9.2.2.9 MMXX_UNIT_DATA_IND

Indication used by MM to transfer the received unacknowledged control-data to the CC, SS or SMS entities.

#### 9.2.2.10 MMCC_SYNC_IND

Indication that a dedicated channel assignment has been performed and/or the channel mode has been changed (only towards the CC entity).

#### 9.2.2.11 MMXX_REEST_REQ

Request to establish a MM connection which has been interrupted by a lower layer failure. The interruption must have been indicated by MMXX_ERR_IND.

#### 9.2.2.12 MMXX_REEST_CNF

Confirmation of the successful re-establishment of the MM connection. The MM connection will continue with PD/TI as it had before.

#### 9.2.2.13 MMXX_ERR_IND

Indication of a lower layer failure interrupting the MM connection. The PD/TI are still kept by MM. In case of parallel transactions this indication is passed to all CM entities for which a MM connection has been established. It is left to the decision of the appropriate CM entity to either request the re-establishment of the MM connection by MMXX_REEST_REQ or to release it by MMXX_REL_REQ.

## 10 Interlayer service interfaces on the Network side

In addition to the services described in this clause, the RR entity and MM entity also provide services to CM entities which don't belong to the functional blocks of CC, SMS, and SS. (For example, the RR entity provides service to Group Call Control and Broadcast Call Control entities.) These services are not further described in this clause.

### 10.1 Services provided by the Radio Resource Management entity

The Radio Resource Management (RR) sublayer provides services to the Mobility Management entity (MM).

The RR services are used for:

- establishing control channel connections;
- establishing traffic channel connections;
- ciphering mode indication;
- releasing control channel connections;
- control-data transfer.

The Radio Resource Management services are represented by the RR service primitives.

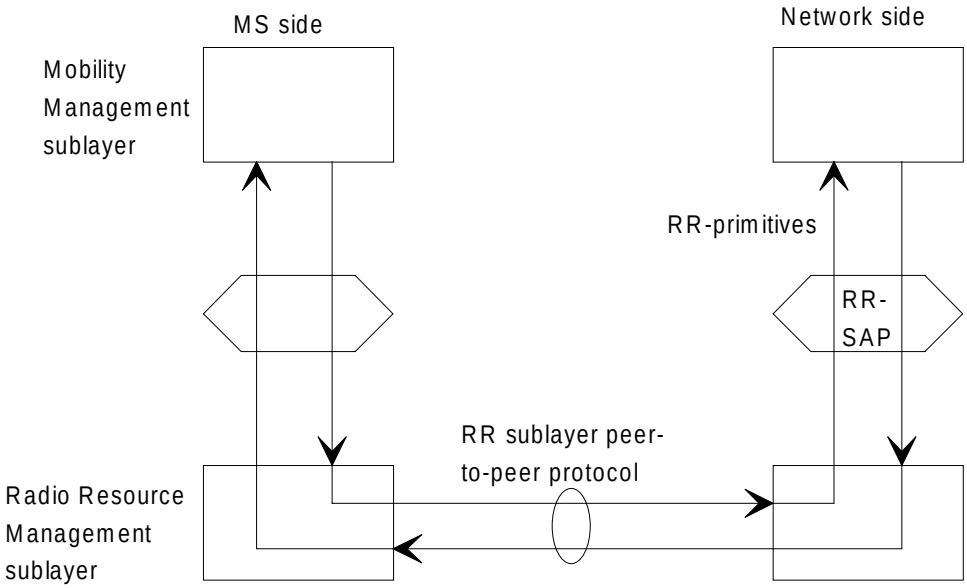
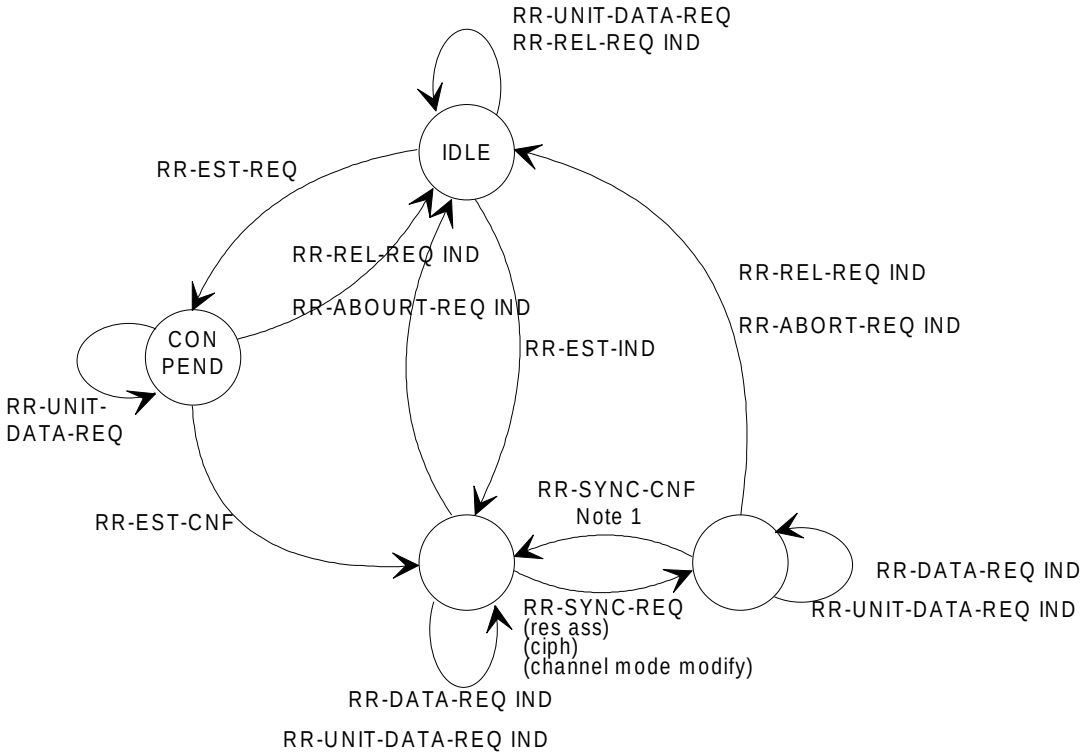



**Figure 10.1: Services provided at RR-SAP - Network side**

### 10.1.1 Service state diagram

The primitives provided by the Radio Resource Management entity and the transition between permitted states are shown in figure 10.2.




STATES:

IDLE - No dedicated channel established.
CONPEND - Connection pending.
DT1 - Data transfer 1, dedicated channel established.
DT2 - Data transfer 2, dedicated channel established, ciphering mode set.

**Figure 10.2: Service graph of the Radio Resource Management entity - Network side**

### 10.1.2 Service primitives

**Table 10.1: Primitives and Parameters at the RR-SAP - Network side**

| PRIMITIVES | PARAMETERS | REFERENCE |
|---|---|---|
| RR_EST_REQ | Parameters for the Initial layer 3 message | 10.1.2.1 |
| RR_EST_IND | Initial layer 3 message | 10.1.2.2 |
| RR_EST_CNF | - | 10.1.2.3 |
| RR_REL_REQ | cause | 10.1.2.4 |
| RR_REL_IND | cause | 10.1.2.5 |
| RR_SYNC_REQ | cause (resource assign, ciphering) | 10.1.2.6 |
| RR_SYNC_CNF | cause (resource assign, ciphering) | 10.1.2.7 |
| RR_DATA_REQ | Layer 3 message | 10.1.2.8 |
| RR_DATA_IND | Layer 3 message | 10.1.2.9 |
| RR_UNIT_DATA_REQ | Layer 3 message | 10.1.2.10 |
| RR_UNIT_DATA_IND | Layer 3 message | 10.1.2.11 |
| RR_ABORT_REQ | cause | 10.1.2.12 |
| RR_ABORT_IND | cause | 10.1.2.13 |

#### 10.1.2.1 RR_EST_REQ

Request used by the Mobility Management entity to request establishment of control channel connections.

#### 10.1.2.2 RR_EST_IND

Indication to the Mobility Management entity that the establishment of control channel connections has been done.

#### 10.1.2.3 RR_EST_CNF

Confirmation used by RR to confirm the establishment of a requested control channel connection.

#### 10.1.2.4 RR_REL_REQ

Request used by the Mobility Management to release a control channel connection.

#### 10.1.2.5 RR_REL_IND

Indication from RR to MM that the main signalling link has been released.

#### 10.1.2.6 RR_SYNC_REQ

Request used by the Mobility Management entity for synchronization with the RR protocol.

#### 10.1.2.7 RR_SYNC_CNF

Confirmation used by RR that the requested synchronization is done.

#### 10.1.2.8 RR_DATA_REQ

Request used by the Mobility Management entity for acknowledged control-data transmission.

#### 10.1.2.9 RR_DATA_IND

Indication used by RR to transfer received control-data, which should be acknowledged, to the Mobility Management entity.

#### 10.1.2.10 RR_UNIT_DATA_REQ

Request used by the Mobility Management entity for unacknowledged control-data transmission.

#### 10.1.2.11 RR_UNIT_DATA_IND

Indication used by RR to transfer received control-data, which should not be acknowledged, to the Mobility Management entity.

#### 10.1.2.12 RR_ABORT_REQ

Request of the abandon of the RR connection.

#### 10.1.2.13 RR_ABORT_IND

Indication that a radio link failure has occurred.

### 10.2 Services provided by the Mobility Management entity

The Mobility Management (MM) sublayer provides services to the Call Control (CC) entity, the Supplementary Service Support (SS) entity and the Short Message Service Support (SMS) entity.

The Mobility Management services primitives are recognized by the MMCC, MMSS and MMSMS prefix.

