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Foreword

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document contains the definition of the SMLCPP protocol to be used between two Serving Mobile Location Centres (SMLC).

The LCS architecture is described in 3GPP TS 43.059. The following aspects of it are relevant to the issue:

- each SMLC controls a number of LMUs, and a given LMU is under the direct control of a single SMLC;
- there is a direct communication path, independent of SMLCPP, between a LMU and the SMLC that controls it;
- deciphering keys are controlled by one SMLC in the location area and sent to other SMLCs in the same location area.

SMLCPP runs between two SMLC functions in the same PLMN. Transport is outside the scope of the present document. It assumes a transport service between these functions, as provided by BSSAP-LE. The present document assumes that the underlying transport (e.g., as described by BSSAP-LE specifications) provides for transport and routing for any two pairs of SMLCs which need to run SMLCPP exchanges.

The main functions of SMLCPP are described in [5]. The key aspects are:

- a) allowing an SMLC to ask for and obtain information about Radio Interface Timing (RIT), as known from measurements done by LMUs not under its direct control;
- c) allowing an SMLC, that controls deciphering keys in the location area, to sent them to other SMLCs in the same location area.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TS 21.905: "Vocabulary for 3GPP Specifications".
- [2] (void)
- [3] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".
- [4] 3GPP TS 24.008: "Mobile radio interface layer 3 specification".
- [5] 3GPP TS 43.059: "Functional Stage 2 Description of Location Services in GERAN (Release 4)".
- [6] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".
- [7] ASN.1 encoding rules "Specification of Packet Encoding Rules (PER)" ITU-T Rec. X.691 (1997) | ISO/IEC 8825-2:1998.
- [8] (void)
- [9] Abstract Syntax Notation One (ASN.1) "Specification of Basic Notation" ITU-T Rec.X.680 (1997) | ISO/IEC 8824 – 1:1998.
- [10] (void)
- [11] 3GPP TS 44.071: "Mobile radio interface layer 3 Location Services (LCS) specification".

- [12] 3GPP TS 49.031: "Location Services (LCS); Base Station System Application Part LCS Extension (BSSAP-LE)".

3 Abbreviations

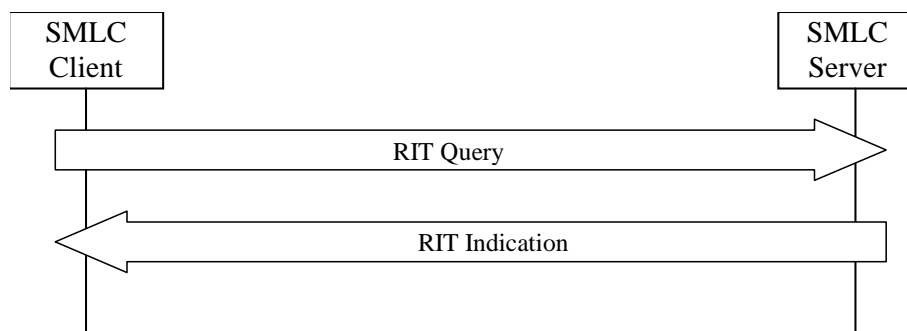
Abbreviations used in the present document are listed in 3GPP TS 21.905 or in 3GPP TS 43.059.

4 Procedures

4.1 RIT Procedures

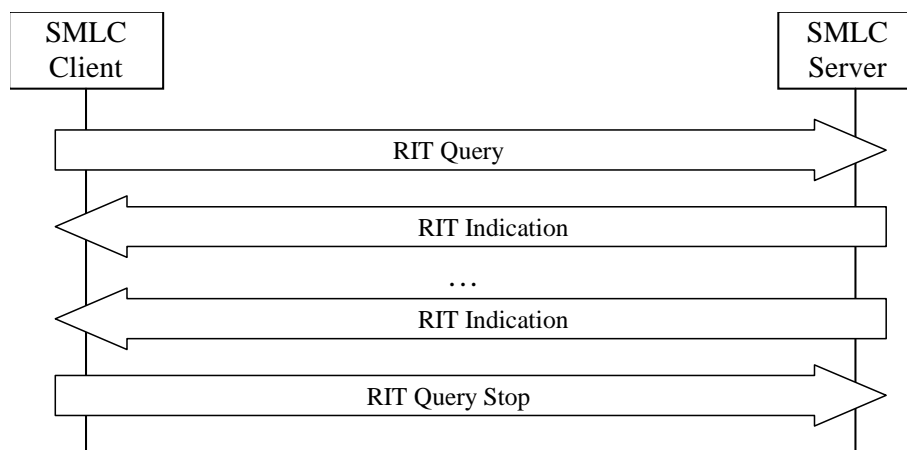
Two modes of operation are supported:

- provision of RIT information on request. In this mode a SMLC Client needing RIT information requests it from another SMLC using the RIT Query operation. The SMLC Server sends the requested RIT information using the RIT Indication operation. There are two cases:
 - single indication: RIT Indication is requested only once.



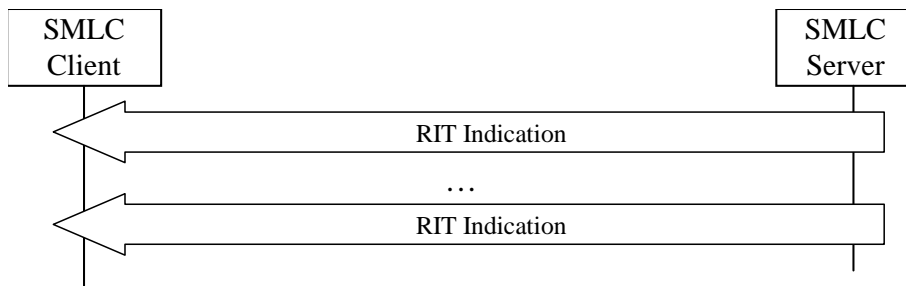
In this case the procedure consists of one RIT Query and one RIT Indication operations.

- Open-ended repetitive RIT Indications: RIT information is requested on a regular basis until the RIT Query Stop operation.



In this case the procedure consists of one RIT Query, one or more RIT Indication, and one RIT Query Stop operations.

