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Technical Specification

3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN Iu-PS interface PCAP signalling (Release 5)



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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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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 specifies the *Positioning Calculation Application Part (PCAP)* between the Radio Network Controller (RNC) and the Stand-alone A-GPS SMLC (SAS). It fulfills the RNC-SAS communication requirements specified in [6] and thus defines the Iupc interface and its associated signaling procedures.

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] UMTS 25.450: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; UTRAN Iupc interface general aspects and principles".
- [2] UMTS 25.451: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; UTRAN Iupc interface layer 1".
- [3] UMTS 25.452: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; UTRAN Iupc interface signalling transport".
- [4] UMTS 25.331: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; RRC Protocol Specification".
- [5] UMTS 25.401: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; UTRAN Overall Description".
- [6] UMTS 25.305: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; Stage 2 Functional Specification of UE Positioning in UTRAN".
- [7] X.680, (12/97) "Information Technology - Abstract Syntax Notation One (ASN.1):Specification of basic notation".
- [8] X.681, (12/97) "Information Technology - Abstract Syntax Notation One (ASN.1): Information object specification".
- [9] X.691, (12/97) "Information technology - ASN.1 encoding rules - Specification of Packed Encoding Rules (PER)".
- [10] ICD-GPS-200: "Navstar GPS Space Segment/Navigation User Interface".
- [11] UMTS 23.032: "Universal Geographical Area Description (GAD)".
- [12] UMTS 25.921: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; Guidelines and Principles for Protocol Description and Error Handling".

3 Definitions and abbreviations

3.1 Definitions

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

Standalone A-GPS SMLC (SAS): A logical node that interconnects to the RNC over the Iupc interface via the PCAP protocol. An SAS performs the following procedures:

- Provide GPS related data to the RNC;
- Performs the position calculation function for UE assisted GPS.

Elementary Procedure: The PCAP consists of Elementary Procedures (EPs). An Elementary Procedure is a unit of interaction between the RNC and the SAS. An EP consists of an initiating message and possibly a response message. Two kinds of EPs are used:

- **Class 1:** Elementary Procedures with response (success or failure).
- **Class 2:** Elementary Procedures without response.

For Class 1 EPs, the types of responses can be as follows:

Successful:

- A signalling message explicitly indicates that the elementary procedure successfully completed with the receipt of the response.

Unsuccessful:

- A signalling message explicitly indicates that the EP failed.

Class 2 EPs are considered always successful.

Information Exchange Context: The Information Exchange Context is created by the first Information Exchange Initiation Procedure initiated by the RNC and requested from the SAS. The Information Exchange Context is deleted by the Information Exchange Termination or the Information Exchange Failure procedure when there is no more Information Exchange to be provided by the RNC to the SAS. The Information Exchange Context is identified by an SCCP connection as, for Information Exchanges, only the connection oriented mode of the signalling bearer is used.

3.2 Abbreviations

A-GPS	Assisted GPS
ASN.1	Abstract Syntax Notation One
CN	Core Network
CRNC	Controlling RNC
DGPS	Differential GPS
EP	Elementary Procedure
GPS	Global Positioning System
MSC	Mobile services Switching Center
PCAP	Positioning Calculation Application Part
PRC	Pseudorange Correction
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RRC	Radio Resource Control
SAS	Standalone A-GPS SMLC
SCCP	Signalling Connection Control Part
SIB	System Information Block
SMLC	Serving Mobile Location Center
SRNC	Serving RNC

SRNS	Serving RNS
TOW	Time of Week
UE	User Equipment
UTRAN	Universal Terrestrial Radio Access Network

4 General

4.1 Procedure Specification Principles

The principle for specifying the procedure logic is to specify the functional behaviour of the SAS exactly and completely. The RNC functional behaviour is left unspecified.

The following specification principles have been applied for the procedure text in chapter 8:

- The procedure text discriminates between:

1) Functionality which "shall" be executed

The procedure text indicates that the receiving node "shall" perform a certain function Y under a certain condition. If the receiving node supports procedure X but cannot perform functionality Y requested in the REQUEST message of a Class 1 EP, the receiving node shall respond with the message used to report unsuccessful outcome for this procedure, containing an appropriate cause value.

2) Functionality which "shall, if supported" be executed

The procedure text indicates that the receiving node "shall, if supported," perform a certain function Y under a certain condition. If the receiving node supports procedure X, but does not support functionality Y, the receiving node shall proceed with the execution of the EP, possibly informing the requesting node about the not supported functionality.

- Any required inclusion of an optional IE in a response message is explicitly indicated in the procedure text. If the procedure text does not explicitly indicate that an optional IE shall be included in a response message, the optional IE shall not be included.

4.2 Forwards and Backwards Compatibility

The forwards and backwards compatibility of the protocol is assured by mechanism where all current and future messages, and IEs or groups of related IEs, include Id and criticality fields that are coded in a standard format that will not be changed in the future. These parts can always be decoded regardless of the standard version.

4.3 Specification Notations

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

Procedure	When referring to an elementary procedure in the specification the Procedure Name is written with the first letters in each word in upper case characters followed by the word "procedure", e.g. Position Calculation procedure.
Message	When referring to a message in the specification the MESSAGE NAME is written with all letters in upper case characters followed by the word "message", e.g. POSITION CALCULATION REQUEST message.
IE	When referring to an information element (IE) in the specification the <i>Information Element Name</i> is written with the first letters in each word in upper case characters and all letters in Italic font followed by the abbreviation "IE", e.g. <i>Request Type</i> IE.
Value of an IE	When referring to the value of an information element (IE) in the specification the "Value" is written as it is specified in subclause 9.2 enclosed by quotation marks, e.g. "Abstract Syntax Error (Reject)" or "Geographical Coordinates".

5 PCAP Services

PCAP provides the signalling services between RNC and SAS that are required to fulfill the PCAP functions described in clause 7. PCAP services are categorized as follows:

1. Position Calculation Service: They are related to a single UE and involve the transfer of GPS measurement data and UE position estimate data over the Iupc interface between the SRNC and the SAS. They utilise connectionless signalling transport provided by the Iupc signalling bearer.
2. Information Exchange Service: They involve the transfer of GPS related data over the Iupc interface between the RNC and the SAS on demand, on modification, or at regular intervals. They utilise connection-oriented signalling transport provided by the Iupc signalling bearer.

6 Services Expected from Signalling Transport

Signalling transport [3] shall provide the following service for the PCAP.

1. Connection oriented data transfer service. This service is supported by a signalling connection between the RNC and the SAS. It shall be possible to dynamically establish and release signalling connections based on the need. Each point-to-point operation shall have its own signalling connection. The signalling connection shall provide in sequence delivery of PCAP messages. PCAP shall be notified if the signalling connection breaks.
2. Connectionless data transfer service. PCAP shall be notified in case a PCAP message did not reach the intended peer PCAP entity.

7 Functions of PCAP

PCAP has the following functions:

- Position Calculation. This function enables the SRNC to interact with an SAS in the process of performing a position estimate of a UE.
- Information Exchange. This function enables the RNC to obtain GPS related data from an SAS.
- Reporting of General Error Situations. This function allows reporting of general error situations for which function specific error messages have not been defined.

The mapping between the above functions and PCAP elementary procedures is shown in the table 1.

Table 1: Mapping between functions and PCAP elementary procedures

Function	Elementary Procedure(s)
Position Calculation	a) Position Calculation
Information Exchange	a) Information Exchange Initiation b) Information Reporting c) Information Exchange Termination d) Information Exchange Failure
Reporting of General Error Situations	a) Error Indication

8 PCAP Procedures

8.1 Elementary Procedures

In the following tables, all EPs are divided into Class 1 and Class 2 EPs (see subclause 3.1 for explanation of the different classes):

Table 2: Class 1

Elementary Procedure	Initiating Message	Successful Outcome	Unsuccessful Outcome
		Response message	Response message
Position Calculation	POSITION CALCULATION REQUEST	POSITION CALCULATION RESPONSE	POSITION CALCULATION FAILURE
Information Exchange Initiation	IIINFORMATION EXCHANGE INITIATION REQUEST	INFORMATION EXCHANGE INITIATION RESPONSE	INFORMATION EXCHANGE INITIATION FAILURE

Table 3: Class 2

Elementary Procedure	Message
Information Reporting	INFORMATION REPORT
Information Exchange Termination	INFORMATION EXCHANGE TERMINATION REQUEST
Information Exchange Failure	INFORMATION EXCHANGE FAILURE INDICATION
Error Indication	ERROR INDICATION

8.2 Position Calculation

8.2.1 General

The purpose of the Position Calculation procedure is to enable an SRNC to query an SAS for a position estimate of a UE. The procedure uses connectionless signalling.

8.2.2 Successful Operation

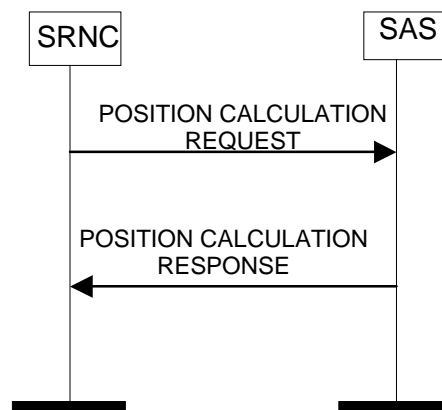


Figure 1: Position Calculation procedure. Successful Operation.