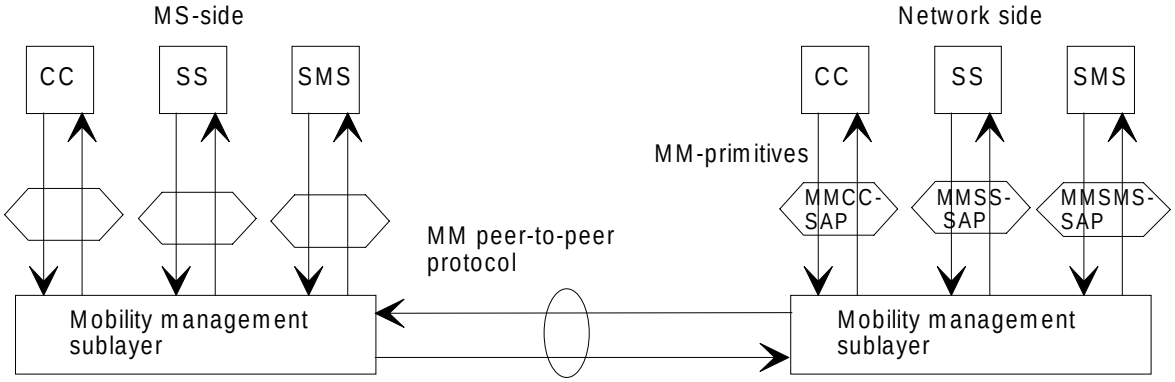
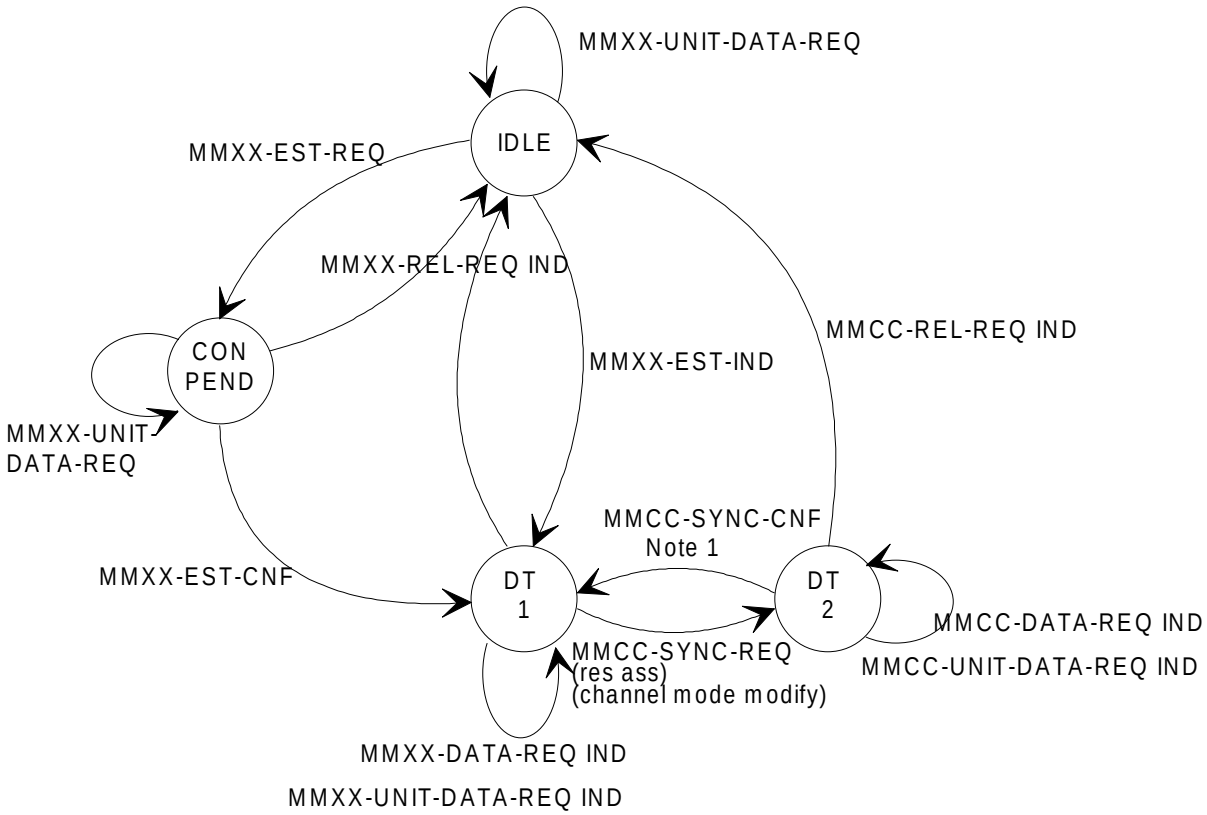



**Figure 10.3: Services provided at MMCC-SAP, MMSS-SAP, MMSMS-SAP - Network side**

### 10.2.1 Service state diagram

The primitives provided by the Mobility Management entity towards Call Control, Short Messages Service Support and call independent Supplementary Services Support as well as the transition between permitted states are illustrated in figure 10.4.




NOTE 1: The parameters in RR_SYNC_CNF must correspond to the parameter in RR_SYNC_REQ.

NOTE 2: MMCC-primitives only at MMCC-SAP.

NOTE 3: The prefix MMXX is used for substitution of MMCC, MMSS or MMSMS.

**Figure 10.4: Service graph of the Mobility Management entity, towards Call Control - Network side**

### 10.2.2 Service primitives

**Table 10.2: Primitives and Parameters at MMCC-SAP, MMSS-SAP, MMSMS-SAP - Network side**

| PRIMITIVES | PARAMETERS | REFERENCE |
|---|---|---|
| MMXX_EST_REQ (see note 1) | Mobile ID | 10.2.2.1 |
| MMXX_EST_IND (see note 1) | First CM message | 10.2.2.2 |
| MMXX_EST_CNF (see note 1) | - | 10.2.2.3 |
| MMXX_REL_REQ (see note 1) | cause | 10.2.2.4 |
| MMXX_REL_IND (see note 1) | cause | 10.2.2.5 |
| MMXX_DATA_REQ (see note 1) | Layer 3 message | 10.2.2.6 |
| MMXX_DATA_IND (see note 1) | Layer 3 message | 10.2.2.7 |
| MMXX_UNIT_DATA_REQ (see note 1) | Layer 3 message | 10.2.2.8 |
| MMXX_UNIT_DATA_IND (see note 1) | Layer 3 message | 10.2.2.9 |
| MMCC_SYNC_REQ (see note 2) | cause (resource assign) | 10.2.2.10 |
| MMCC_SYNC_CNF (see note 2) | cause (resource assign) | 10.2.2.11 |
| NOTE 1: MMXX is used as substitution for MMCC, MMSS or MMSMS.<br>NOTE 2: Only at MMCC-SAP. | | |

#### 10.2.2.1 MMXX_EST_REQ

Request by CC, SS and SMS respectively, for the establishment of a MM connection.

#### 10.2.2.2 MMXX_EST_IND

Indication by the MM sublayer that a MM connection is established.

#### 10.2.2.3 MMXX_EST_CNF

Confirmation of the MM connection establishment by the MM sublayer.

#### 10.2.2.4 MMXX_REL_REQ

Request by CC, SS or SMS respectively, for the release of the MM connection.

#### 10.2.2.5 MMXX_REL_IND

Indication by the MM sublayer that a MM connection has been released.

#### 10.2.2.6 MMXX_DATA_REQ

Request by the CC, SS or SMS entities for acknowledged control-data transmission.

#### 10.2.2.7 MMXX_DATA_IND

Indication used by MM to transfer the received acknowledged control-data to the CC, SS or SMS entities.

#### 10.2.2.8 MMXX_UNIT_DATA_REQ

Request used by the CC, SS or SMS entities for unacknowledged control-data transmission.

#### 10.2.2.9 MMXX_UNIT_DATA_IND

Indication used by MM to transfer the received unacknowledged control-data to the CC, SS or SMS entities.

#### 10.2.2.10 MMCC_SYNC_REQ

Request used by the CC entity to synchronize with the MM entity (resource assign).

#### 10.2.2.11 MMCC_SYNC_CNF

Confirmation used by the MM to inform the CC entity that synchronization is completed (resource assign).

# 11 L3 Messages

This clause specifies the generic methods used in the layer 3 protocol specifications to describe messages. It define in particular a generic message structure, that of the "standard L3 messages". Not all messages in layer 3 protocols follow this structure, but many do, and this section specifies how to interpret the standard description.

This clause also addresses basic aspects of the handling of messages received but not compliant with the allowed structure. In most cases, only the conditions that lead to the diagnosis of an error are described. The reaction of an entity receiving a message leading to such a diagnosis is in general specified for each protocol in the relevant protocol specification.

## 11.1 General

### 11.1.1 Messages

For all concerned protocols, concrete messages are bit strings of variable length, formally a succession of a finite, possibly null, number of bits (i.e., elements of the set {"0", "1"}), with a beginning and an end.

The services provided by lower layers includes the transmission of such bit strings.

Considered as messages, these bit strings follow some structure (the syntax), enabling to organise bits in information pieces of a different meaning level.

The term *message* is used as well for a concrete message (i.e., a bit-string, as defined by the giving of all its bits, in practice appearing at one point of time in a concrete dialog), as for a class of concrete messages sharing a common structure. A concrete message is an instance of the corresponding class of messages. Message classes can be described as sets of potential bit strings, and of a common structure, enabling in particular to identify parts meaningful for the co-operation functions the protocol supports.

In general, in the rest of the clause as in the protocol specifications, the term *message* will be used to refer to the class. It may be used, when the context prevents ambiguity, to refer to a message instance (e.g., a received is usually a message instance). In the rest of this clause, the term *message instance* will be used when needed to refer unambiguously to specific concrete message, i.e., to a specific bit string.

A message (message class) can be described directly as a set of bit strings, using the formal notation described in Annex B.

A message can also be described as a standard L3 message, in which case the interpretation of the message description in term of a set of bit strings is specified in the next sub-clauses.

In all cases, structuring messages is based on the underlying bit string. Thus, the following terms are used :

a *part* of a message instance is a sub-string of the corresponding string ; a part of a message (as a class) is described by a definition applicable to all instances; a part of a message then is both a structural attribute of the message as a class, and a set of sub-strings, composed of the sub-strings obtained by applying the definition to each possible instance ; for instance, « the first octet » of a message instance is defined from the moment its length is greater than 8, and is the sub-string composed of the first 8 bits of the message instance; the « first octet » of a message as a class is the structural definition given above, and the set of all 8-bit octet strings that can be obtained as the first octet of one instance of the class.

'part A *follows* part B' means that in the message the sub-string corresponding to part B is concatenated with the sub-string of part B ;

the *length* of a message instance, or of part of message instance, is the number of bits of the corresponding sub string ; rigorously speaking, a message as a class (or a part seen as a class) has a length only if all the corresponding instances have the same length ; by extension, sentences such as « a message as a length in the range so and so » means that the length of an instances of the class always fall in the range ;

### 11.1.2 Octets

In many places, a message is described as a succession of octets. An octet is generally a succession of 8 bits. Unless otherwise indicated, the term octet is used more restrictively to refer to a part of message, defined when considering a message as a succession of octets, e.g., the first 8 bits of a message, or the $17^{th}$ to the $23^{rd}$, form an octet, but not the second bit to the $9^{th}$.

Unless specified otherwise, the numbering conventions are the following :

Octets in a message or in a part are numbered from 1 onward, starting at the beginning of the bit string. This numbering can be strictly applied only for message instances, and for the first part of a message structurally identical for all instances.

Bits in octets are numbered from 8 down to 1, starting at the beginning of the octet.

When represented as tables showing the different bit positions, octets are presented in the natural occidental order, i.e., from the top of a page downward. Bits in octets are presented with the first bit on the left of the page.

### 11.1.3 Integer

In many places, message parts are described as encoding integers. Two generic encoding are defined in this sub-clause.

#### 11.1.3.1 Binary

A message part is said to encode in binary an integer to indicate that concrete strings are mapped, for some usage, on the set of non signed integers with the following rule :

Let k denote the length of the bit string, and let b(i) denote an integer of value 0 if the $i^{th}$ bit in the string is "0", and 1 otherwise. The encoded integer n respects the equation :

$$n = \sum_{i=1 to k} b(i) 2^{k-i-1}$$

#### 11.1.3.2 2-complement binary

A message part is said to encode in 2-complement binary an integer to indicate that concrete strings are mapped, for some usage, on the set of signed integers with the following rule :

Let k denote the length of the bit string, and let b(i) denote an integer of value 0 if the $i^{th}$ bit in the string is "0", and 1 otherwise. The encoded integer n respects the equation :

$$\text{if } b(1) = 0 \text{ then } n = \sum_{i=1 to k} b(i) 2^{k-i-1}$$
$$\text{else } n = \sum_{i=1 to k} b(i) 2^{k-i-1} - 2^k$$

### 11.1.4 Spare parts

In some cases the specification is that which message instances can be accepted by a receiver comprise more that the legal message instances that can be sent. One example of this is the notion of spare bit. A spare bit has to send as the value indicated in the specification (typically 0), but can be accepted as a 0 or a 1 by the receiver without error diagnosis. A spare field is a field composed entirely of spare bits.