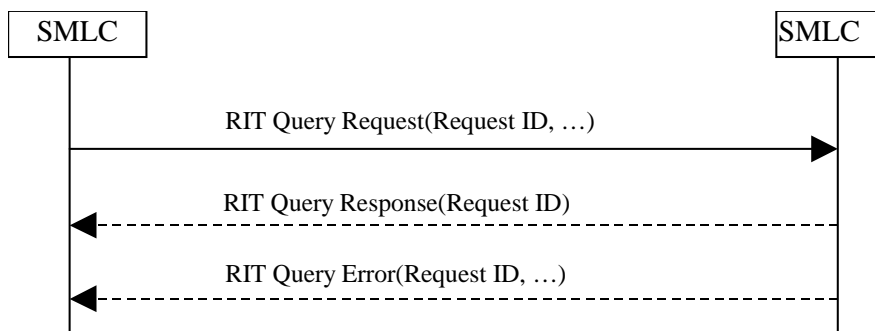
- Autonomous provision of RIT information. In this mode, the RIT information is provided automatically by the SMLC Server, according to an internal configuration not managed through SMLCPP (e.g., by O&M).



In the autonomous mode the procedure consists of one or more RIT Indication operations.

Three RIT related operations are then included in the SMLCPP, one for requesting the provision of RIT data, the second for provision, and the third one for stopping open-ended repetitive indications.

4.1.1 RIT Query Operation

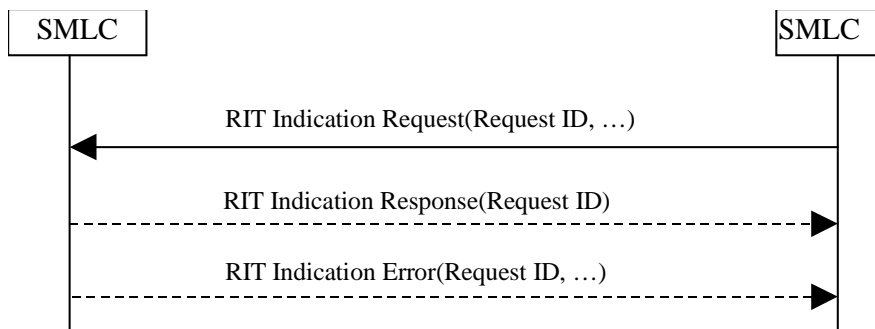


This operation allows a SMLC to query RIT information from another SMLC. This operation consists of sending of a RIT Query Request. It includes the Request ID , that is used to identify different queries. The RIT Query Request also includes the description of the scheduling of RIT Indication operations in the reverse direction. This includes the following cases:

- single indication; RIT Indication is requested only once;
- open-ended repetitive indications; RIT Indication operations are requested on a regular basis until the RIT Query Stop operation.

A RIT Query Response includes the same Request ID that the Request included, and it is used as a positive acknowledgement. A RIT Query Error message can be sent in return, if the SMLC Server detects an error situation (e.g. syntax errors, or overlapping Request ID values), or it can not fulfil the Request (e.g. RIT information is requested for unknown BTSs). It contains the same Request ID values as the Request.

4.1.2 RIT Indication Operation



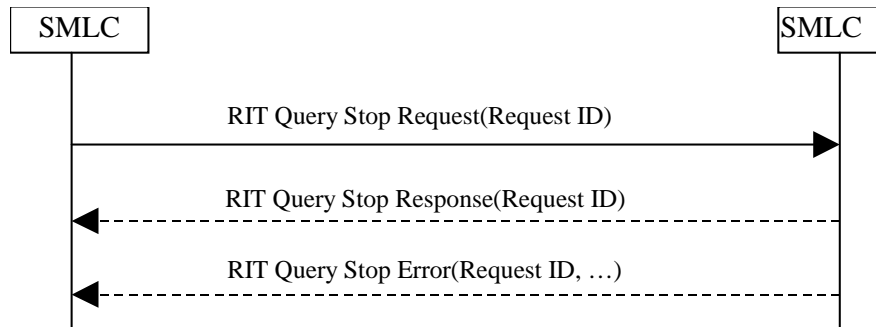
This operation allows a SMLC to send RIT information to another SMLC. It can be used both in the case of autonomous provision, and the provision of RIT information on request.

The RIT Indication Request contains RIT information to be delivered. It also contains the Request ID that:

- has the same value as the RIT Query operation, that invoked the RIT Indication (RIT provision on request);
- has a reserved value indicating autonomous provision.

A RIT Indication Response includes the same Request ID that the Request included, and it is used as a positive acknowledgement. The SMLC Client can send a RIT Indication Error to the SMLC Server, if it detects an error situation (e.g. syntax errors, or unknown Request ID values).

4.1.3 RIT Query Stop Operation



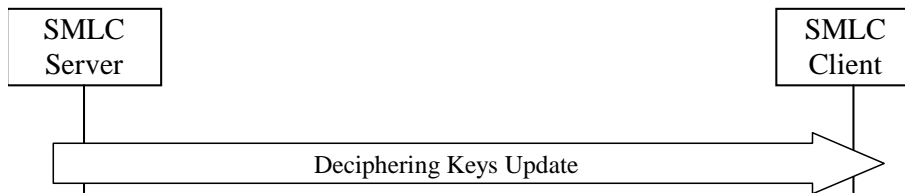
This operation allows a SMLC to send an indication to another SMLCPP to stop sending RIT information, that it has originally asked to obtain on open-ended repetitive basis. The RIT Query Stop Request includes the Request ID values that is the same as in the corresponding RIT Query that should be stopped. A RIT Query Stop Response includes the same Request ID that the Request included, and it is used as a positive acknowledgement. The SMLC Server can send a RIT Query Stop Error to the SMLC Client, if it detects an error situation (e.g. syntax errors, or unknown Request ID values).

4.2 (void)

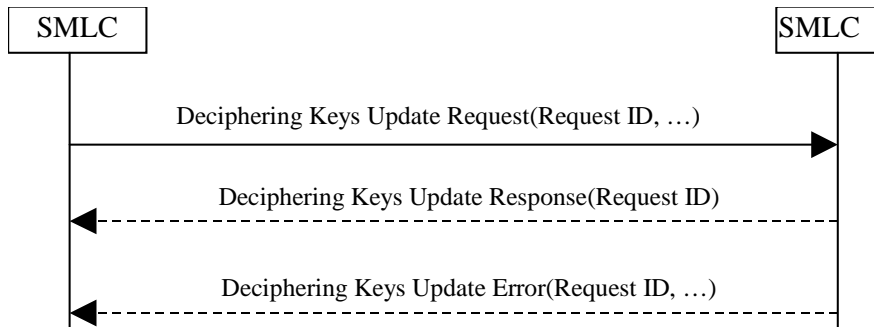
4.3 Deciphering Keys Procedure

This procedure includes one operation that is related to LCS assistance data broadcast deciphering keys. With this operation the SMLC Server controlling the deciphering keys (needed in LCS Assistance Data broadcast) can send the deciphering keys to other SMLC Clients in the same location area. One SMLC (i.e. SMLC Server) in location area is

selected to control the deciphering keys and sending the keys to other SMLC Clients in location area. The sending has to be done to each SMLC Client with a separate message.