The procedure is initiated with a POSITION CALCULATION REQUEST message sent from the SRNC to the SAS. When the SAS receives the POSITION CALCULATION REQUEST message, it shall calculate the UE position based on the provided measurement data.

Response Message:

If the SAS was able to calculate the position estimate, it shall respond with a POSITION CALCULATION RESPONSE message.

8.2.3 Unsuccessful Operation

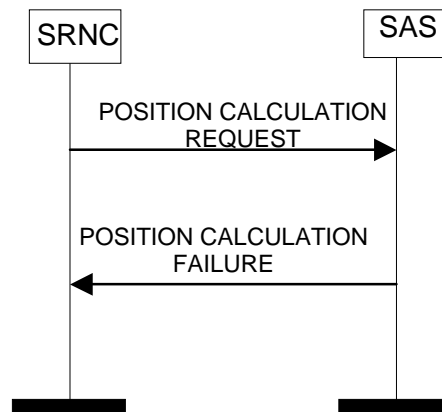


Figure 2: Position Calculation procedure. Unsuccessful Operation.

If the SAS is unable to perform the position estimate for any reason, it shall return a POSITION CALCULATION FAILURE message to the SRNC.

Typical cause values are:

- Invalid reference information
- Position calculation error: invalid GPS measured results
- Processing Overload
- Hardware Failure
- O&M Intervention

8.2.4 Abnormal Conditions

-

8.3 Information Exchange Initiation

8.3.1 General

This procedure is used by a RNC to request the initiation of an information exchange with a SAS.

This procedure uses the signalling bearer connection for the Information Exchange Context.

8.3.2 Successful Operation

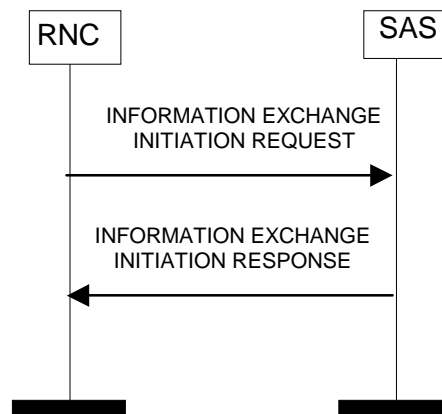


Figure 3: Information Exchange Initiation procedure, Successful Operation

The procedure is initiated with an INFORMATION EXCHANGE INITIATION REQUEST message sent from RNC to SAS.

If the *Information Type IE* is set to 'Implicit', the SAS is responsible for selecting the type of assistance data.

Upon reception, the SAS shall provide the requested information according to the parameters given in the request. Unless specified below, the meaning of the parameters are given in other specifications.

Information Report Characteristics:

The *Information Report Characteristics IE* indicates how the reporting of the information shall be performed.

If the *Information Report Characteristics IE* is set to 'On-Demand', the SAS shall report the requested information immediately.

If the *Information Report Characteristics IE* is set to 'Periodic', the SAS shall periodically initiate the Information Reporting procedure for all the requested information, with the requested report frequency.

If the *Information Report Characteristics IE* is set to 'On-Modification', the SAS shall report the requested information immediately and then shall initiate the Information Reporting procedure in accordance to the following conditions:

- If the *Information Type IE* is set to 'Explicit' and the *Explicit Information Item IE* includes 'Almanac and Satellite Health', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in almanac/health information for at least one visible satellite.
- If the *Information Type IE* is set to 'Explicit' and the *Explicit Information Item IE* includes 'UTC Model', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in the GPS UTC model.
 - If the *Transmission TOW Indicator IE* is set to "requested", then the SAS shall include the *GPS Transmission TOW IE* in the INFORMATION REPORT message.
- If the *Information Type IE* is set to 'Explicit' and the *Explicit Information Item IE* includes 'Ionospheric Model', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in the GPS ionospheric model.
 - If the *Transmission TOW Indicator IE* is set to "requested", then the SAS shall include the *GPS Transmission TOW IE* in the INFORMATION REPORT message.
- If the *Information Type IE* is set to 'Explicit' and the *Explicit Information Item IE* includes 'Navigation Model', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in the clock/ephemeris information for at least one visible satellite or in the list of visible satellites.
 - If the *Transmission TOW Indicator IE* is set to "requested", then the SAS shall include the *GPS Transmission TOW IE* in the INFORMATION REPORT message.

- If the *Information Type* IE is set to 'Explicit' and the *Explicit Information Item* IE includes 'DGPS Corrections', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in the quality of the DGPS corrections information for at least one visible satellite or in the list of visible satellites.
- If the *Information Type* IE is set to 'Explicit' and the *Explicit Information Item* IE includes 'Reference Time', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in the time-of-week assistance information for at least one visible satellite or in the list of visible satellites.
- If the *Information Type* IE is set to 'Explicit' and the *Explicit Information Item* IE includes 'Acquisition Assistance', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in acquisition assistance information for at least one visible satellite or in the list of visible satellites.
- If the *Information Type* IE is set to 'Explicit' and the *Explicit Information Item* IE includes 'Real Time Integrity', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in the real-time integrity status of at least one visible satellite.
- If the *Information Type* IE is set to 'Explicit' and the *Explicit Information Item* IE includes 'Almanac and Satellite Health SIB', the SAS shall initiate the Information Reporting procedure for this specific Explicit Information Type when a change has occurred in almanac/health information for at least one visible satellite.
- If the *Transmission TOW Indicator* IE is set to "requested", then the SAS shall include the *GPS Transmission TOW* IE in the INFORMATION REPORT message.

Response message:

If the SAS was able to determine the information requested by the RNC, it shall respond with the INFORMATION EXCHANGE INITIATION RESPONSE message. The message shall include the same Information Exchange ID that was included in the INFORMATION EXCHANGE REQUEST message.

When the response message includes data to be reported (see above), the SAS shall include at least one IE in the *Requested Data Value* IE.

8.3.3 Unsuccessful Operation

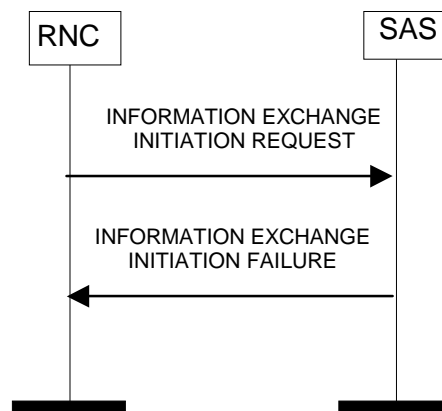


Figure 4: Information Exchange Initiation procedure, Unsuccessful Operation

If the requested Information Type received in the *Information Type* IE indicates a type of information that SAS cannot provide, the SAS shall regard the Information Exchange Initiation procedure as failed.

If the requested information provision cannot be carried out, the SAS shall send the INFORMATION EXCHANGE INITIATION FAILURE message. The message shall include the same Information Exchange ID that was used in the INFORMATION EXCHANGE INITIATION REQUEST message and the *Cause* IE set to an appropriate value.

Typical cause values are as follows:

- Information temporarily not available

- Information Provision not supported for the object
- Processing Overload
- Hardware Failure
- O&M Intervention

8.3.4 Abnormal Conditions

-

8.4 Information Reporting

8.4.1 General

This procedure is used by a SAS to report the result of information requested by a RNC using the Information Exchange Initiation.

This procedure uses the signalling bearer connection for the Information Exchange Context.

8.4.2 Successful Operation

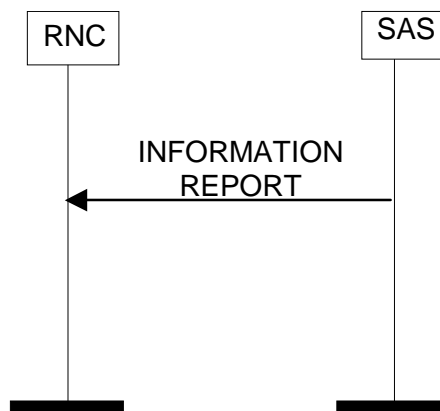


Figure 5: Information Reporting procedure, Successful Operation

If the requested information reporting criteria are met, the SAS shall initiate an Information Reporting procedure. Unless specified below, the meaning of the parameters are given in other specifications.

The *Information Exchange ID* IE shall be set to the Information Exchange ID provided by the RNC when initiating the information exchange with the Information Exchange Initiation procedure.

The *Requested Data Value* IE shall include at least one IE containing the data to be reported.

8.4.3 Abnormal Conditions

-

8.5 Information Exchange Termination

8.5.1 General

This procedure is used by a RNC to terminate the information exchange requested using the Information Exchange Initiation.

This procedure uses the signalling bearer connection for the Information Exchange Context.

8.5.2 Successful Operation

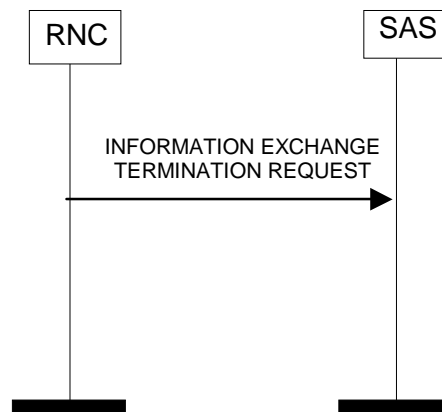


Figure 6: Information Exchange Termination procedure, Successful Operation

This procedure is initiated with an INFORMATION EXCHANGE TERMINATION REQUEST message.