## 11.2 Standard L3 messages

### 11.2.1 Components of a standard L3 message

A standard L3 message consists of an imperative part, itself composed of a header and the rest of imperative part, followed by a non-imperative part. Both the non-header part of the imperative part and the non-imperative part are composed of successive parts referred as standard information elements.

#### 11.2.1.1 Format of standard information elements

A standard IE may have the following parts, in that order:

- an information element identifier (IEI);
- a length indicator (LI);
- a value part.

A standard IE has one of the formats shown in table 11.1:

**Table 11.1: Formats of information elements**

| Format | Meaning | IEI present | LI present | Value part present |
|---|---|---|---|---|
| T | Type only | yes | no | no |
| V | Value only | no | no | yes |
| TV | Type and Value | yes | no | yes |
| LV | Length and Value | no | yes | yes |
| TLV | Type, Length and Value | yes | yes | yes |

Some IEs may appear in the structure, but not in all instances of messages. An IE is then said to be present or not present in the message instance. If an IE is not present in a message instance, none of the three parts is present. Otherwise, parts must be present according to the IE format.

In the message structure, an IE that is allowed not to be present in all message instances is said not to be mandatory. Other IEs are said to be mandatory.

#### 11.2.1.1.1 Information element type and value part

Every standard IE has an information element type which determines the values possible for the value part of the IE, and the basic meaning of the information. The information element type describes only the value part. Standard IEs of the same information element type may appear with different formats. The format used for a given standard IE in a given message is specified within the description of the message.

The value part of a standard IE either consists of a half octet or one or more octets; the value part of a standard IE with format LV or TLV consists of an integral number of octets, between 0 and 255 inclusive ; it then may be empty, i.e., consist of zero octets; if it consists of a half octet and has format TV, its IEI consists of a half octet, too. The value part of a standard IE may be further structured into parts, called fields.

#### 11.2.1.1.2 Length indicator

When present, the LI of a standard IE consists of one octet. It contains the binary encoding of the number of octets of the IE value part. The length indicator of a standard IE with empty value part indicates 0 octets. Standard IE of an information element type such that the possible values may have different values must be formatted with a length field, i.e., LV or TLV.

#### 11.2.1.1.3 Information element identifier

When present, the IEI of a standard IE consists of a half octet or one octet. A standard IE with IEI consisting of a half octet has format TV, and its value part consists of a half octet. The value of the IEI depends on the standard IE, not on its information element type. The IEI, if any, of a given standard IE in a given message is specified within the description of the message. In some protocol specifications, default IEI values can be indicated. They are to be used if not indicated in the message specification. Non mandatory standard IE in a given message, i.e., IE which may be not be present (formally, for which the null string is acceptable in the message), must be formatted with an IEI, i.e., with format T, TV or TLV.

#### 11.2.1.1.4 Categories of IEs; order of occurrence of IEI, LI, and value part

Totally four categories of standard information elements are defined:

- information elements of format V or TV with value part consisting of 1/2 octet (type 1);
- information elements of format T with value part consisting of 0 octets (type 2);
- information elements of format V or TV with value part that has fixed length of at least one octet (type 3);
- information elements of format TLV or LV with value part consisting of zero, one or more octets (type 4);

Type 1 standard information elements of format V provide the value in bit positions 8, 7, 6, 5 of an octet (see figure 11.1) or bits 4, 3, 2, 1 of an octet (see figure 11.2).

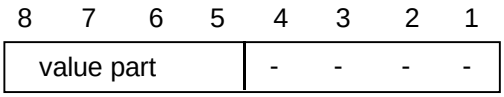



**Figure 11.1: Type 1 IE of format V**

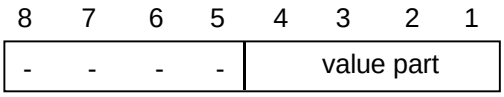



**Figure 11.2: Type 1 IE of format V**

Type 1 standard information elements of format TV have an IEI of a half octet length; they provide the IEI in bit positions 8, 7, 6, 5 of an octet and the value part in bit positions 4, 3, 2, 1 of the same octet, see figure 11.3.

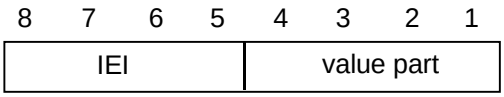



**Figure 11.3: Type 1 IE of format TV**

A type 2 standard IE has format T; its IEI consists of one octet, its value part is empty, see figure 11.4.

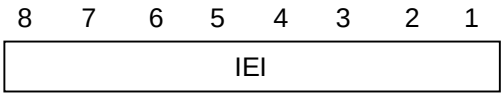



**Figure 11.4: Type 2 IE**

A type 3 standard information element has format V or TV; if it has format TV, its IEI consists of one octet and proceeds the value part in the IE. The value part consists of at least one octet. See figure 11.5 and figure 11.6.

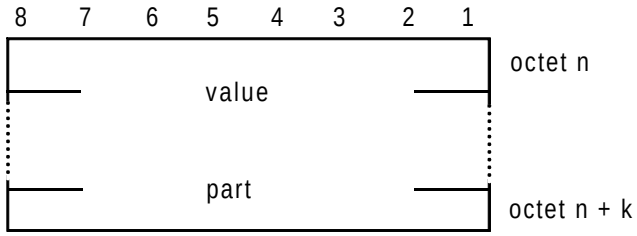



**Figure 11.5: Type 3 IE of format V (k = 0, 1, 2, ...)**

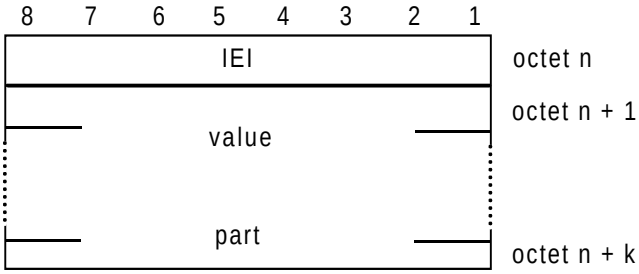



**Figure 11.6: Type 3 IE of format TV (k = 1, 2, ...)**

A type 4 standard information element has format LV or TLV. Its LI precedes the value part, which consists of zero, one, or more octets; if present, its IEI has one octet length and precedes the LI. See figure 11.7 and figure 11.8.

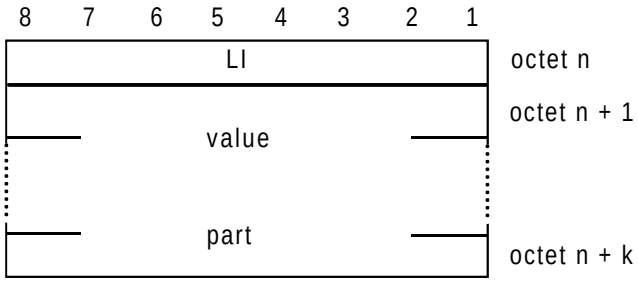



**Figure 11.7: Type 4 IE of format LV (k = 0, 1, 2, ...)**

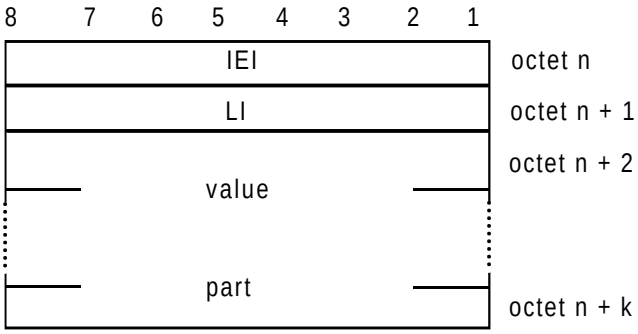



**Figure 11.8: Type 4 IE of format TLV (k = 1, 2, ...)**

### 11.2.2 Description methods for IE structure

Standard IEs can be further structured in parts called fields. Two description methods are recommended and described hereafter.

#### 11.2.2.1 Tables

According to this description method, the IE is presented in its maximum format, i.e., T, TV or TLV, in a picture representing the bits in a table, each line representing an octet. Bits appear in the occidental order, i.e., from left of the page to right of the page, and from top of the page to bottom of the page.

Boxes so delimited contains typically the field name, possibly an indication of whéich bits in the field are in the box, and possibly a value (e.g., for spare bits).

A specific method can be used in the IE description to describe a branching structure, i.e., a structure variable according to the value of particular fields in the IE. This design is unusual outside type 4 IEs, and as, a design rule, should be used only in type 4 IEs.

a) The octet number of an octet within the IE is defined typically in the table. It consists of a positive integer, possibly of an additional letter, and possibly of an additional asterisk, see clause f). The positive integer identifies one octet or a group of octets.

b) Each octet group is a self contained entity. The internal structure of an octet group may be defined in alternative ways.

c) An octet group is formed by using some extension mechanism. The preferred extension mechanism is to extend an octet (N) through the next octet(s) (Na, Nb, etc.) by using bit 8 in each octet as an extension bit.
The bit value "0" indicates that the octet group continues through to the next octet. The bit value "1" indicates that this octet is the last octet of the group. If one octet (Nb) is present, the preceding octets (N and Na) shall also be present.

   In the format descriptions appearing in section 10.5.1 to 10.5.4, bit 8 is marked "0/1 ext" if another octet follows. Bit 8 is marked "1 ext" if this is the last octet in the extension domain.

   Additional octets may be defined in later versions of the protocols ("1 ext" changed to "0/1 ext") and equipments shall be prepared to receive such additional octets; the contents of these octets shall

be ignored. However the length indicated in sections 9 and 10 only takes into account this version of the protocols.

d) In addition to the extension mechanism defined above, an octet (N) may be extended through the next octet(s) (N+1, N+2 etc.) by indications in bits 7-1 (of octet N).

e) The mechanisms in c) and d) may be combined.

f) Optional octets are marked with asterisks (*). As a design rule, the presence of absence of an optional octet should be determinable from information in the IE and preceding the optional octet. Care should be taken not to introduce ambiguities with optional octets.

#### 11.2.2.1.1 Compact notation

The compact notation described in Annex B can be used to describe the value part of a standard IE. This method is recommended for complex structures, or for a branching structure not respecting octet boundaries.

### 11.2.3 Imperative part of a standard L3 message

The imperative part of a standard L3 message is composed a header possibly followed by mandatory standard IEs having the format V or LV.

#### 11.2.3.1 Header

The header of a standard L3 message is composed of two octets, and structured in three main parts, the protocol discriminator (1/2 octet), a message type octet, and a half octet used in some cases as a Transaction Identifier and called skip indicator otherwise.

#### 11.2.3.1.1 Protocol discriminator

Bits 1 to 4 of the first octet of a standard L3 message contain the protocol discriminator (PD) information element. The PD identifies the L3 protocol to which the standard layer 3 message belongs. The correspondence between L3 protocols and PDs is one-to-one.

For future evolution an extension mechanism is foreseen which allows the use of protocol discriminators with one octet length, where bits 4 to one are coded as 1 1 1 0. Messages of such protocols may not be standard L3 messages. In particular, the rest of the header may not respect the structure described in this sub-clause.

The PD can take the following values:

**Table 11.2: Protocol discriminator values**

| **bits 4 3 2 1** | |
|---|---|
| 0 0 0 0 | group call control |
| 0 0 0 1 | broadcast call control |
| 0 0 1 0 | PDSS1 |
| 0 0 1 1 | call control; call related SS messages |
| 0 1 0 0 | PDSS2 |
| 0 1 0 1 | mobility management messages |
| 0 1 1 0 | radio resources management messages |
| 1 0 0 1 | SMS messages |
| 1 0 1 1 | non call related SS messages |
| 1 1 1 0 | reserved for extension of the PD to one octet length |
| 1 1 1 1 | reserved for tests procedures described in GSM 11.10 |

If the network receives, on a SAP where it expects standard L3 messages, a message with a protocol discriminator different from those specified in table 11.2, the network may ignore the message or initiate the channel release procedure defined in GSM 04.08.