4.3.1 Deciphering Keys Update Operation



This operation allows a SMLC controlling deciphering keys to send the keys to another SMLC Client.

The Deciphering Keys Update Request includes the Request ID and information of keys. A Deciphering Keys Update Response includes only the same Request ID that the Request included, and it is used as a positive acknowledgement. The SMLC Client can send a Deciphering Keys Update Error to the SMLC Server, if it detects an error situation (e.g. syntax errors). It contains the same Request ID values as the Request.

5 Error Handling

In this Clause it is described how the SMLC should act in different error situations.

5.1 Missing Message Part

When a SMLC receives a Request message that does not contain one or more expected message parts (e.g. information elements, Arguments, Request ID), it sends an Error with the indication 'Missing Message Part' (if the operation type is known), and ignores the Request.

When a SMLC receives a Response or Error message that does not contain one or more expected message parts, it ignores the message.

5.2 Repeated Message Part

When a SMLC receives a Request message that contains one or more message parts (e.g. information elements, Arguments, Request ID) more times than expected, it sends an Error with the indication 'Repeated Message Part', and ignores the Request.

When a SMLC receives a Response or Error message that contains one or more message parts more times than expected, it ignores the message.

5.3 Unforeseen Message Part

When a SMLC receives a Request message that contains one or more unforeseen message parts (e.g. information elements, Result), it sends an Error with the indication 'Unforeseen Message Part', and ignores the Request.

When a SMLC receives a Response or Error message that contains one or more unforeseen message parts, it ignores the message.

5.4 Incorrect Data

When a SMLC receives a Request message that it can not fully understand, that contains syntax errors, or incorrect values, and no other Error Indication applies, it sends an Error with the indication 'Incorrect Data' (if the operation type is known), and ignores the Request. If the SMLC can not understand the operation of the Request, it just ignores the Request.

When a SMLC receives a Response or Error message that it can not fully understand, that contains syntax errors, or incorrect values, it ignores the message.

5.5 Repeated Operation

When a SMLC receives a Request message containing a Request ID, that is already in use by the same type of operation, the SMLC sends an Error with the indication 'Repeated Operation', and ignores the latter Request. In order to avoid mistaken use of this error indication for an open-ended repetitive RIT Indication, an SMLC server may choose not to send a RIT Indication Request until it has received a RIT Indication Response or RIT Indication Error from the SMLC Client for any previous RIT Indication Request. An SMLC Client may likewise choose not to send this error indication if, before it has responded to a RIT Indication Request, it receives a subsequent RIT Indication Request from the same SMLC Server carrying the same Request ID: if the SMLC client makes this choice, it shall prepare to treat the subsequent RIT Indication Request as legitimate.

5.6 Unforeseen Operation

When a SMLC receives a Request for an operation that is unexpected, and none of the situations in subclause 5.5 applies, then the SMLC sends an Error with the indication 'Unforeseen Operation', and ignores the Request.

5.7 Unknown Request ID

When a SMLC receives a RIT Indication Request that contains a Request ID value, that is not connected to any pending RIT Query operation, or autonomous provision of RIT information, it sends a RIT Indication Error with the indication 'Unknown Request ID'.

When a SMLC receives a RIT Query Stop that contains a Request ID value, that is not connected to any pending RIT Query operation, it sends a RIT Query Stop Error with the indication 'Unknown Request ID'.

When a SMLC receives a Response or Error message, that contains a Request ID that is not connected to any pending operation of that type, the SMLC ignores the message.

5.8 Duplicate Request ID

When a SMLC receives a Request message containing a Request ID, that is already in use by another type of operation, the SMLC sends an Error with the indication 'Duplicate Request ID'.

5.9 No RIT Information

When a SMLC receives a RIT Query Request, and does not have any of the requested RIT information (e.g. all cells, whose RIT information is asked for, are unknown) then the SMLC sends a RIT Query Error with the indication 'No RIT Information'.

When during open-ended repetitive RIT indications, or autonomous provision of RIT information, there is no RIT information available, the requested SMLC refrains from sending RIT Indication Requests.

When the requesting SMLC has asked for open-ended repetitive RIT indications, but it does not receive expected RIT information, it can send a RIT Query Stop, and then a new RIT Query.

5.10 (void)

5.11 Deciphering Keys Error

When a SMLCPP receives a Send Deciphering Keys Request, and it detects an error situation connected with the contents of the message (e.g. the SMLC acts as a controller of deciphering keys for a location area, but it receives from another SMLC keys for the same location area), it sends a Send Deciphering Keys Error message with the indication 'Deciphering Keys Error'.

5.12 Internal Error

When a SMLCPP has any internal errors, that prevent it to act according to a Request, it can use 'Internal Error' indication in the Error message.

5.13 Other Error Situations

When a SMLCPP detects any other error situation when receiving a Request, it can use 'No Indication' indication in the Error message.

5.14 Summary of Indications

The following table summarizes the error indications, and which operations use them.

Table 5.14: Error Indications and operations

Error Indication	RIT Query	RIT Indication	RIT Query Stop	Send Deciphering Keys
Missing Message Part	X	X	X	X
Repeated Message Part	X	X	X	X
Unforeseen Message Part	X	X	X	X
Incorrect Data	X	X	X	X
Repeated Operation	X	X	X	X
Unforeseen Operation		X	X	
Unknown Request ID		X	X	
Duplicate Request ID	X	X	X	X
No RIT Information	X			
Deciphering Keys Error				X
Internal Error	X	X	X	X
No Indication	X	X	X	X

6 Signalling Elements

In this Clause the messages are described.

The formal definitions of the SMLCPP messages are based on:

- Abstract Syntax Notation One (ASN.1) "Specification of Basic Notation" ITU-T Rec. X.680 (1997) | ISO/IEC 8824 – 1:1998
- ASN.1 encoding rules "Specification of Packet Encoding Rules (PER)" ITU-T Rec. X.691 (1997) | ISO/IEC 8825-2:1998
- is consistent with these ITU-T recommendations. Also further definitions in this document are based on the same X.680 and X.691. BASIC-PER, unaligned variant is used.