Upon reception, the SAS shall terminate the information exchange corresponding to the Information Exchange ID.

8.5.3 Abnormal Conditions

-

8.6 Information Exchange Failure

8.6.1 General

This procedure is used by a SAS to notify a RNC that the information exchange it previously requested using the Information Exchange Initiation can no longer be reported.

This procedure uses the signalling bearer connection for the Information Exchange Context.

8.6.2 Successful Operation

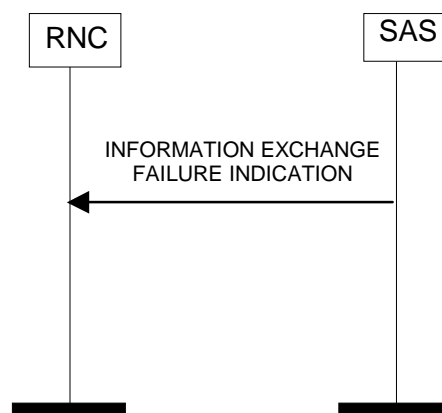


Figure 7: Information Exchange Failure procedure, Successful Operation

This procedure is initiated with a INFORMATION EXCHANGE FAILURE INDICATION message, sent from the SAS to the RNC, to inform the RNC that information previously requested by the Information Exchange Initiation

procedure can no longer be reported. The message shall include the same Information Exchange ID that was used in the INFORMATION EXCHANGE INITIATION REQUEST message and the *Cause* IE set to an appropriate value.

Typical cause values are as follows:

Radio Network Layer Cause:

Information temporarily not available

8.7 Error Indication

8.7.1 General

The Error Indication procedure is used by a node to report detected errors in one incoming message, provided they cannot be reported by an appropriate failure message.

8.7.2 Successful Operation

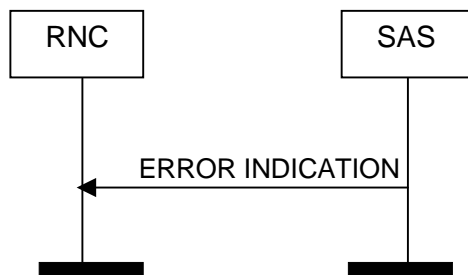


Figure 8: Error Indication procedure, SAS Originated, Successful Operation

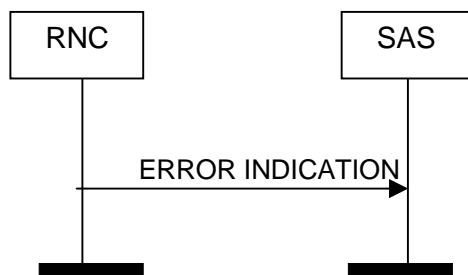


Figure 9: Error Indication procedure, RNC Originated, Successful Operation

When the conditions defined in clause 10 are fulfilled, the Error Indication procedure is initiated by an ERROR INDICATION message sent from the receiving node. This message shall use the same mode of the signalling bearer and the same signalling bearer connection (if connection oriented) as the message that triggers the procedure.

The ERROR INDICATION message shall include either the *Cause* IE, or the *Criticality Diagnostics* IE, or both the *Cause* IE and the *Criticality Diagnostics* IE.

Typical cause values for the ERROR INDICATION message are:

- Transfer Syntax Error
- Abstract Syntax Error (Reject)
- Abstract Syntax Error (Ignore and Notify)
- Message not Compatible with Receiver State

- Unspecified

8.7.3 Abnormal Conditions

-

9 Elements for PCAP Communication

9.1 Message Functional Definition and Content

9.1.1 General

Section 9.1 presents the contents of PCAP messages in tabular format. The corresponding ASN.1 definition is presented in section 9.3. In case there is contradiction between the tabular format in section 9.1 and the ASN.1 definition, the ASN.1 shall take precedence, except for the definition of conditions for the presence of conditional IEs, where the tabular format shall take precedence.

NOTE: The messages have been defined in accordance to the guidelines specified in [12].

9.1.2 Message Contents

9.1.2.1 Presence

All information elements in the message descriptions below are marked mandatory, optional or conditional according to the following table:

Table 4: Meaning of abbreviations used in PCAP messages

Abbreviation	Meaning
M	IEs marked as Mandatory (M) shall always be included in the message.
O	IEs marked as Optional (O) may or may not be included in the message.
C	IEs marked as Conditional (C) shall be included in a message only if the condition is satisfied. Otherwise the IE shall not be included.

9.1.2.2 Criticality

Each Information Element or Group of Information Elements may have a criticality information applied to it. Following cases are possible:

Table 5: Meaning of content within “Criticality” column

Abbreviation	Meaning
–	No criticality information is applied explicitly.
YES	Criticality information is applied. This is usable only for non-repeatable IEs
GLOBAL	The IE and all its repetitions together have one common criticality information. This is usable only for repeatable IEs.
EACH	Each repetition of the IE has its own criticality information. It is not allowed to assign different criticality values to the repetitions. This is usable only for repeatable IEs.

9.1.2.3 Range

The Range column indicates the allowed number of copies of repetitive IEs/IE groups.

9.1.2.4 Assigned Criticality

This column provides the actual criticality information as defined in chapter 10.3.2, if applicable.

9.1.3 POSITION CALCULATION REQUEST

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	reject
Transaction ID	M		9.2.2.28		-	
Initial UE Position Estimate	M		9.2.2.6		YES	reject
Measured Results		0..<maxNoOfSets >				
>GPS Measured Results	M		9.2.2.12		YES	reject

Range bound	Explanation
MaxNoOfSets	Maximum number of sets of GPS Measured Results included in the Position Calculation Request message. The value for maxNoOfSets is 3.

9.1.4 POSITION CALCULATION RESPONSE

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	reject
Transaction ID	M		9.2.2.28		-	
UE Position Estimate	M		9.2.2.6		YES	ignore
Criticality Diagnostics	O		9.2.2.4		YES	ignore

9.1.5 POSITION CALCULATION FAILURE

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	reject
Transaction ID	M		9.2.2.28		-	
Cause	M		9.2.2.3		YES	ignore
Criticality Diagnostics	O		9.2.2.4		YES	ignore

9.1.6 INFORMATION EXCHANGE INITIATION REQUEST

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	reject
Transaction ID	M		9.2.2.28		-	
Information Exchange ID	M		9.2.2.19		YES	reject
Information Exchange Object Type	M		9.2.2.20		YES	reject
CHOICE <i>Information Exchange Object Type</i>	M				YES	reject
>Reference Position					-	
>>Reference Position Estimate/UE Initial Position	M		9.2.2.6		-	reject
Information Type	M		9.2.2.22		YES	reject
Information Report Characteristics	M		9.2.2.21		YES	reject
GPS-UTRAN Time Relationship Uncertainty	C-GPS		9.2.2.18		YES	reject

Condition	Explanation
GPS	The IE shall be present if the information requested in the <i>Information Type</i> IE contains GPS-related data

9.1.7 INFORMATION EXCHANGE INITIATION RESPONSE

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	reject
Transaction ID	M		9.2.2.28		-	
Information Exchange ID	M		9.2.2.19		YES	ignore
CHOICE <i>Information Exchange Object Type</i>	M				YES	ignore
> <i>Reference Position</i>					-	
>>Requested Data Value	M		9.2.2.26		-	ignore
Criticality Diagnostics	O		9.2.2.4		YES	ignore

9.1.8 INFORMATION EXCHANGE INITIATION FAILURE

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	reject
Transaction ID	M		9.2.2.28		-	
Information Exchange ID	M		9.2.2.19		YES	ignore
Cause	M		9.2.2.3		YES	ignore
Criticality Diagnostics	O		9.2.2.4		YES	ignore

9.1.9 INFORMATION REPORT

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	ignore
Transaction ID	M		9.2.2.28		-	
Information Exchange ID	M		9.2.2.19		YES	ignore
CHOICE <i>Information Exchange Object Type</i>	M				YES	ignore
> <i>Reference Position</i>					-	
>>Requested Data Value Information	M		9.2.2.27		-	ignore

9.1.10 INFORMATION EXCHANGE TERMINATION REQUEST

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	ignore
Transaction ID	M		9.2.2.28		-	
Information Exchange ID	M		9.2.2.19		YES	ignore

9.1.11 INFORMATION EXCHANGE FAILURE INDICATION

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	ignore
Transaction ID	M		9.2.2.28		-	
Information Exchange ID	M		9.2.2.19		YES	ignore
Cause	M		9.2.2.3		YES	ignore

9.1.12 ERROR INDICATION

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.2.24		YES	ignore
Transaction ID	M		9.2.2.28		-	
Cause	O		9.2.2.3		YES	ignore
Criticality Diagnostics	O		9.2.2.4		YES	ignore

9.2 Information Element Functional Definitions and Contents

9.2.1 General

Section 9.2 presents the PCAP IE definitions in tabular format. The corresponding ASN.1 definition is presented in section 9.3. In case there is contradiction between the tabular format in section 9.2 and the ASN.1 definition, the ASN.1 shall take precedence, except for the definition of conditions for the presence of conditional elements, where the tabular format shall take precedence.