If the Mobile Station receives, on a SAP where it expects standard L3 messages, a standard L3 message with a protocol discriminator different from those specified in table 11.2, or for a protocol that it does not support, the Mobile Station shall ignore the message.

#### 11.2.3.1.2 Skip indicator

Bits 5 to 8 of octet 1 of a standard L3 message may be used differently, depending on the protocol and the SAP. The use of this half-octet is consistent for a given PD and SAP. One possibility is that this half-octet contains the skip indicator. Unless otherwise specified in the protocol, the skip indicator IE is a spare field.

#### 11.2.3.1.3 Transaction identifier

A L3 protocol may define that bits 5 to 8 of octet 1 of a standard L3 message of the protocol contains the transaction identifier (TI). The TI allows to distinguish up to 16 different bi-directional messages flows for a given PD and a given SAP. Such a message flow is called a transaction.

The TI IE is coded as shown in figure 11.9 and table 11.3. It is composed of the TI value and the TI flag.

The TI value and the TI flag occupy bits 5 - 7 and bit 8 of the first octet respectively.

Transactions are dynamically created, and their TI value is assigned at creation time. TI values are assigned by the side of the interface initiating a transaction. At the beginning of a transaction a free TI value (i.e., a value not yet used for the given PD, the given SAP, and with the given initiator) is chosen and assigned to this transaction. It then remains fixed for the lifetime of the transaction. After a transaction ends, the associated TI value is free and may be reassigned to a later transaction.

Two identical TI values may be used when each value pertains to a transaction initiated by the different sides of the interface. In this case the TI flag shall avoid ambiguity. The transaction identifier flag can take the values "0" or "1". The TI flag is used to identify which side of the interface initiated the transaction. A message has a TI flag set to "0" when it belongs to transaction initiated by its sender, and to "1" otherwise.

Hence the TI flag identifies who allocated the TI value for this transaction and the only purpose of the TI flag is to resolve simultaneous attempts to allocate the same TI value.

The TI may in future evolutions of the L3 protocols be extended by using a combination of bits in the TI value field that is specified as "reserved for future extension" in table 11.3. In the present version, messages received on a SAP where standard L3 messages are expected and with a TI of TI value 111 may be ignored.

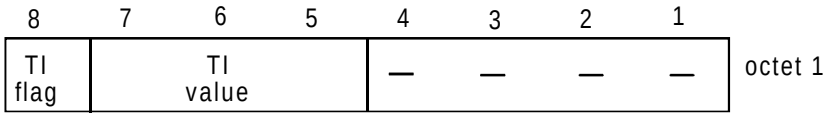



**Figure 11.9: Transaction identifier**

**Table 11.3. Transaction identifier**

| | |
|---|---|
| TI flag (octet 1) | |
| Bit | |
| 8 | |
| 0 | The message is sent from the side that originates the TI |
| 1 | The message is sent to the side that originates the TI |
| | |
| TI value (octet 1) | |
| Bits | |
| 7 6 5 | |
| 0 0 0 | TI value 0 |
| 0 0 1 | - - 1 |
| 0 1 0 | - - 2 |
| 0 1 1 | - - 3 |
| 1 0 0 | - - 4 |
| 1 0 1 | - - 5 |
| 1 1 0 | - - 6 |
| 1 1 1 | Reserved for future extension. |

#### 11.2.3.2 Message type octet

The message type octet is the second in a standard L3 message.

When a standard L3 message is expected, and a message is received that is less than 16 bit long, that message shall be ignored.

The message type IE is coded as shown in figure 11.10.

Bit 8 is encoded as "0"; value "1" is reserved for possible future use as an extension bit. A protocol entity expecting a standard L3 message, and receiving a message containing bit 8 of octet 2 encoded as "1" shall diagnose a " message not defined for the PD" error and treat the message accordingly.

In messages sent using the transmission functionality provided by the RR layer to upper layers, and sent from the mobile station to the network , bit 7 of octet 2 is used by the RR protocol.

In all other standard layer 3 messages bit 7 is set to 0 A protocol entity expecting a standard L3 message, and not using the transmission functionality provided by the RR layer, and receiving a message containing bit 7 of octet 2 encoded as 1 shall diagnose a "message not defined for the PD" error and treat the message accordingly.

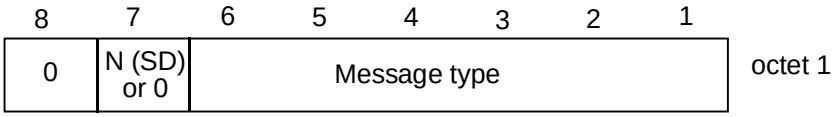



**Figure 11.10: Message type IE**

Bit 1 to 6 of octet 2 of standard L3 messages contain the message type.

The message type determines the function of a message within a protocol in a given direction and for a given lower layer SAP. The meaning of the message type is therefore dependent on the protocol (the same value may have different meanings in different protocols), the direction (the same value may have different meanings in the same protocol, when sent from the Mobile Station to the network and when sent from the network to the Mobile Station) and the lower layer SAP (the same value may have different meanings, e.g., whether the message was sent on the SACCH or on the main DCCH).

Each protocol defines a list of allowed message types for each relevant SAP. A message received analysed as a standard L3 message, and with a message type not in the corresponding list leads to the diagnosis "message not defined for the PD". Some message types may correspond to a function not implemented by the receiver. They are then said to be non implemented by the receiver.

The reaction of a protocol entity expecting a standard L3 message and receiving a message with message type not defined for the PD or not implemented by the receiver and the reception conditions is defined in the relevant protocol specification. As a general rule, a protocol specification should not force the receiver to analyse the message further.

#### 11.2.3.3 Standard information elements of the imperative part

The message type octet of a standard L3 message may be followed by mandatory standard IEs having the format V or LV as specified in the message description in the relevant protocol specification.

As a design rule, octet boundaries must be respected. This implies that half-octet standard IEs (i.e., V formatted type 1 standard IEs) must appear by pair.

If message is received as a standard L3 message, and that is too short to contain the complete imperative part as specified in the relevant protocol specification, an imperative message part error is diagnosed. (The same error may be diagnosed at detection of certain contents of the imperative part of a message; this is defined in the relevant protocol specification.) The treatment of an imperative message part error is defined in the relevant protocol specification.

### 11.2.4 Non-imperative part of a standard L3 message

The imperative part of a standard L3 message is followed by the (possibly empty) non-imperative part. The relevant protocol specification defines where the imperative part of a standard L3 message ends. The non-imperative part of a standard L3 message is composed of (zero, one, or several) standard IEs having the format T, TV, or TLV. The receiver of a standard L3 message shall analyse the non imperative part as a succession of standard IEs each containing an IEI, and shall be prepared for the non-imperative part of the message to contain standard IEs that are not specified in the relevant protocol specification.

An IEI may be known in a message or unknown in a message. Each protocol specification lists, for each message (i.e., according to the message type, the direction and the lower layer SAP), the known standard IEs in the non-imperative part.

An IEI that is known in a message designates the IE type of the IE the first part of which the IEI is, as well as the use of the information. Which IE type it designates is specified in the relevant protocol specification. Within a message, different IEIs may designate the same IE type if that is defined in the relevant protocol specification.

Whether the second part of an IE with IEI known in a message is the length or not (in other words, whether the IEI is the first part of an IE formatted as TLV or not) is specified in the relevant protocol specification.

Unless otherwise specified in the protocol specification, the receiver shall assume that IE with unknown IEI are TV formatted type 1, T formatted type 2 or TLV formatted type 4 standard IEs. The IEI of unknown IEs together with, when applicable, the length indicator, enable the receiver to determine the total length of the IE, and then to skip unknown IEs. The receiver shall assume the following rule for IEs with unknown IEI :

Bit 8 of the IEI octet is set to "1" indicates a TV formatted type 1 standard IE or a T formatted type 2 IEs, and to "0" indicates a TLV formatted type 4 IE. Hence, a 1 valued bit 8 indicates that the whole IE is one octet long, and a 0 valued bit 8 indicates that the following octet is a length octet.

As a design rule, it is recommended that IEIs of any TV formatted type 1, T formatted type 2 or TLV formatted type 4 IE follow the rule, even if assumed to be known by all potential receivers.

A message may contain two or more IEs with equal IEI. Two IEs with the same IEI in a same message must have the same format, and, when of type 3, the same length. More generally, care should be taken not to introduce ambiguities by using an IEI for two purposes. Ambiguities appear in particular when two IEs potentially immediately successive have the same IEI but different meanings and when both are non-mandatory. As a recommended design rule, messages should contain a single IE of a given IEI.

Each protocol specification may put specific rules for the order of IEs in the non-imperative part. An IE known in the message, but at a position non compliant with these rules is said to be out of sequence. An out of sequence IE is decoded according to the format, and, when of type 3 the length, as defined in the message for its IEI.

### 11.2.5 Presence requirements of information elements

The relevant protocol specification may define three different presence requirements (M, C, or O) for a standard IE within a given standard L3 message:

- M ("Mandatory") means that the IE shall be included by the sending side, and that the receiver diagnoses a "missing mandatory IE" error when detecting that the IE is not present. An IE belonging to the imperative part of a message has presence requirement M. An IE belonging to the non-imperative part of a message may have presence requirement M;

- C ("Conditional") means:

  * that inclusion of the IE by the sender depends on conditions specified in the relevant protocol specification;

  * that there are conditions for the receiver to expect that the IE is present and/or conditions for the receiver to expect that the IE is not present in a received message of a given PD, SAP and message type; these conditions depend only on the content of the message itself, and not for instance on the state in which the message was received, or on the receiver characteristics; they are known as static conditions;

  * that the receiver detecting that the IE is not present when sufficient static conditions are fulfilled for its presence, shall diagnose a "missing conditional IE" error;

  * that the receiver detecting that the IE is present when sufficient static conditions are fulfilled for its non-presence, shall diagnose an "unexpected conditional IE" error.

  Only IEs belonging to the non-imperative part of a message may have presence requirement C;

- O ("Optional") means that the receiver shall never diagnose a "missing mandatory IE" error, a "missing conditional IE" error, or an "unexpected conditional IE" error because it detects that the IE is present or that the IE is not present. (There may however be conditions depending on the states, resources, etc. of the receiver to diagnose other errors.) Only IEs belonging to the non-imperative part of a message may have presence requirement O.

Unless otherwise specified the presence of a IE of unknown IEI or of an out of sequence IE shall not lead by itself to an error. An alternative specification is the ‘comprehension required’ scheme specified hereafter. The comprehension required scheme is to be applied if explicitly indicated in the protocol specification.

The ‘comprehension required’ scheme is specified as follows. The reception of an unknown or out of sequence IE with bit 5, 6 and 7 set to 0 shall lead to the diagnosis of an "non-existent information element" error.

### 11.2.6 Description of standard L3 messages

This sub-clause describes a generic description method for standard L3 messages, the tabular description. Protocol specification may follow other methods.

A standard L3 message is described by a table listing the header elements and the standard IEs in the message. For each element is given

- if applicable the IEI, in hexadecimal representation (one digit followed by and hyphen for TV formatted type 1, and two digits for the other cases);

- The name of the IE (this is used in particular for the description of conditional presence rules);

- The type of the information element, with a reference of where the internal structure of the value part is specified;

- The format of the standard IE (T, V, TV, LV or TLV); and

- The length, or the range of lengths, of the whole standard IE, including when applicable the T and L parts.