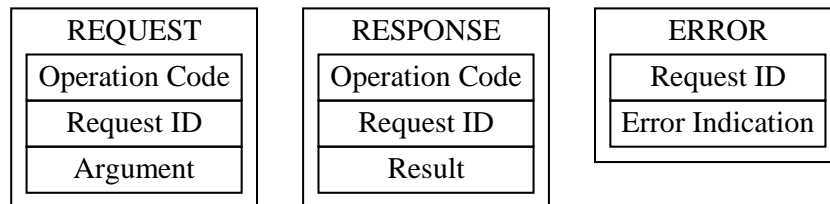
6.1 Messages

This clause describes the contents of the different messages.

There are three different types of messages:

- request;
- response;
- error

Operations use some or all of these message types, as described in Clause 4. The messages structures are as follows.



The following ASN.1 description gives the formal definition of the messages.

```

SMLCPP-PDUs
-- { SMLCPP-Operations object identifier }

DEFINITIONS AUTOMATIC TAGS::=

BEGIN

-- Export all operations as default

IMPORTS
    SMLCPP-OPERATION, ERROR
FROM
    SMLCPP-OperationDefinition

    rit-Query-Req, rit-Indication-Req,
    decipheringKeysUpdate-Req, rit-QueryStop-Req
FROM
    SMLCPP-Operations
;

-- Request, Response or errorPDU is encapsulated to SMLCPP-PDU.
SMLCPP-PDU ::= CHOICE {
    requestPDU      SMLCPP-REQ-PDU,
    responsePDU     SMLCPP-RSP-PDU,
    errorPDU        SMLCPP-ERROR-PDU,
    ...
}

-- PDU definitions for Requests
SMLCPP-REQ-PDU ::= SEQUENCE {
    code            SMLCPP-OPERATION.&code ({{SMLCPP-Operation-table}}),
    requestID       INTEGER (0..255),
    value           SMLCPP-OPERATION.&Argument ({{SMLCPP-Operation-table}}{@code})
}

-- PDU definitions for Responses
SMLCPP-RSP-PDU ::= SEQUENCE {
    code            SMLCPP-OPERATION.&code ({{SMLCPP-Operation-table}}),
    requestID       INTEGER (0..255),
    value           SMLCPP-OPERATION.&Result ({{SMLCPP-Operation-table}}{@code})
}

-- PDU definition for ERROR messages
SMLCPP-ERROR-PDU ::= SEQUENCE {
    requestID       INTEGER (0..255),
    value           ERROR.&code
}

```

```

}

SMLCPP-Operation-table SMLCPP-OPERATION ::= {
    rit-Query-Req |
    rit-Indication-Req |
    decipheringKeysUpdate-Req |
    rit-QueryStop-Req,
    ...
}

END

```

6.1.1 Operation Code

Operation code identifies different operations. Possible operations are those described in clause 4:

- RIT Query;
- RIT Indication;
- RIT Query Stop;
- Deciphering Keys Update.

The following ASN.1 operation description is based on the operation definition in the Annex A, and gives the formal definition of operations.

```

SMLCPP-Operations
-- { SMLCPP-Operations object identifier }

DEFINITIONS AUTOMATIC TAGS::=

BEGIN

-- Export all operations as default

IMPORTS

-- SMLCPP-OPERATION and ERROR definitions from
SMLCPP-OPERATION, ERROR
FROM
    SMLCPP-OperationDefinition

-- SMLCPP Datatypes
RIT-Query-Arg, RIT-QueryRsp-Arg, RIT-Indication-Arg, RIT-IndicationRsp-Arg,
DecipheringKeys-Arg,
DecipheringKeysRsp-Arg, RIT-StopQuery-Arg, RIT-StopQueryRsp-Arg
FROM
    SMLCPP-DataTypes

-- SMLCPP Errors
missingMsgPart, repeatedMsgPart, unforeseenMsgPart, incorrectData,
repeatedOperation, unforeseenOperation, unknownRequestID,
duplicateErrorID, noRITInfo,
decipheringKeyError, internalError, noIndication
FROM
    SMLCPP-Errors
;

-- SMLCPP Operations

-- RIT Query Request Operation
rit-Query-Req SMLCPP-OPERATION ::= {
    ARGUMENT    RIT-Query-Arg
    RESULT      RIT-QueryRsp-Arg
    ERRORS {    missingMsgPart |
                repeatedMsgPart |
                unforeseenMsgPart |
                incorrectData |
                repeatedOperation |

```

```

        unknownRequestID |
        duplicateErrorID |
        noRITInfo |
        internalError |
        noIndication
    }
    CODE 1
}

-- RIT Indication Operation
rit-Indication-Req SMLCPP-OPERATION ::= {
    ARGUMENT    RIT-Indication-Arg
    RESULT      RIT-IndicationRsp-Arg
    ERRORS {    missingMsgPart |
                repeatedMsgPart |
                unforeseenMsgPart |
                incorrectData |
                repeatedOperation |
                unforeseenOperation |
                unknownRequestID |
                duplicateErrorID |
                internalError |
                noIndication
            }
    CODE 2
}

-- CODE 3 is reserved (Perform TOA Measurement Operation)

-- Deciphering Keys Update Operation
decipheringKeysUpdate-Req SMLCPP-OPERATION ::= {
    ARGUMENT    DecipheringKeys-Arg
    RESULT      DecipheringKeysRsp-Arg
    ERRORS {    missingMsgPart |
                repeatedMsgPart |
                unforeseenMsgPart |
                incorrectData |
                repeatedOperation |
                unforeseenOperation |
                duplicateErrorID |
                decipheringKeyError |
                internalError |
                noIndication
            }
    CODE 4
}

-- RIT Query Stop Operation
rit-QueryStop-Req SMLCPP-OPERATION ::= {
    ARGUMENT    RIT-StopQuery-Arg
    RESULT      RIT-StopQueryRsp-Arg
    ERRORS {    missingMsgPart |
                repeatedMsgPart |
                unforeseenMsgPart |
                incorrectData |
                repeatedOperation |
                unforeseenOperation |
                unknownRequestID |
                duplicateErrorID |
                internalError |
                noIndication
            }
    CODE 5
}

END

```

6.1.2 Request ID

Request ID is used to refer to different requests from the same SMLC, or to refer to autonomous sending in the case of RIT Indication operation.