9.2.2 Radio Network Layer Related IEs

9.2.2.1 Almanac and Satellite Health SIB

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
GPS Almanac and Satellite Health	M		9.2.2.9	
SatMask	M		Bitstring(1..32)	indicates the satellites that contain the pages being broadcast in this data set
LSB TOW	M		Bit string(8)	

9.2.2.2 Altitude and direction

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Direction of Altitude	M		ENUMERATED (Height, Depth)	
Altitude	M		INTEGER (0...2 ¹⁵ -1)	The relation between the value (N) and the altitude (a) in meters it describes is $N \leq a < N+1$, except for $N=2^{15}-1$ for which the range is extended to include all greater values of (a).

9.2.2.3 Cause

The purpose of the cause information element is to indicate the reason for a particular event for the whole protocol.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
CHOICE <i>Cause Group</i>				
> <i>Radio Network Layer</i>				
>>Radio Network Layer Cause	M		ENUMERATED (invalid reference information, information temporarily not available, Information Provision not supported for the object, position calculation error: invalid GPS measured results, ...)	
> <i>Transport Layer</i>				
>>Transport Layer Cause	M		ENUMERATED (Transport Resource Unavailable, Unspecified, ...)	
> <i>Protocol</i>				
>>Protocol Cause	M		ENUMERATED (Transfer Syntax Error, Abstract Syntax Error (Reject), Abstract Syntax Error (Ignore and Notify), Message not Compatible with Receiver State, Semantic Error, Unspecified, Abstract Syntax Error (Falsely Constructed Message), ...)	
> <i>Misc</i>				
>>Misc Cause	M		ENUMERATED (Processing Overload, Hardware Failure, O&M Intervention, Unspecified ...)	

The meaning of the different cause values is described in the following table. In general, "not supported" cause values indicate that the concerning capability is missing. On the other hand, "not available" cause values indicate that the concerning capability is present, but insufficient resources were available to perform the requested action.

Radio Network Layer cause	Meaning
Invalid reference information	The reference information (GPS-UTRAN Time Relationship Uncertainty and/or Initial UE Position Estimate) provided by the RNC are invalid
Information temporarily not available	The information requested by RNC is temporarily not available
Information Provision not supported for the object	The SAS does not support provision of the requested information for the concerned object types
Position calculation error: invalid GPS measured results	The SAS cannot calculate position due to invalid GPS measured results

Transport Network Layer cause	Meaning
Transport resource unavailable	The required transport resources are not available
Unspecified	Sent when none of the above cause values applies but still the cause is Transport Network Layer related

Protocol cause	Meaning
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Abstract Syntax Error (Reject)	The received message included an abstract syntax error and the concerning criticality indicated "reject" (see subclause 10.3)
Abstract Syntax Error (Ignore and Notify)	The received message included an abstract syntax error and the concerning criticality indicated "ignore and notify" (see subclause 10.3)
Abstract syntax error (falsely constructed message)	The received message contained IEs or IE groups in wrong order or with too many occurrences (see subclause 10.3)
Message not Compatible with Receiver State	The received message was not compatible with the receiver state (see subclause 10.4)
Semantic Error	The received message included a semantic error (see subclause 10.4)
Transfer Syntax Error	The received message included a transfer syntax error (see section 10.2)
Unspecified	Sent when none of the above cause values applies but still the cause is Protocol related

Miscellaneous cause	Meaning
Processing Overload	RNC/SAS processing overload
Hardware Failure	RNC/SAS hardware failure
O&M Intervention	Operation and Maintenance intervention related to RNC/SAS equipment
Unspecified	Sent when none of the above cause values applies and the cause is not related to any of the categories Radio Network Layer, Transport Network Layer or Protocol

9.2.2.4 Criticality Diagnostics

The *Criticality Diagnostics* IE is sent by the RNC or the SAS when parts of a received message have not been comprehended or are missing. It contains information about which IE was not comprehended or is missing.

For further details on how to use the *Criticality Diagnostics* IE, see Annex B.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Procedure Code	O		INTEGER (0..255)	
Triggering Message	O		ENUMERATED (initiating message, successful outcome, unsuccessful outcome, outcome)	The Triggering Message is used only if the Criticality Diagnostics is part of Error Indication.
Procedure Criticality	O		ENUMERATED (reject, ignore, notify)	This Procedure Criticality is used for reporting the Criticality of the Triggering message (Procedure). The value 'ignore' shall never be used.
Transaction ID	O		Transaction ID	
Information Element Criticality Diagnostics		<i>0..<maxnoof errors></i>		
>IE Criticality	M		ENUMERATED (reject, ignore, notify)	The IE Criticality is used for reporting the criticality of the triggering IE. The value 'Ignore' shall never be used.
>IE Id	M		INTEGER (0..65535)	The IE Id of the not understood or missing IE as defined in the ASN.1 part of the specification.
>Repetition Number	O		INTEGER (0..255)	<p>The <i>Repetition Number</i> IE gives</p> <ul style="list-style-type: none"> - in case of a not understood IE: The number of occurrences of the reported IE up to and including the not understood occurrence - in case of a missing IE: The number of occurrences up to but not including the missing occurrence. <p>Note: All the counted occurrences of the reported IE must have the same topdown hierarchical message structure of IEs with assigned criticality above them.</p>
>Message Structure	O		9.2.2.23	The <i>Message Structure</i> IE describes the structure where the not understood or missing IE was detected. This IE is included if the not understood IE is not the top level of the message.
>Type of Error	M		ENUMERATED (not understood, missing, ...)	

Range bound	Explanation
Maxnooferrors	Maximum number of IE errors allowed to be reported with a single message.

9.2.2.5 DGPS Corrections

This IE contains DGPS corrections which may be employed to compensate for ranging errors due to atmospheric delay, orbital modeling, and satellite clock drift.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
GPS TOW sec	M		Integer(0..604799)	In seconds GPS time-of-week when the DGPS corrections were calculated
Status/Health	M		Enumerated(UDRE scale 1.0, UDRE scale 0.75, UDRE scale 0.5, UDRE scale 0.3, UDRE scale 0.2, UDRE scale 0.1, no data, invalid data)	
DPGS information	C- Status/Health	$1..<maxSat>$		
>SatID	M		Enumerated(0..63)	
>IODE	M		Integer(0..239)	
>UDRE	M		Enumerated(UDRE \leq 1.0 m, 1.0m < UDRE \leq 4.0m, 4.0m < UDRE \leq 8.0m, 8.0m < UDRE)	The value in this field shall be multiplied by the UDRE Scale Factor in the IE Status/Health to determine the final UDRE estimate for the particular satellite.
>PRC	M		Integer(-2047..2047)	Scaling factor 0.32 Meters
>Range Rate Correction	M		Integer(-127..127)	Scaling factor 0.032 meters/sec
>Delta PRC2	M		Integer(-127..127)	In meters
>Delta Range Rate Correction 2	M		Integer(-7..7)	Scaling factor 0.032 meters/sec
>Delta PRC3	O		Integer(-127..127)	In meters
>Delta Range Rate Correction 3	O		Integer(-7..7)	Scaling factor 0.032 meters/sec

Condition	Explanation
Status/Health	This IE shall be present if the <i>Status/Health</i> IE is not equal to "no data" or "invalid data"

Range bound	Explanation
MaxSat	Maximum number of satellites for which data is included in this IE.

9.2.2.6 Geographical Area

Geographical Area IE is used to identify an area using geographical coordinates. The reference system is the same as the one used in [11].

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE <i>Geographical Area</i>				
> <i>Point</i>				Ellipsoid point
>>Geographical Coordinates	M		9.2.2.7	
> <i>Point With Uncertainty</i>				Ellipsoid point with uncertainty circle
>>Geographical Coordinates	M		9.2.2.7	
>>Uncertainty Code	M		INTEGER(0...127)	The uncertainty "r" is derived from the "uncertainty code" k by $r = 10x(1.1^k - 1)$
> <i>Polygon</i>				List of Ellipsoid points
>> Polygon		1..<maxnoofPoints>		
>>>Geographical Coordinates	M		9.2.2.7	
> <i>Ellipsoid point with uncertainty Ellipse</i>				
>>Geographical Coordinates	M		9.2.2.7	
>>Uncertainty Ellipse	M		9.2.2.30	
>>Confidence	M		INTEGER(0...127)	
> <i>Ellipsoid point with altitude</i>				
>>Geographical Coordinates	M		9.2.2.7	
>>Altitude and direction	M		9.2.2.2	
> <i>Ellipsoid point with altitude and uncertainty Ellipsoid</i>				
>>Geographical Coordinates	M		9.2.2.7	
>>Altitude and direction	M		9.2.2.2	
>>Uncertainty Ellipse	M		9.2.2.30	
>>Uncertainty Altitude	M		INTEGER(0...127)	
>>Confidence	M		INTEGER(0...127)	
> <i>Ellipsoid Arc</i>				
>>Geographical Coordinates	M		9.2.2.7	
>>Inner radius	M		INTEGER (0...2 ¹⁶ -1)	The relation between the value (N) and the radius (r) in meters it describes is $5N \leq r < 5(N+1)$, except for $N=2^{16}-1$ for which the range is extended to include all greater values of (r).
>>Uncertainty radius	M		INTEGER(0...127)	The uncertainty "r" is derived from the "uncertainty code" k by $r = 10x(1.1^k - 1)$
>>Offset angle	M		INTEGER(0...179)	The relation between the value (N) and the angle (a) in degrees it describes is $2N \leq a < 2(N+1)$
>>Included angle	M		INTEGER(0...179)	The relation between the value (N) and the angle (a) in degrees it describes is $2N \leq a < 2(N+1)$
>>Confidence	M		INTEGER(

			0...127)	
--	--	--	----------	--

Range bound	Explanation
maxnoofPoints	Maximum no. of points in polygon. Value is 15.