The list of elements is given in the table in the order they appear in the resulting bit string, with the exception of half-octet elements in the imperative part : half octets in a pair are inverted. This applies in particular for the two first header elements : the protocol discriminator appears first in a table describing a standard L3 message.

## 11.3 Non standard L3 messages

In some protocols, the structure of part or all of the messages might not always follow the standard L3 message structure. As a design rule, this should be consistent for a given protocol, direction and lower layer SAP.

A possibility is to describe the message with the compact notation described in Annex B.

A few consistent structures are found in the present protocol specifications, and are described hereafter.

Other structures can be described directly in the protocol specifications.

### 11.3.1 Case A : BCCH and AGCH/PCH messages

In these cases, the SAP capability is for fixed length messages. The messages are structured as standard L3 messages plus one octet in front, the L2 pseudo length octet, and a rest octet part at the end.

#### 11.3.1.1 L2 Pseudo Length octet

This octet, the L2 pseudo length indicator octet, indicates the length in octets of the subsequent octet string that can be analysed as a standard L3 message .

The octet is structured as follows :

Bits 3 to 8 encodes in binary the L2 pseudo length, i.e., the length of the part to be analysed as a standard L3 message ;

Bit 2 is set to "0" ;

Bit 1 is set to "1".

A receiver expecting a message so structured and receiving a message with bit 1 of octet 1 (i.e., the $8^{th}$ bit of the message) set to "1" and bit 2 of octet 1 (i.e., the $7^{th}$ bit of the message) different from "0", shall abandon the analysis of the message.

A receiver expecting a message so structured and receiving a message with an L2 pseudo length indicator encoding 0 or 1 shall skip the indicated number of octets and not try to analyse the standard L3 message part.

A receiver expecting a message so structured and receiving a L2 pseudo length indicator bigger than what is compatible with the SAP capability shall abandon the analysis of the message.

#### 11.3.1.2 Rest Octets

The part after the part structured as a standard L3 message, and up to the end of the message as constrained by lower layers, is presented as a non standard IE of variable length (sometime indicated as of type 5), the ‘rest octets’ IE.

The rest octets element may be described by table description, or, preferably, using the compact notation described in Annex B of this document.

#### 11.3.1.3 Description of a modified standard L3 message

The description can be provided in the same way as a standard L3 message, with in the case of a tabular description one non standard IE at the beginning (of type L2 pseudo length), and one non standard IE at the end.

### 11.3.2 Case B : SACCH messages sent in unacknowledged mode

The messages are structured either as standard L3 messages, or in the so-called short header format. The value of the $8^{th}$ bit (bit 1 of octet 1) of the link layer PDU distinguishes the two cases. In the case of the short header, the L3 message is the same bit string as the link layer PDU, and has a fixed length. The following description includes the 2-bit link layer header.

#### 11.3.2.1 The first octet

Bits 1 and 2 are the link layer header. Bit 2 of octet 1 is set to "0", and bit 1 is reserved for the link layer.

A protocol discriminator is the first part of the message (starting bit 8 of octet 1). The protocol discriminator field may have different lengths. The following protocol discriminator is defined :

0 RR

All additional PD defined for this structure shall start by 1. The reception of a message with bit 8 of octet 1 set to 1 when expecting a message structured as defined by this clause shall be diagnosed as an unknown PD, and the message ignored.

As a design rule, a message type field should follow the PD, and of a length such that the PD and the message type fit in the 6 first bits of the message.

#### 11.3.2.2 The rest of the message

The rest of the structure is not more constrained.

The preferred description method is the one described in Annex B.

### 11.3.3 Design guidelines for non standard parts

The guidelines in this sub-clause apply to non standard parts, such as rest octets, short header broadcast message or fully non standard L3 messages.

#### 11.3.3.1 General

The structure should be as far as possible be such that the analysis can be conducted from beginning to end. In other terms, the conditions determining the syntactic analysis of a part (e.g., tags, lengths) should appear before that part.

The part should be structured as a succession of information elements, each carrying an elementary semantic information. An information element should be composed of (possibly) a tag, than (possibly) a length indicator, then a value part.

Tags can be of fixed or variable length, their extent being analysable from beginning to end. A typical tagging is the one bit tagging, which should preferably used as follows : value "0" indicates that the IE is no more than the tag bit, and "1" indicates that the IE continues at least with the next bit.

Variable length tagging should be used to distinguish between several possible formats of the element. Tag lengths are then chosen according to packing efficiency criteria.

The T field of standard IEs can be presented as a variable tagging with only two lengths : 4 and 8 bits.

The length indicator can be of fixed or variable length, their extent being analysable from beginning to end. It should preferably be presented as encoding the length in bits of the value part.

The L field of standard IEs can be presented as a fixed length (one octet) length indicator which can encode only lengths multiple of 8 bits.

The value part can be described as further structured, in a similar way. This can be used to help the reading, and to cover some presence dependence.

### 11.4 Handling of superfluous information

All equipment should be able to ignore any extra information present in an L3 message, which is not required for the proper operation of that equipment. For example, a mobile station may ignore the calling party BCD number if that number is of no interest to the Mobile Station when a SETUP message is received.

#### 11.4.1 Information elements that are unnecessary in a message

The relevant protocol specification may define certain IEs to be under some conditions unnecessary in a L3 message. A protocol entity detecting an unnecessary IE in a received L3 message shall ignore the contents of that IE for treating the message; it is not obliged to check whether the contents of the IE are syntactically correct.

#### 11.4.2 Other syntactic errors

This section applies to the analysis of the value part of an information element. It defines the following terminology:

- An IE is defined to be syntactically incorrect in a message if it contains at least one value defined as "reserved", or if its value part violates syntactic rules given in the specification of the value part. However it is not a syntactical error that a type 4 standard IE specifies in its length indicator a greater length than possible according to the value part specification : extra bits are ignored.

- A message is defined to have semantically incorrect contents if it contains information which, possibly dependant on the state of the receiver, is in contradiction to the resources of the receiver and/or to the procedural part.