Value '0' may indicate autonomous sending in the case of the RIT Indication operation. This value is not used by any other operation.

Other values 1-255 indicate an ID from the requesting SMLC, that can select the value from those not already used between it and a certain recipient SMLC. No certain order of Request ID values is used (e.g. the value does not need to be sequential 1, 2, 3,...).

Within an operation possible Response and Error use the same Request ID that was in the Request.

In the case of open ended repetitive RIT Indications, the RIT Query operation contains a certain Request ID value, that the successive RIT Indication operations and the RIT Query Stop operation also use to refer to this reporting task. The value shall not be the one for autonomous sending.

6.1.3 Argument

Argument contains operation specific information in the Request message. See Annex B for the contents in each operation, and 6.2 for the formal ASN.1 definition.

6.1.4 Result

Result contains operation specific information in the Response message. See annex B for the contents in each operation, and subclause 6.2 for the formal ASN.1 definition.

6.1.5 Error Indication

Error Indication provides some precision on a detected error. The possible values of Error Indication are listed in table 1 in clause 5.

If an Error Indication is received encoding a value not in that table, the receiver shall behave as if the value was 'No indication'.

The following ASN.1 error description is based on the error definition in the annex A, and gives the formal definition of errors.

```

SMLCPP-Errors
-- { SMLCPP-Errors object identifier }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- Export all errors as default

IMPORTS

-- Operation definitions
    ERROR
FROM
    SMLCPP-OperationDefinition
;

-- Message contents errors

missingMsgPart  ERROR ::= {CODE 1} -- Missing message Part
repeatedMsgPart  ERROR ::= {CODE 2} -- Repeated message Part
unforeseenMsgPart  ERROR ::= {CODE 3} -- Unforeseen message Part
incorrectData    ERROR ::= {CODE 4} -- Incorrect Data

-- Operation errors

repeatedOperation  ERROR ::= {CODE 5} -- Repeated Operation
unforeseenOperation ERROR ::= {CODE 6} -- Unforeseen Operation

-- Request ID errors

unknownRequestID  ERROR ::= {CODE 7} -- Unknown request ID
duplicateErrorID  ERROR ::= {CODE 8} -- Duplicate Request ID

```

```

-- SMLCPP data errors

noRITInfo      ERROR ::= {CODE 9} -- No RIT information
-- CODE 10 is reserved (noTOAMeasurements)
decipheringKeyError ERROR ::= {CODE 11} -- Deciphering Key error

-- Other errors

internalError  ERROR ::= {CODE 12} -- Internal Error
noIndication   ERROR ::= {CODE 13} -- No indication

END

```

6.2 ASN.1 Definition of Arguments, Results, and IEs

The following ASN.1 description gives the formal definition of Arguments, Results, and Information Elements.

```

SMLCPP-DataTypes
-- { object identifier }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- Export all operations as default

IMPORTS

-- Datatypes from 02.071, LLP
  CI, LAC, TimeSlot, FrameNumber
FROM
  LLP-DataTypes
  -- { LLP-DataTypes object identifier }

  ExtensionContainer
FROM MAP-ExtensionDataTypes {
  ccitt identified-organization (4) etsi (0) mobileDomain (0)
  gsm-Network (1) modules (3) map-ExtensionDataTypes (21) version7 (7)}

;

-- ARGUMENT DEFINITIONS

-- RIT Indication Request (ARGUMENT)
RIT-Indication-Arg ::= SEQUENCE {
  referenceClock      ReferenceClock,
  rit-ATDRTDQualityRes  INTEGER (0..3), -- defines the resolution for ATDRTD values
  rit-ATDRTDChangeQualityRes  INTEGER (0..3), -- defines the resolution for ATDRTD change values
  rit-Data            SeqOfRITData,
  extensionContainer  ExtensionContainer  OPTIONAL,
  ...
}

-- RIT Indication Response (RESULT)
RIT-IndicationRsp-Arg ::= SEQUENCE {
  extensionContainer  ExtensionContainer  OPTIONAL,
  ...
}

-- RIT Query Request (ARGUMENT)
RIT-Query-Arg ::= SEQUENCE {
  requestType        RequestType,
  rit-RequestDellList SeqOfRequestedRITCell,
  extensionContainer  ExtensionContainer  OPTIONAL,
  ...
}

-- RIT Query Response (RESULT)
RIT-QueryRsp-Arg ::= SEQUENCE {
  extensionContainer  ExtensionContainer  OPTIONAL,

```

```

}
...
}

-- RIT Stop Query (ARGUMENT)
RIT-StopQuery-Arg ::= SEQUENCE {
    extensionContainer      ExtensionContainer      OPTIONAL,
    ...
}

-- RIT Stop Query Rsp (RESULT)
RIT-StopQueryRsp-Arg ::= SEQUENCE {
    extensionContainer      ExtensionContainer      OPTIONAL,
    ...
}

-- Deciphering Keys (ARGUMENT)
DecipheringKeys-Arg ::= SEQUENCE {
    decipheringKeyType      DecipheringKeyType,
    decipheringKeySet      DecipheringKeys,
    lac                     LAC,
    extensionContainer      ExtensionContainer      OPTIONAL,
    ...
}

-- Deciphering Keys Rsp(RESULT)
DecipheringKeysRsp-Arg ::= SEQUENCE {
    extensionContainer      ExtensionContainer      OPTIONAL,
    ...
}

-- FIELDS IN ARGUMENTS

-- RIT-Query-Arg DEFINITIONS
-- RequestType
RequestType ::= CHOICE {
    -- Send only one RIT Indication
    singleSending          NULL,

    -- Send RIT Indications until stop is received
    openEnded              OpenEndedType
}

OpenEndedType ::= SEQUENCE {
    -- Reporting period
    reportingPeriodInfo    ReportingPeriodInfo,

    -- Thresholds for change of AT and deviation of AT
    changeLimit            INTEGER (0..250)    OPTIONAL,
    deviationLimitInfo     INTEGER (0..250)    OPTIONAL
}

-- Units and value of Reporting Period
ReportingPeriodInfo ::= SEQUENCE {
    periodFormat           PeriodFormat,
    periodValue            INTEGER (0..120)
}

PeriodFormat ::= ENUMERATED {
    tensOfSeconds(0),
    tensOfMinutes(1)
}

-- RequestedRITCell is actually a sequence of requested cells
SeqOfRequestedRITCell ::= SEQUENCE (SIZE (1..16)) OF RequestedRITCell
RequestedRITCell ::= SEQUENCE {
    cellLAC                LAC,
    cellCI                 CI
}

-- RIT-Indication-Arg DEFINITIONS
-- Reference clock definition, including reference cell and time
ReferenceClock ::= SEQUENCE {
    referenceLAC           LAC,
    referenceCI            CI,
    referenceFrameNumber   FrameNumber,

    -- If absoluteTime is absent, AT value of reference
    -- cell is not known