9.2.2.7 Geographical Coordinates

This IE contains the geographical coordinates.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Latitude Sign	M		ENUMERATED (North, South)	
Degrees Of Latitude	M		INTEGER (0...2 ²³ -1)	The IE value (N) is derived by this formula: $N \leq 2^{23} \times X / 90 < N+1$ X being the latitude in degree (0°.. 90°)
Degrees Of Longitude	M		INTEGER (-2 ²³ ...2 ²³ -1)	The IE value (N) is derived by this formula: $N \leq 2^{24} \times X / 360 < N+1$ X being the longitude in degree (-180°..+180°)

9.2.2.8 GPS Acquisition Assistance

This IE contains parameters that enable fast acquisition of the GPS signals in UE-assisted GPS positioning.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
GPS TOW msec	M		Integer(0..6.048*10 ⁸ -1)	GPS Time of Week in milliseconds (rounded down to the nearest millisecond unit).
Satellite information		<i>1..<maxSat</i> >		
>SatID	M		Integer(0..63)	
>Doppler (0 th order term)	M		Integer(-2048..2047)	Scaling factor 2.5Hz
>Extra Doppler		<i>0..1</i>		
>>Doppler (1 st order term)	M		Integer(-42..21)	Scaling factor 1/42
>>Doppler Uncertainty	M		Enumerated(12.5,25,50,100,200)	In Hz
>Code Phase	M		Integer(0..1022)	In Chips, specifies the centre of the search window
>Integer Code Phase	M		Integer(0..19)	Number of 1023 chip segments
>GPS Bit number	M		Integer(0..3)	Specifies GPS bit number (20 1023 chip segments)
>Code Phase Search Window	M		Integer(1023,1,2,3,4,6,8,12,16,24,32,48,64,96,128,192)	Specifies the width of the search window.
>Azimuth and Elevation		<i>0..1</i>		
>>Azimuth	M		Integer(0..31)	Scaling factor 11.25 Degrees
>>Elevation	M		Integer(0..7)	Scaling factor 11.25 Degrees

Range bound	Explanation
maxSat	Maximum number of satellites for which data is included in this IE.

9.2.2.9 GPS Almanac and Satellite Health

This IE contains a reduced-precision subset of the clock and ephemeris parameters.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
WN _a	M		Bit string(8)	
Satellite information		$1..<maxSat>$		
>DataID	M		Bitstring(2)	See [10]
>SatID	M		Enumerated(0..63)	Satellite ID
>e	M		Bit string(16)	Eccentricity [10]
>t _{oa}	M		Bit string(8)	Reference Time Ephemeris [10]
>δi	M		Bit string(16)	
>OMEGADOT	M		Bit string(16)	Longitude of Ascending Node of Orbit Plane at Weekly Epoch (semi-circles/sec) [10]
>SV Health	M		Bit string(8)	
>A ^{1/2}	M		Bit string(24)	Semi-Major Axis (meters) ^{1/2} [10]
>OMEGA ₀	M		Bit string(24)	Longitude of Ascending Node of Orbit Plane at Weekly Epoch (semi-circles) [10]
>M ₀	M		Bit string(24)	Mean Anomaly at Reference Time (semi-circles) [10]
>ω	M		Bit string(24)	Argument of Perigee (semi-circles) [10]
>af ₀	M		Bit string(11)	apparent clock correction [10]
>af ₁	M		Bit string(11)	apparent clock correction [10]
SV Global Health	O		Bit string(192)	This enables GPS time recovery and possibly extended GPS correlation intervals

Range bound	Explanation
maxSat	Maximum number of satellites for which data is included in this IE.

9.2.2.10 GPS Clock and Ephemeris Parameters

The IE contains the GPS clock information and GPS Ephemeris.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
C/A or P on L2	M		Bit string(2)	Code(s) on L2 Channel [10]
URA Index	M		Bit string(4)	User Range Accuracy [10]
SV Health	M		Bit string(6)	[10]
IODC	M		Bit string(10)	Issue of Data, Clock [10]
L2 P Data Flag	M		Bit string(1)	[10]
SF 1 Reserved	M		Bit string(87)	[10]
T _{GD}	M		Bit string(8)	Estimated group delay differential [10]
t _{oc}	M		Bit string(16)	apparent clock correction [10]
af ₂	M		Bit string(8)	apparent clock correction [10]
af ₁	M		Bit string(16)	apparent clock correction [10]
af ₀	M		Bit string(22)	apparent clock correction [10]
C _{rs}	M		Bit string(16)	Amplitude of the Sine Harmonic Correction Term to the Orbit Radius (meters) [10]
Δn	M		Bit string(16)	Mean Motion Difference From Computed Value (semi-circles/sec) [10]
M ₀	M		Bit string(32)	Mean Anomaly at Reference Time (semi-circles) [10]
C _{uc}	M		Bit string(16)	Amplitude of the Cosine Harmonic Correction Term To The Argument Of Latitude (radians) [10]
e	M		Bit string(32)	C
C _{us}	M		Bit string(16)	Amplitude of the Sine Harmonic Correction Term To The Argument Of Latitude (radians) [10]
(A) ^{1/2}	M		Bit string(32)	Semi-Major Axis (meters) ^{1/2} [10]
t _{oe}	M		Bit string(16)	Reference Time Ephemeris [10]
Fit Interval Flag	M		Bit string(1)	[10]
AODO	M		Bit string(5)	Age Of Data Offset [10]
C _{ic}	M		Bit string(16)	Amplitude of the Cosine Harmonic Correction Term To The Angle Of Inclination (radians) [10]
OMEGA ₀	M		Bit string(32)	Longitude of Ascending Node of Orbit Plane at Weekly Epoch (semi-circles) [10]
C _{is}	M		Bit string(16)	Amplitude of the Sine Harmonic Correction Term To The Angle Of Inclination (radians) [10]
i ₀	M		Bit string(32)	Inclination Angle at Reference Time (semi-circles) [10]
C _{rc}	M		Bit string(16)	Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius (meters) [10]
ω	M		Bit string(32)	Argument of Perigee (semi-circles) [10]
OMEGA _{dot}	M		Bit string(24)	Longitude of Ascending Node of Orbit Plane at Weekly Epoch (semi-circles/sec) [10]
Idot	M		Bit string(14)	Rate of Inclination Angle (semi-circles/sec) [10]

9.2.2.11 GPS Ionospheric Model

The IE contains fields needed to model the propagation delays of the GPS signals through the ionosphere.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
α_0	M		Bit string(8)	Note 1
α_1	M		Bit string(8)	Note 1
α_2	M		Bit string(8)	Note 1
α_3	M		Bit string(8)	Note 1
β_0	M		Bit string(8)	Note 2
β_1	M		Bit string(8)	Note 2
β_2	M		Bit string(8)	Note 2
β_3	M		Bit string(8)	Note 2

NOTE 1: The parameters α_n are the coefficients of a cubic equation representing the amplitude of the vertical delay [10].

NOTE 2: The parameters β_n are the coefficients of a cubic equation representing the period of the ionospheric model [10].

9.2.2.12 GPS Measured Results

The purpose of this information element is to provide reported GPS measurement information from the SRNC to the SAS.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
GPS TOW msec	M		Integer(0..6.048*10 ⁸ -1)	GPS Time of Week in milliseconds (rounded down to the nearest millisecond unit). This time is the GPS TOW measured by the UE. GPS Time of Week in microseconds = 1000 * GPS TOW msec + GPS TOW rem usec
GPS TOW rem usec	O		Integer(0..999)	GPS Time of Week in microseconds MOD 1000.
Measurement Parameters		1..<maxSat>		
>Satellite ID	M		Enumerated(0..63)	
>C/N ₀	M		Integer(0..63)	the estimate of the carrier-to-noise ratio of the received signal from the particular satellite used in the measurement. It is given in whole dBs. Typical levels observed by UE-based GPS units will be in the range of 20 – 50 dB.
>Doppler	M		Integer(-32768..32768)	Hz, scale factor 0.2.
>Whole GPS Chips	M		Integer(0..1023)	Unit in GPS chips
>Fractional GPS Chips	M		Integer(0..(2 ¹⁰ -1))	Scale factor 2 ⁻¹⁰
>Multipath Indicator	M		Enumerated(NM, low, medium, high)	See note 1
>Pseudorange RMS Error	M		Enumerated(range index 0..range index 63)	See note 2

Range bound	Explanation
maxSat	Maximum number of satellites for which data is included in this IE.

NOTE 1: The following table gives the mapping of the multipath indicator field.