## Annex A (informative): MN-Services arrow diagram

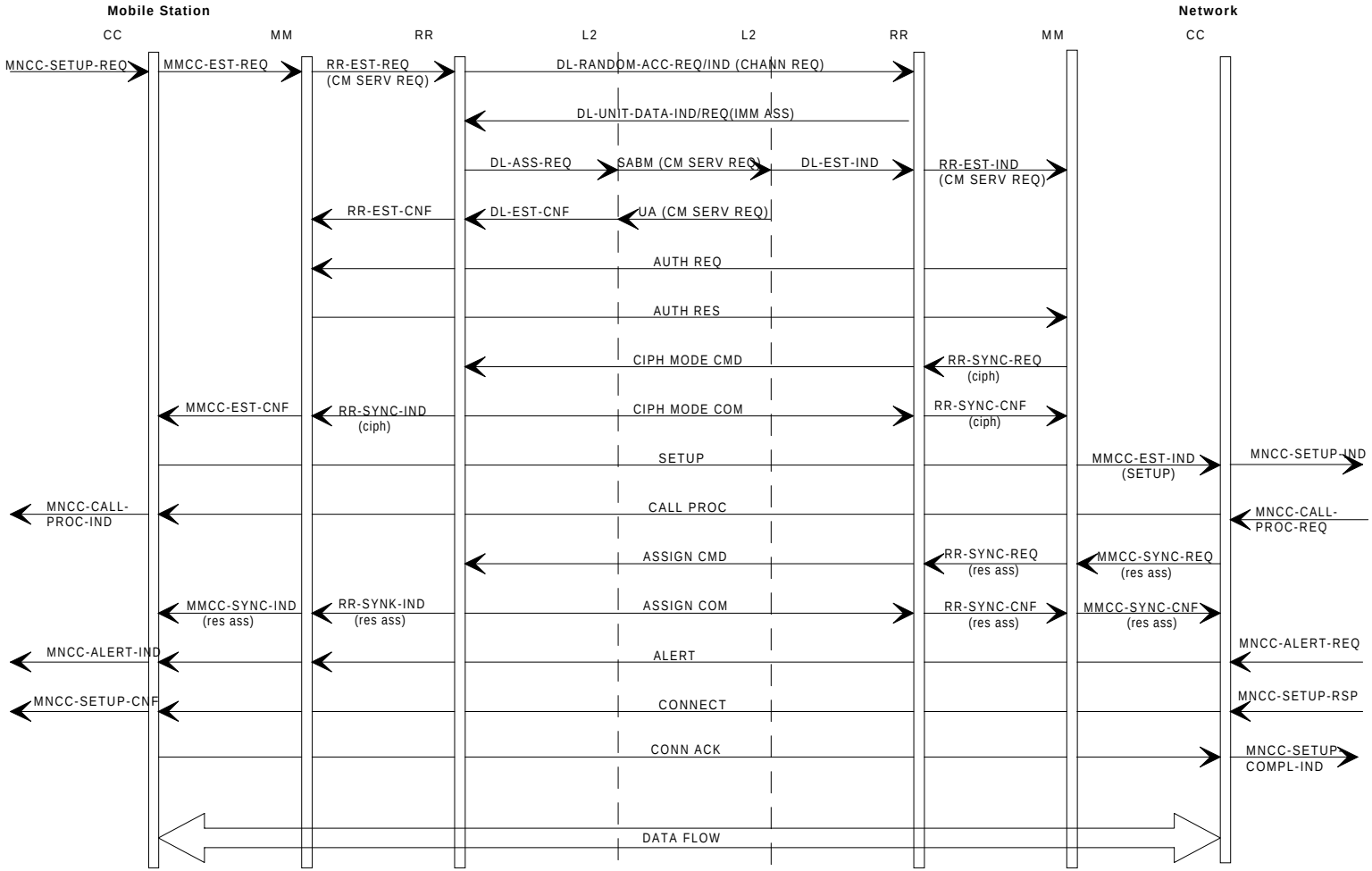



**Figure A.1: Mobile originated Call Setup. Successful case**

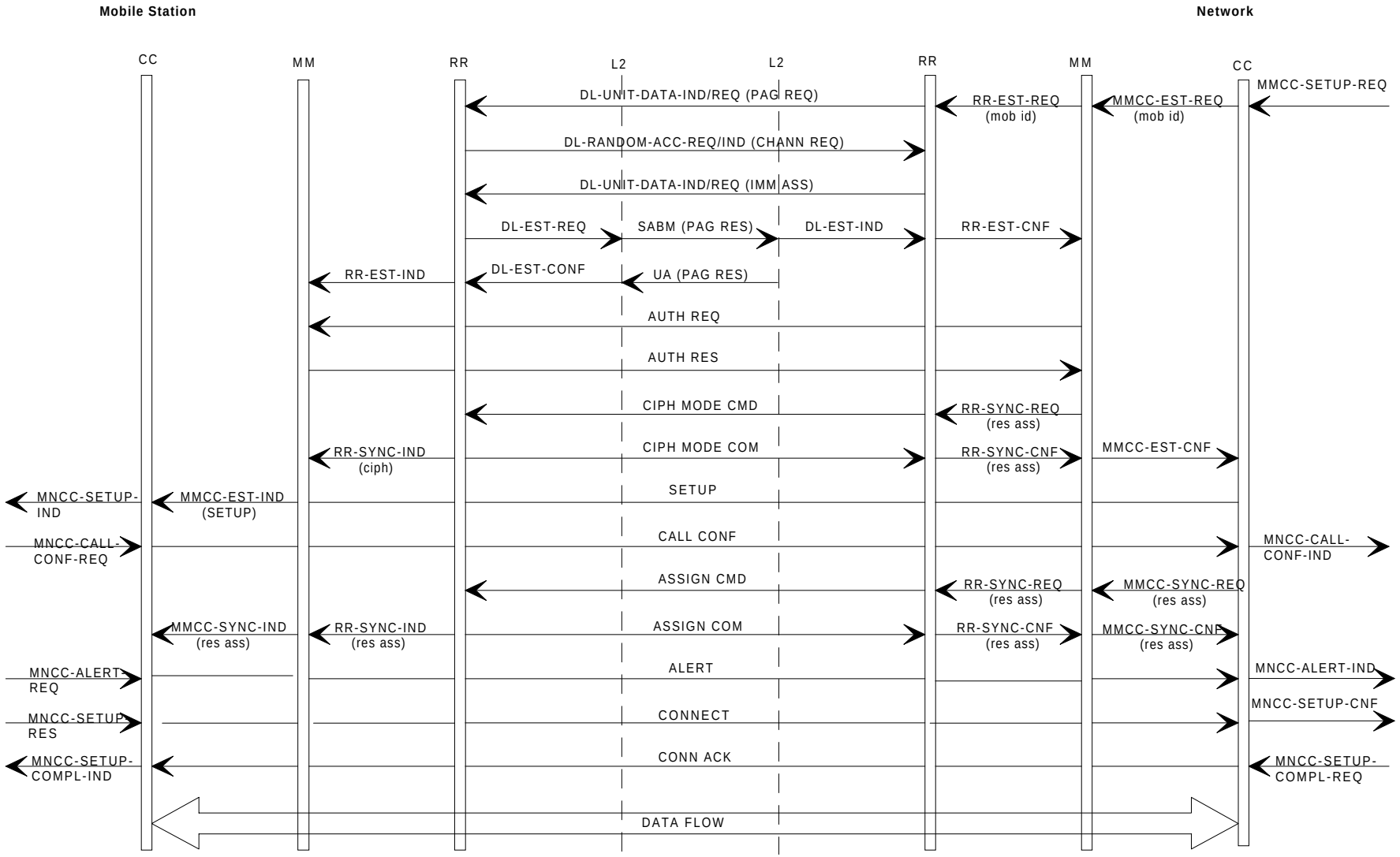



**Figure A.2: Mobile terminated Call Setup. Successful case**

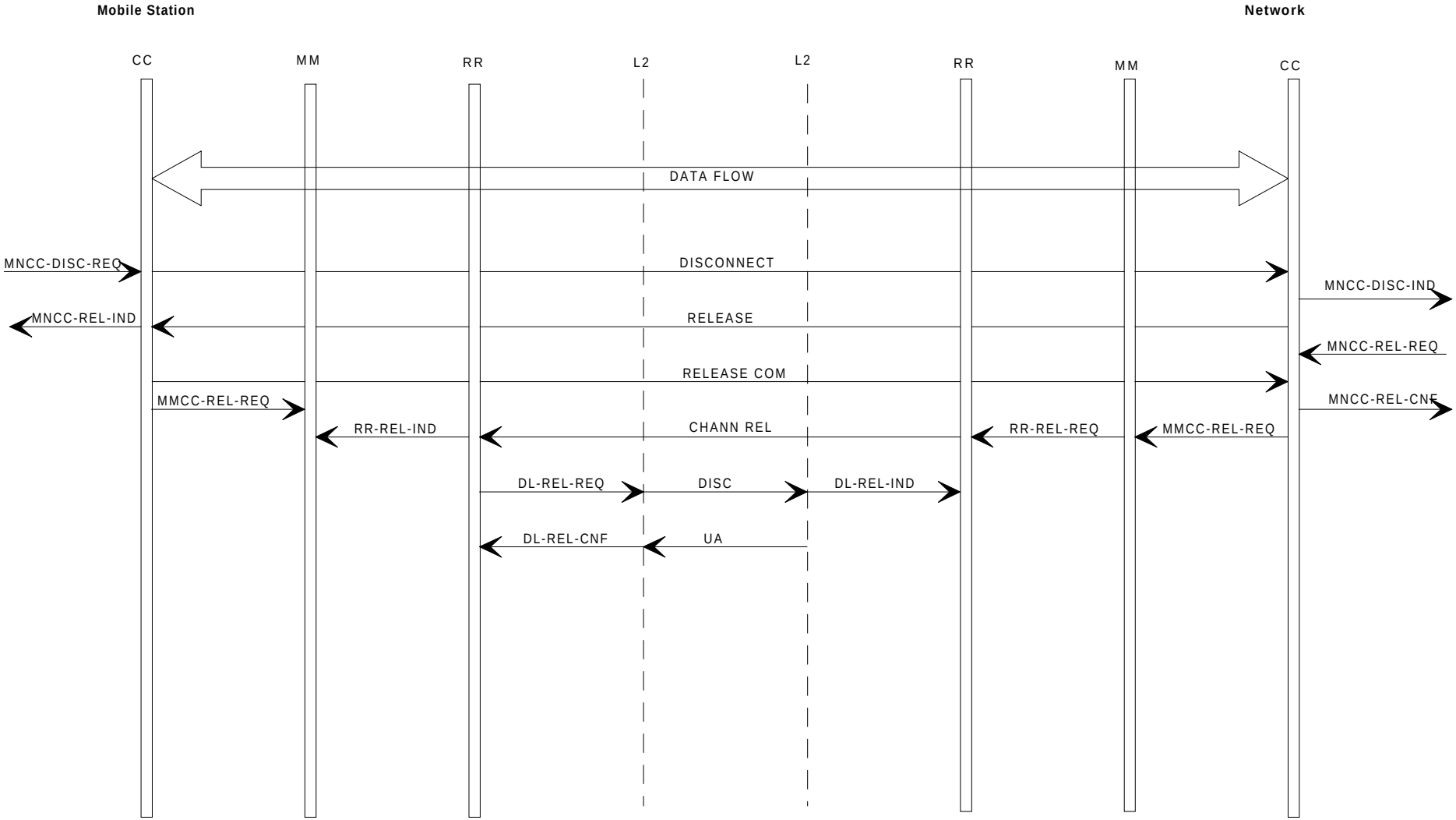



**Figure A.3: Mobile originated, Call Release and Channel Release. Successful case**

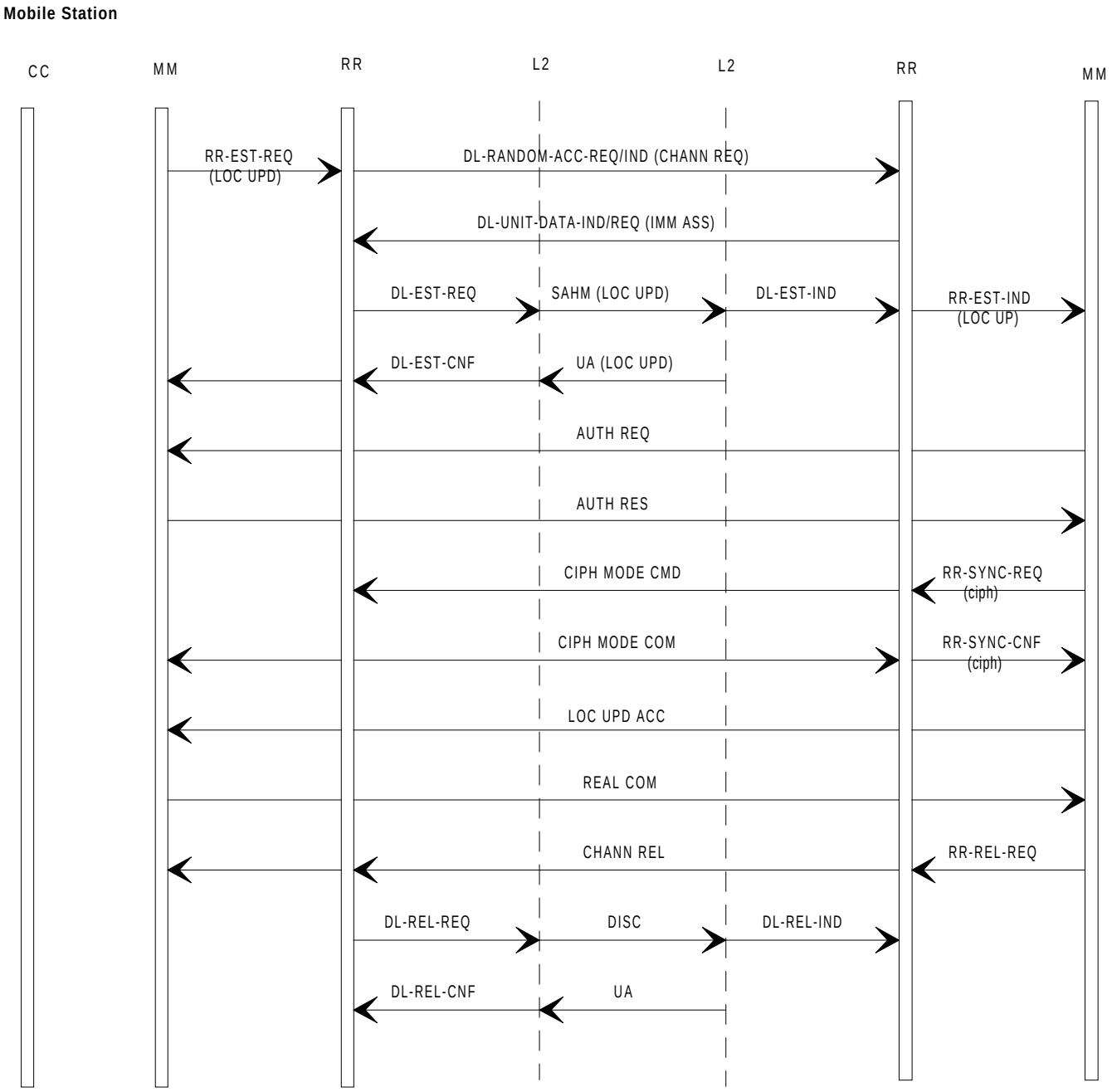



**Figure A.4: Location updating. Successful case**

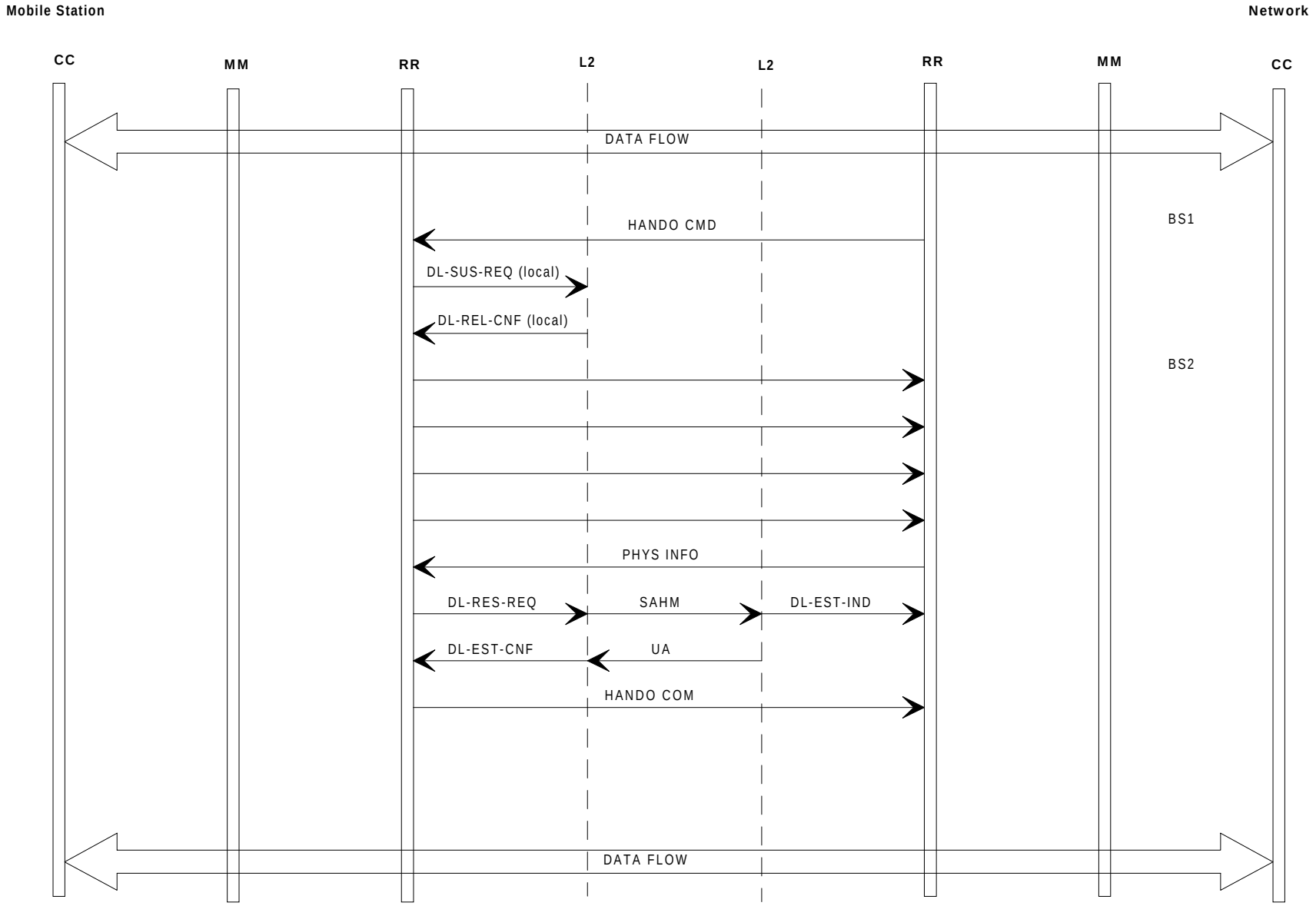



**Figure A.5: Handover. Successful case**

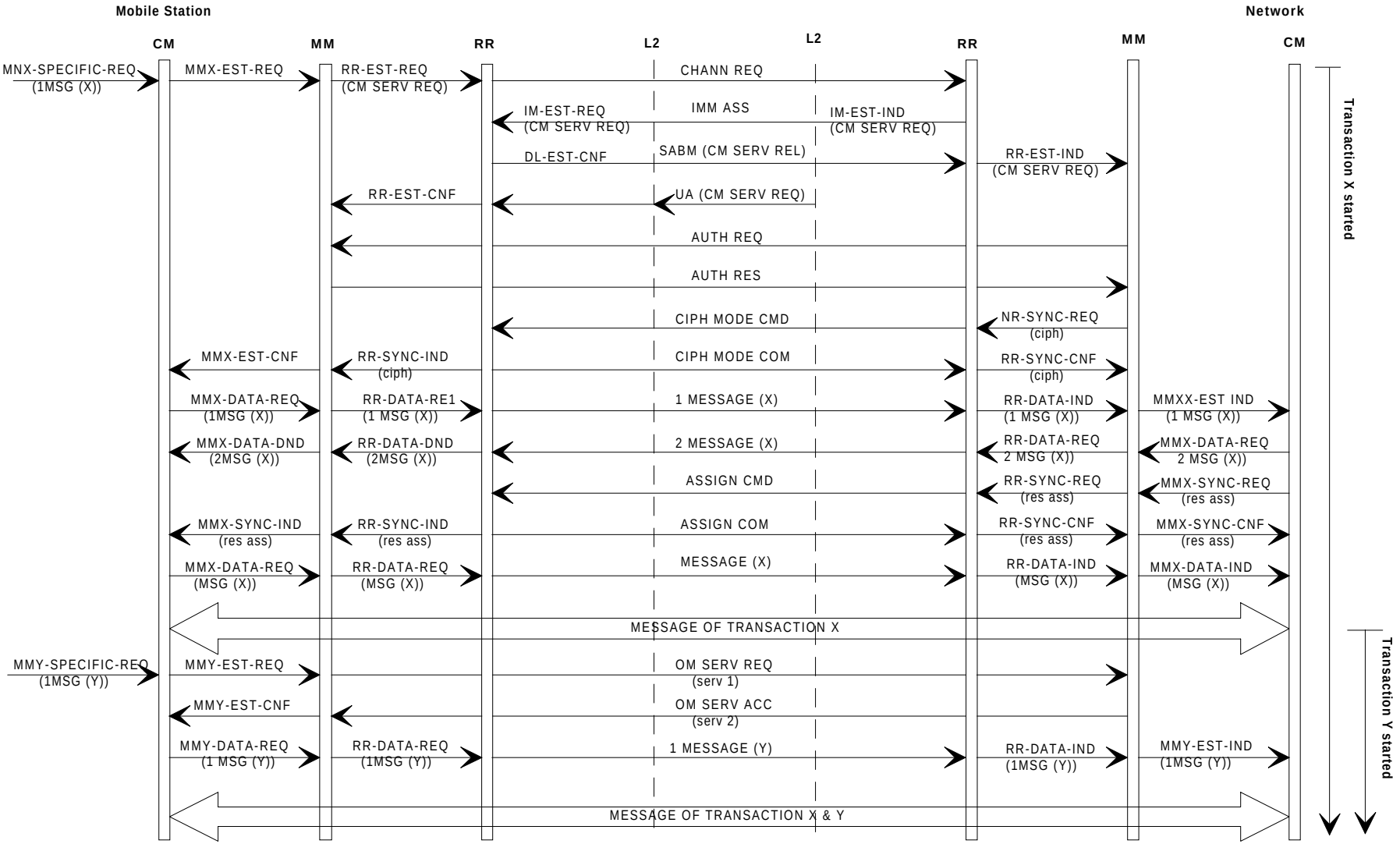



**Figure A.6: Establishment of parallel transactions (General view)**

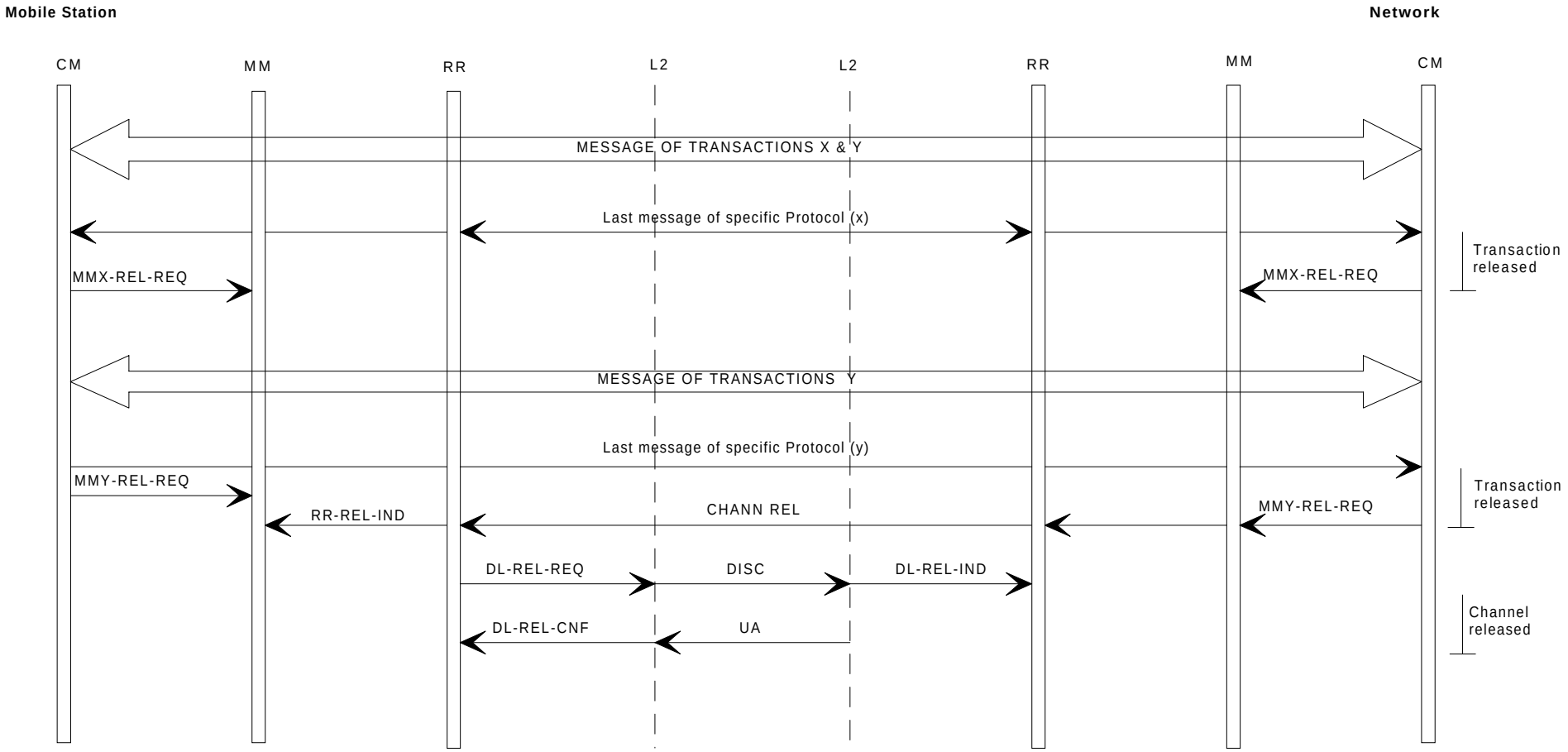



**Figure A.7: Release of parallel transactions (General view)**

# Annex B (informative): Description of CSN.1

The goal of the notation described hereafter is to describe the structure of the syntactically correct messages for a given signalling protocol, or of part of such messages. The notation addresses the cases where the concrete messages are binary strings. The notation allows to describe *sets* of strings : the structure of a message defined a protocol defines a set of allowable bit strings. It also allows to put labels on parts of strings that follow a given structure.

One aspect of the specification of message set is to define the set of strings that are acceptable as when received. All the strings that cannot be recognised as syntactically correct messages are to be rejected for syntactical reasons. In many cases, only a subset of this set are allowed to be sent. The notation allows also to distinguish the set of the strings that can be sent and the set of strings that are recognised as syntactically correct.

Another aspect of the specification of messages is the splitting of an acceptable string in a number of sub-strings that will be use to derive the exact significance of the message. The notation provides this function by labelling sub-strings. These labels can then in turn be used in textual or formal semantic descriptions which are not covered in this document.

The notation described here could be enhanced in the future, with the addition of new rules.

## B.1 The Basic Rules

The following rules (B1 to B6) form the core part of the notation, more or less directly inherited from BNF. Rules B7 to B8 add what is needed in addition to encode the rest octet parts of fixed length messages as defined in GSM 04.08.