```

```

    absoluteTime          AbsoluteTime    OPTIONAL
  }

ReferenceAT ::= SEQUENCE {
    seconds      INTEGER (0..59),
    nsecs       INTEGER (0..999999999)
}

-- Absolute time definition for reference cell
AbsoluteTime ::= SEQUENCE {
    universalClock      UniversalClockType,

    -- AT and ATChange definitions
    referenceAT         ReferenceAT,
    -- This Quality information defines the quality of AT value
    -- Resolution defines the resolution of Quality field as follows,
    -- 0= 0.005 us, 1= 0.01 us, 2= 0.05 us
    rit-RefATQuality    SEQUENCE {
        resolution      INTEGER (0..3),
        atQuality       INTEGER (0..63) },
    referenceATChange   INTEGER (-1000..1000),
    -- This Quality information defines the quality of ATChange value
    -- Resolution defines the resolution of Quality field as follows,
    -- 0= 0.00005 ppm, 1= 0.0001 ppm, 2= 0.0005
    rit-RefATChangeQuality SEQUENCE {
        resolution      INTEGER (0..3),
        atChangeQuality INTEGER (0..63) }
}

UniversalClockType ::= ENUMERATED {
    gpsClock (0),
    ...,
    galileoClock(1),
    glonassClock (2),
    qzssClock (3),
    bdsClock (4),
    spare4(5),
    spare5(6),
    spare6(7),
    spare7(8),
    spare8(9),
    spare9(10)
}

-- RIT Data is actually a sequence of RIT data elements
SeqOfRITData ::= SEQUENCE (SIZE (1..16)) OF RIT-Data
RIT-Data ::= SEQUENCE {
    lac          LAC,
    ci           CI,
    frameNumber  FrameNumber,

    -- ATD/RTD value and ATD/RTD change with quality figures
    atdRTD       INTEGER (0..923199),
    atdRTDQuality    INTEGER (0..63),
    atdRTDChange    INTEGER (-2000..2000),
    atdRTDChangeQuality INTEGER (0..63)
}

-- CIPHERING KEY INFORMATION
-- Octets in DecipheringKeys are coded in the same way as the octets 3
-- to 17 of Deciphering Key IE in 3GPP 49.031. I.e. these octets contain
-- Current Deciphering Key, Next Deciphering Key and Ciphering Key Flag.
DecipheringKeys ::= OCTET STRING (SIZE (15))

-- Deciphering key type indicates the positioning method
-- value 0 corresponds to E-OTD
-- value 1 corresponds to GPS
DecipheringKeyType ::= INTEGER (0..1)

END

```

Annex A (normative): Operation and Error Definition

The following ASN.1 operation and error definition is the basis for the ASN.1 description of operations and errors in this specification.

```
SMLCPP-OperationDefinition
-- {object identifier }

DEFINITIONS AUTOMATIC TAGS::=

BEGIN

SMLCPP-OPERATION ::= CLASS {
    &Argument,
    &Result      OPTIONAL,
    &Errors      ERROR,
    &code        INTEGER (0..255)
}
WITH SYNTAX {
    ARGUMENT      &Argument
    [RESULT      &Result]
    ERRORS        &Errors
    CODE          &code
}

ERROR ::= CLASS {
    &code        INTEGER (0..255)
}
WITH SYNTAX {
    CODE          &code
}

END
```

Annex B (informative): Description of Arguments, Results and Information elements

B.1 Description of elements

B.1.1 Arguments and Results

The following subchapters describe the contents of Arguments and Results of different operations. The formal ASN.1 definitions of Arguments, Results, and the Information Elements in them is given in 6.2.

B.1.1.1 RIT Query Operation

B.1.1.1.1 Argument

Table B.1.1.1.1: RIT Query operation Argument

Information element	Type/Reference	Presence
Request Type	Request Type B.1.2.1	M
Cell List	Cell List B.1.2.2	M

Request Type IE

This IE provides the parameters for the requested RIT Indication operations and their scheduling.

Cell List IE

This IE defines the cells whose RIT information is requested.

B.1.1.1.2 Result

The Result is empty in the case of RIT Query operation. The RIT Query Response message is interpreted as a positive acknowledgement.

B.1.1.2 RIT Indication

B.1.1.2.1 Argument

Table B.1.1.2.1: RIT Indication operation Argument

Information element	Type/Reference	Presence
Reference Clock	Reference Clock B.1.2.3	M
RIT Data	RIT Data B.1.2.4	M

Reference Clock IE

The RTD and/or ATD values in this message are expressed relative to the reference clock indicated in this IE. In this version of the standard, the reference clock is the internal clock of some BTS or the GPS time reference. In the former case the BTS has to be measured by LMUs of both SMLCs.

RIT Data IE

This IE contains the RIT information from different cells reported relative to the reference clock defined in the previous IE.

B.1.1.2.2 Result

The RIT Indication operation has an empty Response message.

B.1.1.3 RIT Query Stop

B.1.1.3.1 Argument

The RIT Query Stop operation has an empty Argument.

B.1.1.3.2 Result

The RIT Query Stop operation has an empty Response message.

B.1.1.4 (void)

B.1.1.5 Send Deciphering Keys

B.1.1.5.1 Request

Table B.1.1.5.1: Send Deciphering Keys operation Argument

Information element	Type/Reference	Presence
Deciphering Key Type	Deciphering Key Type 7	M
Deciphering Keys	Deciphering Keys 1.2.19	M
Location Area	Location Area 1.2.20	M

Deciphering Key Type IE

This IE defines the type of deciphering keys, i.e. whether the keys are applicable to E-OTD or GPS positioning method.

Deciphering Keys IE

This IE contains the Deciphering Keys information to be sent.

Location Area

This IE contains the LAC of the Location Area for which the deciphering keys are valid.

B.1.1.5.2 Result

The Send Deciphering Keys operation has an empty Result.

B.1.2 Information elements

This clause describes the information structure of information elements independently from the messages where they appear. The formal ASN.1 definition of information elements is given in subclause 6.2.