Value	Multipath Indication
NM	Not measured
Low	MP error < 5m
Medium	5m < MP error < 43m
High	MP error > 43m

NOTE 2: The following table gives the bitmapping of the Pseudorange RMS Error field.

Range Index	Mantissa	Exponent	Floating-Point value, x_i	Pseudorange value, P
0	000	000	0.5	$P < 0.5$
1	001	000	0.5625	$0.5 \leq P < 0.5625$
I	X	Y	$0.5 * (1 + x/8) * 2^Y$	$x_{i-1} \leq P < x_i$
62	110	111	112	$104 \leq P < 112$
63	111	111	--	$112 \leq P$

9.2.2.13 GPS Navigation Model

This IE contain information required to manage the transfer of precise navigation data to the GPS-capable UE.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Satellite information		$1..<maxSat>$		
>SatID	M		Enumerated(0..63)	Satellite ID
>Satellite Status	M		Enumerated(NS_NN, ES_SN, ES_NN, REVD)	See note 1
>GPS Clock and Ephemeris parameters	C- <i>Satellite status</i>		9.2.2.10	

NOTE 1: The UE shall interpret enumerated symbols as follows.

Value	Indication
NS_NN	New satellite, new Navigation Model
ES_SN	Existing satellite, same Navigation Model
ES_NN	Existing satellite, new Navigation Model
REVD	Reserved

Condition	Explanation
<i>Satellite status</i>	The IE shall be present if the <i>Satellite Status</i> IE is not set to ES_SN

Range bound	Explanation
MaxSat	Maximum number of satellites for which data is included in this IE.

9.2.2.14 GPS Real Time Integrity

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
CHOICE <i>Bad Satellites Presence</i>	M			
> Bad Satellites				
>> Satellite information		$1..<MaxNo Sat>$		
>>>BadSatID	M		Enumerated(0..63)	Satellite ID
> <i>No Bad Satellites</i>			NULL	

Range bound	Explanation
MaxNoSat	Maximum number of satellites for which data is included in this IE.

9.2.2.15 GPS Reference Time

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
GPS Week	M		Integer(0..1023)	
GPS TOW msec	M		Integer(0..6.048*10 ⁸ -1)	GPS Time of Week in milliseconds (rounded down to the nearest millisecond unit).
GPS TOW rem usec	O		Integer(0..999)	GPS Time of Week in microseconds MOD 1000. GPS Time of Week in microseconds = 1000 * GPS TOW msec + GPS TOW rem usec
GPS TOW Assist		0..<maxSat>		
>SatID	M		Enumerated(0..63)	
>TLM Message	M		Bit string(14)	
>Anti-Spoof	M		Enumerated (present, not present)	
>Alert	M		Enumerated (present, not present)	
>TLM Reserved	M		Bit string(2)	

Range bound	Explanation
maxSat	Maximum number of satellites for which data is included in this IE.

9.2.2.16 GPS Transmission TOW

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
GPS Transmission TOW			Integer (0..604799)	The GPS time-of-week in seconds

9.2.2.17 GPS UTC Model

The UTC Model field contains a set of parameters needed to relate GPS time to Universal Time Coordinate (UTC).

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
A ₁	M		Bit string(24)	sec/sec [10]
A ₀	M		Bit string(32)	seconds [10]
t _{ot}	M		Bit string(8)	seconds [10]
Δt _{LS}	M		Bit string(8)	seconds [10]
WN _t	M		Bit string(8)	weeks [10]
WN _{LSF}	M		Bit string(8)	weeks [10]
DN	M		Bit string(8)	days [10]
Δt _{LSF}	M		Bit string(8)	seconds [10]

9.2.2.18 GPS-UTRAN Time Relationship Uncertainty

This IE contains the uncertainty of the GPS and UTRAN time relationship.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
GPS-UTRAN Time Relationship Uncertainty			ENUMERATED (50ns, 500ns, 1us, 10us, 1ms, 10ms, 100ms, unreliable)	RNC estimate of uncertainty in GPS-UTRAN time relationship

9.2.2.19 Information Exchange ID

The Information Exchange ID uniquely identifies any requested information per RNC-SAS pair.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Information Exchange ID			Integer(0 .. 2 ²⁰ -1)	

9.2.2.20 Information Exchange Object Type

The Information Exchange Object type indicates the type of object that the requested information shall be valid for.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Information Exchange Object Type			ENUMERATED(Reference Position, ...)	

9.2.2.21 Information Report Characteristics

The information report characteristics define how the reporting shall be performed.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Information Report Characteristics Type	M		ENUMERATED(On Demand, Periodic, On Modification, ...)	
Information Report Periodicity	C-Periodic		ENUMERATED(1min...1hr, ...) step 1min, (1hr...24hr, ...) step 1hr, ...	Indicates the frequency with which the SAS shall send broadcast data reports.

Condition	Explanation
Periodic	This IE shall be present if the <i>Information Report Characteristics Type</i> IE indicates 'periodic'

9.2.2.22 Information Type

The Information Type indicates which kind of information the SAS shall provide.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
CHOICE <i>Information Type</i>	M			
> Implicit				
>>Method Type	M		9.2.2.25	
> Explicit				
>> Explicit Information		1..<maxnoofExplInfo>		
>>>CHOICE <i>Explicit Information Item</i>	M			
>>>>Almanac and Satellite Health			NULL	
>>>> UTC Model				
>>>>>Transmission TOW Indicator	M		9.2.2.29	
>>>>> Ionospheric Model				
>>>>>Transmission TOW Indicator	M		9.2.2.29	
>>>>> Navigation Model				
>>>>>Transmission TOW Indicator	M		9.2.2.29	
>>>>> Nav. Model Additional Data		0..1		
>>>>>>GPS Week	M		Integer (0..1023)	
>>>>>>GPS_Toe	M		Integer (0..167)	GPS time of ephemeris in hours of the latest ephemeris set
>>>>>>T-Toe limit	M		Integer (0..10)	ephemeris age tolerance in hours
>>>>>> Satellite related data		0..<maxSat-1>		
>>>>>>>SatID	M		Integer (0..63)	
>>>>>>>IODE	M		Integer (0..239)	Issue of Data Ephemeris for SatID
>>>>>>> DGPS Corrections			NULL	
>>>>>>> Reference Time			NULL	
>>>>>>> Acquisition Assistance			NULL	
>>>>>>> Real Time Integrity			NULL	
>>>>>>> Almanac and Satellite Health SIB				
>>>>>>>>Transmission TOW Indicator	M		9.2.2.29	

Range Bound	Explanation
MaxnoofExplInfo	Maximum number of Explicit Information supported in one Information Exchange.
maxSat	Maximum number of satellites for which data is included in this IE.

9.2.2.23 Message Structure

The *Message Structure* IE gives information for each level with assigned criticality in an hierarchical message structure from top level down to the lowest level above the reported level for the occurred error (reported in the *Information Element Criticality Diagnostics* IE).

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message structure		<i>1..<maxnooflevels></i>		The first repetition of the <i>Message Structure</i> IE corresponds to the top level of the message. The last repetition of the <i>Message Structure</i> IE corresponds to the level above the reported level for the occurred error of the message.	GLOBAL	ignore
>IE ID	M		INTEGER (0..65535)	The IE ID of this level's IE containing the not understood or missing IE.	-	
>Repetition Number	O		INTEGER (1..256)	The <i>Repetition Number</i> IE gives, if applicable, the number of occurrences of this level's reported IE up to and including the occurrence containing the not understood or missing IE. Note: All the counted occurrences of the reported IE must have the same topdown hierarchical message structure of IEs with assigned criticality above them.	-	

Range bound	Explanation
maxnooflevels	Maximum no. of message levels to report. The value for maxnooflevels is 256.

9.2.2.24 Message Type

Message Type IE uniquely identifies the message being sent. It is mandatory for all messages.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Procedure Code	M		ENUMERATED (Position Calculation, Information Exchange Initiation, Information Reporting, Information Exchange Termination, Information Exchange Failure, Error Indication, ...)	
Type of Message	M		ENUMERATED (Initiating Message, Successful Outcome, Unsuccessful Outcome, Outcome)	

9.2.2.25 Method Type

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Method Type			ENUMERATED (UE_Assisted, UE_Based.)	

9.2.2.26 Requested Data Value

The Requested Data Value contains the relevant data concerning the ongoing information exchange.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Almanac and Satellite Health	O		9.2.2.9	
UTC Model	O		9.2.2.17	
Ionospheric Model	O		9.2.2.11	
Navigation Model	O		9.2.2.13	
DGPS Corrections	O		9.2.2.5	
Reference Time	O		9.2.2.15	
Acquisition Assistance	O		9.2.2.8	
Real Time Integrity	O		9.2.2.14	
Almanac and Satellite Health SIB	O		9.2.2.1	
GPS Transmission TOW	O		9.2.2.16	

9.2.2.27 Requested Data Value Information

The Requested Data Value Information IE provides information both on whether or not the Requested Data Value is provided in the message or not and if provided also the Requested Data Value itself.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
CHOICE <i>Information Availability Indicator</i>	M				–	
> <i>Information Available</i>					–	
>>Requested Data Value	M		9.2.2.26		–	
> <i>Information not Available</i>			NULL		–	

9.2.2.28 Transaction ID

The Transaction ID is used to associate all the messages belonging to the same procedure. Messages belonging to the same procedure shall use the same Transaction ID.