Rule A1 is not needed to describe sets of strings at this stage. It is the one allowing to label parts of messages.

### B.1.1 Core Rules

#### B.1.1.1 Rule B1 : Bits

A "bit string" is an ordered sequence of symbols, each belonging to a two-value set.

The character "0" and "1" are used to indicate one bit, respectively of one or the other value.

Formally, the notations « 0 » and « 1 » denote each a set composed of a single bit string of a single bit, of different values.

#### B.1.1.2 Rule B2 : Null String

Where needed, the word "null" call be used to indicate the null string, i.e., the string of no symbols.

Formally, the notation « null » denote the set composed of a single bit string, the empty string.

#### B.1.1.3 Rule B3 : Concatenation

A succession of two string descriptions describe the concatenation of the strings.

More formally : a succession of two string descriptions describes the strings obtained by concatenation of one string taken in the subset described by the first string description and then one string taken in the subset described by the second string description. The rule extends to any number of string descriptions.

For instance

| |
|---|
| 00 |

This denotes the set composed of the single bit string of length 2 composed of two zeros.

#### B.1.1.4 Rule B4 : Choice

A list of choices is noted using as separator the character "|". An alternative notation uses instead the word "or" (this is not used in this document).

Note : An idea is to allow not to used strange characters, by giving in each case a verbose equivalent. This is not done systematically yet in this document.

Formally : the notation A | B, where A and B are string set descriptions, describes the set of the strings which are in the set described by A or in the set described by B, that is the union of sets described by A and B.

The concatenation has a higher precedence than the choice.

Examples:

```
00 | 01
```

This indicates that bit strings 00 and 01 are part of the set (10 and 11 are not).

The characters "{" and "}" are used for delimiting a string set description from what follows and/or precedes.

```
0 {0|1}
```

This indicates the same set of bit strings as in the previous case.

Precedence example :

```
10 | 11
1 0|1
```

Because of the priority rule, the two descriptions are not equivalent, the second noting the set (10, 1).

It is allowed that the different sets in a choice have non null intersections. To allow message decoding, a rule must then be given to choose the branch. The rule is that any matching set can be chosen (the concatenation is a true set union).

In practice, it is preferable to have non intersecting choice sets. Moreover, the ability to select the branch to take rapidly is important for obtaining simple message decoders. Except for strong reasons, a design should only include choice construction that can be rewritten using only constructions matching the pattern {*a*1 *s*1 |*a*2 *s*2} where *a*1 and *a*2 are non-intersecting sets of strings of the same non-null length. A tolerable derogation is to use intersecting *a*n.

Examples:

{100 xx | 001 zz} is acceptable.

{00 xx | 010 yy | 011 zz} is acceptable, since it can be rewritten {00 xx | 01 {0 yy | 1 zz}}.

{{00|01|10} xx | {00|11} yy} is not recommended (the start 00 is ambiguous).

In practice this covers fixed length tagging (like tagging by an IEI, or 1-bit tagging in rest octets), and also non-intersecting variable length tagging as used for instance in the frequency list IE (tag list such as 0, 100, 101, 110, 11100, 11101, 11110, 11111, where no tag is the start of another one).

#### B.1.1.5 Rule B5 : Naming

The characters "<" and ">" are used to delimit a *reference* to the description of a string set. This can be used inside a string set description, to refer to a string set described elsewhere.

For compilability, the name must be used somewhere else to define the corresponding string set. For a simple description, the description of the reference could be done by normal text.

The name, that is the part sequence of characters between "<" and ">" must not be empty, and is constituted freely of characters, with the exception of "<" and ">". Case is not significant, nor are heading or tailing spaces. Any succession of space characters is treated as a single character. To avoid difficulties with more advanced rules, the use of the characters ":", "=", "(" and ")" should be avoided. More generally, it is not recommended to use many other characters, such as "<" for instance. The space character can (and should!) be used, to allow a good legibility for human beings.

Example :

```
<bit pair>
```

#### B.1.1.6 Rule B6 : Definition

A reference followed by the character sequence "::=" followed by a string set description is used to associate the description with the reference.

Recursive definition is allowed, e.g., the reference can appears on the right hand side of the "::=". To avoid too much difficulties for would-be-compilers, only tail recursivity should be used, i.e., a recursive term should appear only as the last term of a definition.

Examples:

```
<bit pair> ::= 00 | 01 | 10 | 11
```

This could have been noted as well :

```
<bit pair> ::= {00 | 01 | 10 | 11}
```

or

```
<bit pair> ::= {0|1} {0|1}
```

Recursive example :

```
<all bit strings> ::= null | { {0 | 1} <all bit strings>}
```

Another recursive, but not tail-recursive (and then not recommended) example :

```
<all bit strings> ::= null |  {<all bit strings> {0 | 1}}
```

When several descriptions are given, they are separated by the character ";", at least when compilability is looked for. For instance :

```
<bit pair> ::= {00 | 01 | 10 | 11} ;
<nibble>::= <bit pair> <bit pair>
```

### B.1.2 Spare parts

For the purpose of message description it is in many cases needed to specify differently the set of bit strings that are acceptable when received and the corresponding set of bit strings which may be sent. The second set is included in the first. A first example are the spare parts.

Notations related to spare parts are different in nature from the bit string set description seen so far. They define two sets as the same time, the sent set and the received set. A construction rule of general application will be defined in advanced rules. For the moment, only two ad-hoc constructions are described.

### B.1.2.1 Rule B7 : Spare bits

The following construction

```
<spare bit>
```

describes a 0 when emitted and a bit (0 or 1) in reception.

### B.1.2.2 Rule B8 : Padding bits

An issue specific to the GSM radio interface protocols is that in some cases the messages cannot take arbitrary lengths. Padding is then necessary to fill up the message up to the desired length. Moreover, the padding uses a particular sequence of bits, of fixed position, i.e., the value of a padding bit depends on its position relative to the start of the message. The padding sequence is protocol-specific. In most cases it is constituted of all 0 values, in which case the following notation is of no use. In the case of GSM 04.08, the padding sequence is the repetition of octet 00101011, starting on an octet boundary.

The special notations "L" and "H" are used to denote the respectively the bit value corresponding to the padding spare bit for that position, and the other value.

The notations "0", "1", "null", "L" and "H" are the only terminals in CSN.1.

Padding spare bits are bits which are set to the indicated value in emission whereas in reception any bit string is acceptable. The following notation

```
<spare L>
```

describes a bit which has a logical value L in emission, and is a bit (0 or 1) in reception

The term <implicit spare> denotes the required padding spare bits needed to fill up the message. The construction can be developed only partially from the rules described so far, because the length limitation does not appear in the following description :

```
<implicit spare> ::= <spare L> {null | <implicit spare>};
```

### B.1.3 Predefined sets

The notation allows a modular description of the messages. This means in particular the possibility to build a library of bit string set definitions to be used wherever needed. The following is an example of an elementary library, which could be specified once and can be used in other specifications without being redefined.

```
<bit> ::= 0|1 ;
<bit string(1)> ::= <bit>
<bit string(2)> ::= <bit> <bit>;
<bit string(3)> ::= <bit string(2)> <bit>;
<bit string(4)> ::= <bit string(3)> <bit>;
<bit string(5)> ::= <bit string(4)> <bit>;
<bit string(6)> ::= <bit string(5)> <bit>;
<bit string(7)> ::= <bit string(6)> <bit>;
<octet> ::= <bit string(7)> <bit>;
<half octet> ::= <bit string(4)>;
<spare half octet> ::= <spare bit><spare bit><spare bit><spare bit>;
        <spare padding> ::= <spare L> {null | <spare padding>};
        <bit string> ::= null | <bit> <bit string> ;
<octet string(i)> ::= <octet>(i) ;
```

NOTE 1: The definition of generic constructions such as <bit string(i)> is somewhat cumbersome with only the basic rules. More advanced rules would allow a much more compact notation.

NOTE 2: The use of the characters "(" and ")" within a reference is done consistently with potential advanced rules.

NOTE 3: This basic library is not exhaustive and can be extended when the needs arise.

### B.1.4 Labelling Parts

#### B.1.4.1 Rule A1 : Labels

Delimited names as defined by Rule B6 identify sets of sub strings. In many cases this can be used within the context of a message to refer to the specific part of the message. However, this is not of general application, since it may happen that two parts of a message follow the same structure, and economy of notation requires that the structure is described but once.

The general syntax that follows allows to refer to a part inside a description:

| |
|---|
| <*name1* : > *string description* |

The label refers to the sub-string whose description immediately follows.

The following syntax

| |
|---|
| <*name1* : *name2*> |

is the shortcut of

| |
|---|
| <*name1* :>< *name2*> |

and can be used instead of a simple reference.

At this stage, labels has no use for describing message syntax, but can be used to refer to the corresponding part of the string, e.g., in the description of the message specifying the relationship between the syntactical content and the semantical contents of the message, or to associate properties with effective sub-strings in effective messages (rather than with sets of sub strings). Syntactical use of the semantical identifier are presented in more advanced rules.

The same name may appear in several places. Designers have to be careful to use non ambiguous names if non-ambiguous reference is desired.

### B.1.5 Goodies

#### B.1.5.1 Rule G1 : Comments

Comments can be added, starting with the term "--" and ended by the end of line. Comments can be used in particular to indicate the section where a particular description can be found.

## B.2 Advanced rules

### B.2.1 Rule A2 : Exponent notation

An arithmetic expression used as exponent after a delimited string description are used to indicate repetitions.

A numerical expression between parentheses indicates a fixed number of repetitions.

| |
|---|
| <octet> ::= {0 \| 1}$^{(8)}$ |

is equivalent to

| |
|---|
| <octet> ::= {0 \| 1} {0 \| 1} {0 \| 1} {0 \| 1} {0 \| 1} {0 \| 1} {0 \| 1} {0 \| 1} |

Simple arithmetic, using numbers, terms "+", "-", "*" and "/", and parentheses are allowed in expressions. In this case, the exponent must be fully parenthesed.

The writing :

```
<octet> ::= {0 | 1}(8)
```

is allowed, but the subscript notation should be preferred for easing the reading by human beings.

Example :

```
<octet string(4)> ::= <octet>^(8*(4+1))
```

A star used as exponent indicates a finite, possibly null, but indeterminate, number of repetitions. (The star can be understood here also as meaning the union of all the sets obtained by replacing the star by some positive integer.)

```
<all bit strings> ::= {0 |1}*
```

This allows a shorter notation of recursive constructions such as:

```
<all bit strings> ::= {null | {0|1} <all bit strings>}
```

#### B.2.1.1 Application note

The usage of indeterminately repeated fields requires some care : the receiver must be able to know how many instances there are in a message instance. Here follows some classical techniques.

Explicit number

The exact number can be given in a field preceding the repetition :

```
Construction : :=
        <Number of instances : bit string(3)>
        <repeated field>* ;
```

It should be noted that with the rules so far, the syntactic relationship between the first field and the number of instances in the variable array is not explicit with the notation.

One-bit tagging

The use of one bit in front of each instance allows to point the last instance :

```
<construction> : :=
        {1 <repeated field>}* 0 ;
```

This constructions includes the string 0, with no <repeated field>. To obtain a construction with at least one element, the one-bit tagging approach can be :

```
<construction> : :=
        <repeated field> {1 <repeated field>}* 0 ;
```

which can be noted using recursion as :

```
<construction> : :=
        <repeated field> {1 <construction> | 0} ;
```

## History

| Document history | | | |
|---|---|---|---|
| December 1995 | Publication of GSM 04.07 version 5.0.0 | | |
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