B.1.2.1 Request Type IE

This IE gives the description of the type of the RIT information request. It contains the following fields:

Reporting Type

This field indicates how long the SMLC should report RIT information. This field is mandatory. This field has the following values:

'0': 'Single Indication': Send only one RIT Indication;

'1': 'Open ended repetitive RIT Indications': Send RIT Indications, according to instructions in the following fields, until told otherwise with a RIT Query Stop operation.

Reporting Period Format

This field describes the units of the Reporting Period field. This field is conditional, and included, if the Reporting Type field is '1', i.e. open ended repetitive RIT Indications are requested. If this field is included the minimal time period between the RIT Indication operations is as expressed in this and Reporting Period fields.

'0': Reporting Period is told in tens of seconds;

'1': Reporting Period is in tens of minutes.

Reporting Period

This field together with the Reporting Period Format field describes the maximum time period between the RIT Indication operations. This field is conditional and included only if the Reporting Type has the value '1', i.e. open ended repetitive RIT Indications are requested.

The encoding shall provide for the range from 10 seconds to 20 hours, with a quantization of 10 minutes on the whole range, and no greater than 10 seconds in the range 10 seconds to 20 minutes. The Reporting Period Format field indicates the units for the value expressed in this field. Value '0' means that the RIT Indication operations should be performed as often as possible.

Range: 0 - 120.

Change Limit

This field indicates a threshold for the change of AT or ATD /RTD values. If any requested AT or ATD/RTD value has changed more than the threshold since the last RIT Indication for the same request, a new RIT Indication operation is performed. In rigorous terms, noting RIT_i the last reported value, and RIT_c the current one, a RIT Indication operation is performed when RIT_c moves out of the interval [RIT_i-threshold, RIT_i+threshold].

This field is meaningless unless the Reporting Type is '1', i.e. open ended repetitive RIT Indications are requested, in which case the field is optional. If this field is not included and the Reporting Type '1', the threshold is infinite (in other words, the difference since the last RIT Indication for the same request is not a trigger for a new Indication).

The encoding shall provide for a time in a range of 0.02 microseconds to 5 microseconds, with a quantization of 0.02 microseconds.

Range: 1-250.

Deviation Limit

This field indicates the threshold for the deviation of the AT or ATD/RTD values. If any time the predicted AT or ATD/RTD value, as computed from the reported AT or ATD/RTD values and rates of change in the last RIT Indication operation, has deviated more than the threshold compared to the current measurement result, a new RIT Indication operation is performed.

This field is meaningless unless the Reporting Type is '1', i.e. open ended repetitive RIT Indications have been requested, in which case the field is optional. If this field is not included and the Reporting Type is '1', the threshold is infinite (in other words, the difference with the predicted value is not a trigger for a new Indication).

The encoding shall provide for the range 0.02 to 5 microseconds, with a quantization of 0.02 microseconds.

Range: 1-250.

B.1.2.2 Cell List IE

This IE contains a list of one or several cells whose RIT information is requested.

This IE contains the following fields.

Number of Cells

This field indicates the number of cells in this IE. This field is mandatory.

Range: 1 - 16.

The following fields are repeated the number of times included in the Number of Cells field.

LAC

This field indicates the Location Area Code of the cell whose RIT information is requested, within the PLMN. This field is mandatory.

Range: 0 - 65 535.

NOTE: The protocol does not provide for data exchange between SMLCs of different PLMNs.

CI

This field indicates the Cell Identity of the cell whose RIT information is requested, within the PLMN. This field is mandatory.

Range: 0 - 65 535.

B.1.2.3 Reference Clock IE

This IE describes a reference clock. A clock includes a time reference, and a frequency reference. In this version of the document, the only supported method for indicating a time reference consists in indicating a particular frame in a particular reference cell. The frequency reference is then that of the cell. The time reference is then the beginning of this frame in the downlink direction, as perceived by a receiver as close as possible from transmitting antennae for the reference cell. In addition, and optionally, the time reference is indicated relative to a universal time reference, and an indication of the drift of the frequency reference relative to the universal time reference is provided.

This IE contains the following fields.

LAC

This field indicates the Location Area Code of the reference cell, within the PLMN. This field is mandatory.

Range: 0 - 65 535.

NOTE: The protocol does not provide for data exchange between SMLCs of different PLMNs.

CI

This field indicates the Cell Identity of the reference cell, within the PLMN. This field is mandatory.

Range: 0 - 65 535.

Reference Frame Number

This field indicates the TDMA frame number FN, as numbered according to 3GPP TS 25.010, of the reference cell corresponding to the reported values in this message. This field is mandatory.

The encoding shall provide for a range of at least 2 hours before the instant the field is received.

Range: 0 - 2 715 647.

Absolute Time Present

This field indicates whether AT of the reference cell is reported or not. This field is mandatory.

'0': AT of reference cell is not reported;

'1': AT of reference cell is reported.

Universal Clock

This field indicates the type of the universal reference clock for absolute time (AT) indications. This field is optional, and included only if the Absolute Time Present field is '1'.

- '0': GPS clock is used;
- '1': Galileo clock is used;
- '2': GLONASS clock is used;
- '3': QZSS clock is used;
- '4': BDS clock is used.

Reference AT

This field indicates the time of the reference instant (i.e., the starting moment of reference frame), relative to the universal reference clock indicated in the previous field.

It is counted in two parts: seconds after last minute change, and nanoseconds after last second change. This field is conditional, and included only if the Absolute Time Present field is '1'.

Range:

seconds: 0 - 59

nanoseconds: 0 - 999 999 999

Reference AT Change

This field indicates the first time derivative of the AT value relative to the clock of the reference cell. A positive value indicates that the clock of the reference cell lags behind that of the universal reference clock. This field is conditional, and included only if the Absolute Time Present field is '1'.

The range is -0,05 ... 0,05 ppm, with a quantization of 0,000 05 ppm.

Range: -1 000 ... 1 000.

Reference AT Quality Resolution

Reference AT Quality Resolution field includes the resolution used in Reference AT Quality field. Encoding on 2 bits as follows

'00'	0.005 micro seconds
'01'	0.01 micro seconds
'10'	0.05 micro seconds
'11'	Reserved.

This field is conditional, and included only if the Absolute Time Present field is '1'.

Reference AT Quality

Reference AT Quality field includes the quality of reported RIT measurement. This Reference AT Quality field can be e.g. used to evaluate the reliability of AT measurements in the SMLC. Reference AT quality is defined as

$$\text{Reference AT Quality} = \sqrt{E[(x - \mu)^2]} = \text{Std of reported AT value,}$$

where x is the reported Reference AT value and $\mu = E[x]$ is its expectation value. The reporting resolution of Reference AT Quality is defined by Reference AT Quality resolution field.