The Transaction ID is determined by the initiating peer of a procedure.

The Transaction ID shall uniquely identify a procedure among all ongoing parallel procedures using the same procedure code, and initiated by the same protocol peer.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Transaction ID			CHOICE INTEGER (0..127) or INTEGER (0..32767)	

9.2.2.29 Transmission TOW Indicator

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Transmission TOW Indicator			ENUMERATED(requested, not requested)	

9.2.2.30 Uncertainty Ellipse

This IE contains the uncertainty ellipse of a geographical area.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Uncertainty semi-major	M		INTEGER(0...127)	The uncertainty "r" is derived from the "uncertainty code" k by $r = 10x(1.1^k - 1)$
Uncertainty semi-minor	M		INTEGER(0...127)	The uncertainty "r" is derived from the "uncertainty code" k by $r = 10x(1.1^k - 1)$
Orientation of major axis	M		INTEGER(0...179)	The relation between the value (N) and the angle (a) in degrees it describes is $2N \leq a < 2(N+1)$

9.3 Message and Information Element Abstract Syntax (with ASN.1)

9.3.0 General

PCAP ASN.1 definition conforms with [7], [8], and [9].

The ASN.1 definition specifies the structure and content of PCAP messages. PCAP messages can contain any IEs specified in the object set definitions for that message without the order or number of occurrence being restricted by ASN.1. However, for this version of the standard, a sending entity shall construct a PCAP message according to the PDU definitions module and with the following additional rules (Note that in the following IE means an IE in the object set with an explicit id. If one IE needed to appear more than once in one object set, then the different occurrences have different IE ids):

- IEs shall be ordered (in an IE container) in the order they appear in object set definitions.
- Object set definitions specify how many times IEs may appear. An IE shall appear exactly once if the presence field in an object has value "mandatory". An IE may appear at most once if the presence field in an object has value "optional" or "conditional". If in a tabular format there is multiplicity specified for an IE (i.e. an IE list) then in the corresponding ASN.1 definition the list definition is separated into two parts. The first part defines an IE container list where the list elements reside. The second part defines list elements. The IE container list appears as an IE of its own. For this version of the standard an IE container list may contain only one kind of list elements.

If a PCAP message that is not constructed as defined above is received, this shall be considered as Abstract Syntax Error, and the message shall be handled as defined for Abstract Syntax Error in section 10.3.6.

Section 9.3 presents the Abstract Syntax of PCAP protocol with ASN.1. In case there is contradiction between the ASN.1 definition in this section and the tabular format in sections 9.1 and 9.2, the ASN.1 shall take precedence, except for the definition of conditions for the presence of conditional elements, where the tabular format shall take precedence.

9.3.1 Usage of private message mechanism for non-standard use

The private message mechanism for non-standard use may be used:

- for special operator- (and/or vendor) specific features considered not to be part of the basic functionality, i.e. the functionality required for a complete and high-quality specification in order to guarantee multivendor interoperability;
- by vendors for research purposes, e.g. to implement and evaluate new algorithms/features before such features are proposed for standardisation.

The private message mechanism shall not be used for basic functionality. Such functionality shall be standardised.

9.3.2 Elementary Procedure Definitions

-- *****

```

--
-- Elementary Procedure definitions
--
-- *****

PCAP-PDU-Descriptions {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
ums-Access (20) modules (3) pcap(8) version1 (1) pcap-PDU-Descriptions (0)}

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- *****
--
-- IE parameter types from other modules.
--
-- *****

IMPORTS
    Criticality,
    ProcedureCode,
    TransactionID
FROM PCAP-CommonDataTypes

    PositionCalculationRequest,
    PositionCalculationResponse,
    PositionCalculationFailure,
    InformationExchangeInitiationRequest,
    InformationExchangeInitiationResponse,
    InformationExchangeInitiationFailure,
    InformationReport,
    InformationExchangeTerminationRequest,
    InformationExchangeFailureIndication,
    ErrorIndication,
    PrivateMessage
FROM PCAP-PDU-Contents

    id-PositionCalculation,
    id-InformationExchangeInitiation,
    id-InformationReporting,
    id-InformationExchangeTermination,
    id-InformationExchangeFailure,
    id-ErrorIndication,
    id-privateMessage
FROM PCAP-Constants;

-- *****
--
-- Interface Elementary Procedure Class
--
-- *****

```

```

PCAP-ELEMENTARY-PROCEDURE ::= CLASS {
    &InitiatingMessage      ,
    &SuccessfulOutcome      OPTIONAL,
    &UnsuccessfulOutcome    OPTIONAL,
    &Outcome                OPTIONAL,
    &procedureCode          ProcedureCode  UNIQUE,
    &criticality            Criticality    DEFAULT ignore
}

WITH SYNTAX {
    INITIATING MESSAGE      &InitiatingMessage
    [SUCCESSFUL OUTCOME    &SuccessfulOutcome]
    [UNSUCCESSFUL OUTCOME  &UnsuccessfulOutcome]
    [OUTCOME               &Outcome]
    PROCEDURE CODE         &procedureCode
    [CRITICALITY           &criticality]
}

-- *****
--
-- Interface PDU definitions
--
-- *****

PCAP-PDU ::= CHOICE {
    initiatingMessage      InitiatingMessage,
    successfulOutcome      SuccessfulOutcome,
    unsuccessfulOutcome    UnsuccessfulOutcome,
    outcome                Outcome,
    ...
}

InitiatingMessage ::= SEQUENCE {
    procedureCode          PCAP-ELEMENTARY-PROCEDURE.&procedureCode          ( { PCAP-ELEMENTARY-PROCEDURES } ),
    criticality            PCAP-ELEMENTARY-PROCEDURE.&criticality            ( { PCAP-ELEMENTARY-PROCEDURES } { @procedureCode } ),
    transactionID         TransactionID,
    value                 PCAP-ELEMENTARY-PROCEDURE.&InitiatingMessage      ( { PCAP-ELEMENTARY-PROCEDURES } { @procedureCode } )
}

SuccessfulOutcome ::= SEQUENCE {
    procedureCode          PCAP-ELEMENTARY-PROCEDURE.&procedureCode          ( { PCAP-ELEMENTARY-PROCEDURES } ),
    criticality            PCAP-ELEMENTARY-PROCEDURE.&criticality            ( { PCAP-ELEMENTARY-PROCEDURES } { @procedureCode } ),
    transactionID         TransactionID,
    value                 PCAP-ELEMENTARY-PROCEDURE.&SuccessfulOutcome      ( { PCAP-ELEMENTARY-PROCEDURES } { @procedureCode } )
}

UnsuccessfulOutcome ::= SEQUENCE {
    procedureCode          PCAP-ELEMENTARY-PROCEDURE.&procedureCode          ( { PCAP-ELEMENTARY-PROCEDURES } ),
    criticality            PCAP-ELEMENTARY-PROCEDURE.&criticality            ( { PCAP-ELEMENTARY-PROCEDURES } { @procedureCode } ),
    transactionID         TransactionID,
    value                 PCAP-ELEMENTARY-PROCEDURE.&UnsuccessfulOutcome    ( { PCAP-ELEMENTARY-PROCEDURES } { @procedureCode } )
}

```

```

Outcome ::= SEQUENCE {
    procedureCode    PCAP-ELEMENTARY-PROCEDURE.&procedureCode    ({PCAP-ELEMENTARY-PROCEDURES}),
    criticality      PCAP-ELEMENTARY-PROCEDURE.&criticality      ({PCAP-ELEMENTARY-PROCEDURES}{@procedureCode}),
    transactionID    TransactionID,
    value           PCAP-ELEMENTARY-PROCEDURE.&Outcome          ({PCAP-ELEMENTARY-PROCEDURES}{@procedureCode})
}

-- *****
--
-- Interface Elementary Procedure List
--
-- *****

PCAP-ELEMENTARY-PROCEDURES PCAP-ELEMENTARY-PROCEDURE ::= {
    PCAP-ELEMENTARY-PROCEDURES-CLASS-1 |
    PCAP-ELEMENTARY-PROCEDURES-CLASS-2 ,
    ...
}

PCAP-ELEMENTARY-PROCEDURES-CLASS-1 PCAP-ELEMENTARY-PROCEDURE ::= {
    positionCalculation |
    informationExchangeInitiation,
    ...
}

PCAP-ELEMENTARY-PROCEDURES-CLASS-2 PCAP-ELEMENTARY-PROCEDURE ::= {
    informationReporting |
    informationExchangeTermination |
    informationExchangeFailure |
    errorIndication |
    privateMessage,
    ...
}

-- *****
--
-- Interface Elementary Procedures
--
-- *****

positionCalculation PCAP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      PositionCalculationRequest
    SUCCESSFUL OUTCOME      PositionCalculationResponse
    UNSUCCESSFUL OUTCOME    PositionCalculationFailure
    PROCEDURE CODE          id-PositionCalculation
    CRITICALITY             ignore
}

informationExchangeInitiation PCAP-ELEMENTARY-PROCEDURE ::= {