This field is conditional, and included only if the Absolute Time Present field is '1'.

Reference AT Change Quality Resolution

Reference AT Change Quality Resolution field includes the resolution used in Reference AT Change Quality field. Encoding on 2 bits as follows

'00'	0,000 05 ppm
'01'	0,000 1 ppm
'10'	0,000 5 ppm
'11'	Reserved.

This field is conditional, and included only if the Absolute Time Present field is '1'.

Reference AT Change Quality

Reference AT Change Quality field includes the quality of reported Reference AT Change. This Reference AT Change Quality field can be e.g. used to evaluate the reliability of RIT measurements in the SMLC. Reference AT Change Quality is defined as

$$\text{Reference AT Change Quality} = \sqrt{E[(x - \mu)^2]} = \text{Std of reported AT Change value}$$

where x is the reported Reference AT Change and $\mu = E[x]$ is its expectation value. The reporting resolution of Reference AT Change Quality is defined by Reference AT Change Quality Resolution field.

This field is conditional, and included only if the Absolute Time Present field is '1'.

B.1.2.4 RIT Data IE

This IE contains the requested RIT information. It contains the following fields.

Number of Cells

This field indicates the number of cells in this IE. This field is mandatory.

Range: 1 - 16.

ATD/RTD Quality Resolution

ATD/RTD Quality Resolution field includes the resolution used in ATD/RTD Quality field. Encoding on 2 bits as follows

'00'	0,005 micro seconds
'01'	0,01 micro seconds
'10'	0,05 micro seconds
'11'	Reserved.

This field is mandatory.

ATD/RTD Change Quality Resolution

ATD/RTD Change Quality Resolution field includes the resolution used in ATD/RTD Change Quality field. Encoding on 2 bits as follows

'00'	0,000 05 ppm
'01'	0,000 1 ppm
'10'	0,000 5 ppm
'11'	Reserved.

This field is mandatory.

The following fields are repeated the number of times included in the Number of Cells field.

LAC

This field indicates the Location Area Code of the cell whose RIT information is given, within the PLMN. This field is mandatory.

Range: 0 - 65 535.

CI

This field indicates the Cell Identity of the cell whose RIT information is given, within the PLMN. This field is mandatory.

Range: 0 - 65 535.

Cell Frame Number

This field indicates the TDMA frame number, as numbered according to 3GPP TS 25.010, of the first whole slot that has been (or would have been) sent by the cell at the time reference or immediately after. This field is mandatory.

Range: 0 - 2 715 647.

ATD/RTD Value

This field indicates elapsed time between starting moment of the reference frame and starting moment of the next whole neighbor frame in the downlink direction as perceived by a receiver as close as possible from transmitting antennae for the cell. The result is thus always positive. This field is mandatory.

The encoding shall provide for a range of 0 to 1 250 bit periods, with a quantization of 0,005 microseconds (around 1,5 metres at light speed).

Range: 0 ... 923 199

ATD/RTD Quality

ATD/RTD Quality field includes the quality of reported RIT measurement. This ATD/RTD Quality field can be e.g. used to evaluate the reliability of RIT measurements in the SMLC. ATD/RTD quality is defined as

$$\text{ATD/RTD Quality} = \sqrt{E[(x - \mu)^2]} = \text{Std of reported ATD/RTD value,}$$

where x is the reported ATD/RTD value and $\mu = E[x]$ is its expectation value. The reporting resolution of ATD/RTD Quality is defined by ATD/RTD Quality resolution field.

Range: 0 to 63

This field is mandatory.

ATD/RTD Change

This field indicates the first time derivative of the ATD/RTD value between the transmissions of signals from the reference cell and the measured cell. This field is mandatory.

The encoding shall provide for a range of -0,10 ... 0,10 ppm, with a quantization of 0,000 05 ppm.

Range: -2 000 ... 2 000.

ATD/RTD Change Quality

ATD/RTD Change Quality field includes the quality of reported ATD/RTD Change. This ATD/RTD Change Quality field can be e.g. used to evaluate the reliability of RIT measurements in the SMLC. ATD/RTD Change Quality is defined as

$$\text{ATD/RTD Change Quality} = \sqrt{E[(x - \mu)^2]} = \text{Std of reported ATD/RTD Change value,}$$

where x is the reported ATD/RTD Change and $\mu = E[x]$ is its expectation value. The reporting resolution of ATD/RTD Change Quality is defined by ATD/RTD Change Quality resolution field.

Range: 0 to 63

This field is mandatory.

B.1.2.5 (void)

B.1.2.6 (void)

B.1.2.7 (void)

B.1.2.8 (void)

B.1.2.9 (void)

B.1.2.10 (void)

B.1.2.11 (void)

B.1.2.12 (void)

B.1.2.13 (void)

B.1.2.14 (void)

B.1.2.15 (void)

B.1.2.16 Deciphering Key Type IE

This IE defines the type of deciphering keys, i.e. whether the keys are applicable to E-OTD or GPS positioning method.

'0' E-OTD;

'1' GPS.

B.1.2.17 Deciphering Keys IE

The contents of this IE are as in 3GPP TS 49.031 in the corresponding IE excluding the BSSAP-LE Information Element Identifier, the length indicator, and the spare bits.

B.1.2.18 Location Area IE

This IE includes the LAC of the Location Area. This IE contains the following fields.

LAC

This field indicates the Location Area Code of the location area whose deciphering keys are included in this IE. This field is mandatory.

Range: 0 - 65 535.

B.1.2.19 (void)

Annex C (informative): Change History

Meeting#	CR	Rev	Subject/Comment	New Version
January 2016	-	-	Rel-13 version created based on v12.0.0	13.0.0

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2017-03	RP-75					Version for Release 14 (frozen at TSG-75)	14.0.0
2018-06	RP-80	-	-	-	-	Update to Rel-15 version (MCC)	15.0.0
2020-07	RP-88e	-	-	-	-	Upgrade to Rel-16 version without technical change	16.0.0
2022-03	RP-95e	-	-	-	-	Upgrade to Rel-17 version without technical change	17.0.0
2024-03	RP-103	-	-	-	-	Upgrade to Rel-18 version without technical change	18.0.0

History

Document history		
V18.0.0	May 2024	Publication