```

```

INITIATING MESSAGE      InformationExchangeInitiationRequest
SUCCESSFUL OUTCOME      InformationExchangeInitiationResponse
UNSUCCESSFUL OUTCOME    InformationExchangeInitiationFailure
PROCEDURE CODE          id-InformationExchangeInitiation
CRITICALITY             reject
}

informationReporting PCAP-ELEMENTARY-PROCEDURE ::= {
  INITIATING MESSAGE      InformationReport
  PROCEDURE CODE          id-InformationReporting
  CRITICALITY             ignore
}

informationExchangeTermination PCAP-ELEMENTARY-PROCEDURE ::= {
  INITIATING MESSAGE      InformationExchangeTerminationRequest
  PROCEDURE CODE          id-InformationExchangeTermination
  CRITICALITY             ignore
}

informationExchangeFailure PCAP-ELEMENTARY-PROCEDURE ::= {
  INITIATING MESSAGE      InformationExchangeFailureIndication
  PROCEDURE CODE          id-InformationExchangeFailure
  CRITICALITY             ignore
}

errorIndication PCAP-ELEMENTARY-PROCEDURE ::= {
  INITIATING MESSAGE      ErrorIndication
  PROCEDURE CODE          id-ErrorIndication
  CRITICALITY             ignore
}

privateMessage PCAP-ELEMENTARY-PROCEDURE ::= {
  INITIATING MESSAGE      PrivateMessage
  PROCEDURE CODE          id-privateMessage
  CRITICALITY             ignore
}

```

END

9.3.3 PDU Definitions

```

-- *****
--
-- PDU definitions for PCAP.
--
-- *****

```

```
PCAP-PDU-Contents {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) pcap(8) version1 (1) pcap-PDU-Contents (1) }
```

```
DEFINITIONS AUTOMATIC TAGS ::=
```

```
BEGIN
```

```
-- *****
--
-- IE parameter types from other modules.
--
-- *****
```

```
IMPORTS
```

```
    Cause,
    CriticalityDiagnostics,
    GPS-UTRAN-TRU,
    InformationExchangeID,
    InformationReportCharacteristics,
    InformationType,
    MeasuredResultsList,
    RequestedDataValue,
    RequestedDataValueInformation,
    UE-PositionEstimate
FROM PCAP-IEs
```

```
    TransactionID
FROM PCAP-CommonDataTypes
```

```
    PrivateIE-Container{},
    ProtocolExtensionContainer{},
    ProtocolIE-ContainerList{},
    ProtocolIE-Container{},
    PrivateIE-Container{},
    PCAP-PRIVATE-IES,
    PCAP-PROTOCOL-EXTENSION,
    PCAP-PROTOCOL-IES
FROM PCAP-Containers
```

```
    id-Cause,
    id-CriticalityDiagnostics,
    id-GPS-UTRAN-TRU,
    id-InformationExchangeID,
    id-InformationExchangeObjectType-InfEx-Rprt,
    id-InformationExchangeObjectType-InfEx-Rqst,
    id-InformationExchangeObjectType-InfEx-Rsp,
    id-InformationReportCharacteristics,
    id-InformationType,
    id-MeasuredResultsList,
    id-RequestedDataValue,
    id-RequestedDataValueInformation,
```

```

    id-TransactionID,
    id-UE-PositionEstimate
FROM PCAP-Constants;

-- *****
--
-- POSITION CALCULATION REQUEST
--
-- *****

PositionCalculationRequest ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    { {PositionCalculationRequestIEs} },
    protocolExtensions  ProtocolExtensionContainer { {PositionCalculationRequestExtensions} } OPTIONAL,
    ...
}

PositionCalculationRequestIEs PCAP-PROTOCOL-IES ::= {
    { ID id-UE-PositionEstimate      CRITICALITY reject  TYPE UE-PositionEstimate      PRESENCE mandatory } |
    { ID id-MeasuredResultsList      CRITICALITY reject  TYPE MeasuredResultsList      PRESENCE mandatory },
    ...
}

PositionCalculationRequestExtensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- POSITION CALCULATION RESPONSE
--
-- *****

PositionCalculationResponse ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    { {PositionCalculationResponseIEs} },
    protocolExtensions  ProtocolExtensionContainer { {PositionCalculationResponseExtensions} } OPTIONAL,
    ...
}

PositionCalculationResponseIEs PCAP-PROTOCOL-IES ::= {
    { ID id-UE-PositionEstimate      CRITICALITY ignore  TYPE UE-PositionEstimate      PRESENCE mandatory } |
    { ID id-CriticalityDiagnostics    CRITICALITY ignore  TYPE CriticalityDiagnostics    PRESENCE optional },
    ...
}

PositionCalculationResponseExtensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- POSITION CALCULATION FAILURE
--

```



```

-- *****
PositionCalculationFailure ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    { {PositionCalculationFailureIEs} },
    protocolExtensions  ProtocolExtensionContainer { {PositionCalculationFailureExtensions} }  OPTIONAL,
    ...
}

PositionCalculationFailureIEs PCAP-PROTOCOL-IES ::= {
    { ID id-Cause          CRITICALITY ignore  TYPE Cause          PRESENCE mandatory } |
    { ID id-CriticalityDiagnostics  CRITICALITY ignore  TYPE CriticalityDiagnostics  PRESENCE optional },
    ...
}

PositionCalculationFailureExtensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- INFORMATION EXCHANGE INITIATION REQUEST
--
-- *****

InformationExchangeInitiationRequest ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    {{InformationExchangeInitiationRequest-IEs}},
    protocolExtensions  ProtocolExtensionContainer {{InformationExchangeInitiationRequest-Extensions}}  OPTIONAL,
    ...
}

InformationExchangeInitiationRequest-IEs PCAP-PROTOCOL-IES ::= {
    { ID id-InformationExchangeID          CRITICALITY reject  TYPE InformationExchangeID          PRESENCE mandatory } |
    { ID id-InformationExchangeObjectType-InfEx-Rqst  CRITICALITY reject  TYPE InformationExchangeObjectType-InfEx-Rqst  PRESENCE mandatory } |
    -- This IE represents both the Information Exchange Object Type IE and the choice based on the Information Exchange Object Type
    -- as described in the tabular message format in subclause 9.1.
    { ID id-InformationType          CRITICALITY reject  TYPE InformationType          PRESENCE mandatory } |
    { ID id-InformationReportCharacteristics  CRITICALITY reject  TYPE InformationReportCharacteristics  PRESENCE mandatory } |
    { ID id-GPS-UTRAN-TRU          CRITICALITY reject  TYPE GPS-UTRAN-TRU          PRESENCE conditional },
    -- This IE shall be present if the information requested in the Information Type IE contains GPS-related data
    ...
}

InformationExchangeInitiationRequest-Extensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

InformationExchangeObjectType-InfEx-Rqst ::= CHOICE {
    referencePosition          RefPosition-InfEx-Rqst,
    ...
}

RefPosition-InfEx-Rqst ::= SEQUENCE {

```

```

referencePositionEstimate      UE-PositionEstimate,
iE-Extensions                  ProtocolExtensionContainer { { RefPositionItem-InfEx-Rqst-ExtIEs } } OPTIONAL,
...
}

RefPositionItem-InfEx-Rqst-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
...
}

-- *****
--
-- INFORMATION EXCHANGE INITIATION RESPONSE
--
-- *****

InformationExchangeInitiationResponse ::= SEQUENCE {
  protocolIEs          ProtocolIE-Container  {{InformationExchangeInitiationResponse-IEs}},
  protocolExtensions   ProtocolExtensionContainer  {{InformationExchangeInitiationResponse-Extensions}} OPTIONAL,
  ...
}

InformationExchangeInitiationResponse-IEs PCAP-PROTOCOL-IES ::= {
  { ID   id-InformationExchangeID          CRITICALITY ignore TYPE InformationExchangeID          PRESENCE mandatory }|
  { ID   id-InformationExchangeObjectType-InfEx-Rsp CRITICALITY ignore TYPE InformationExchangeObjectType-InfEx-Rsp PRESENCE mandatory }|
  { ID   id-CriticalityDiagnostics         CRITICALITY ignore TYPE CriticalityDiagnostics         PRESENCE optional },
  ...
}

InformationExchangeInitiationResponse-Extensions PCAP-PROTOCOL-EXTENSION ::= {
...
}

InformationExchangeObjectType-InfEx-Rsp ::= CHOICE {
  referencePosition      RefPosition-InfEx-Rsp,
  ...
}

RefPosition-InfEx-Rsp ::= SEQUENCE {
  requestedDataValue     RequestedDataValue,
  iE-Extensions          ProtocolExtensionContainer { { RefPositionItem-InfEx-Rsp-ExtIEs } } OPTIONAL,
  ...
}

RefPositionItem-InfEx-Rsp-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
...
}

-- *****
--
-- INFORMATION EXCHANGE INITIATION FAILURE

```

```

--
-- *****
InformationExchangeInitiationFailure ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    {{InformationExchangeInitiationFailure-IEs}},
    protocolExtensions   ProtocolExtensionContainer {{InformationExchangeInitiationFailure-Extensions}}    OPTIONAL,
    ...
}

InformationExchangeInitiationFailure-IEs PCAP-PROTOCOL-IES ::= {
    { ID    id-InformationExchangeID          CRITICALITY ignore TYPE InformationExchangeID    PRESENCE mandatory }|
    { ID    id-Cause                          CRITICALITY ignore TYPE Cause                          PRESENCE mandatory }|
    { ID    id-CriticalityDiagnostics         CRITICALITY ignore TYPE CriticalityDiagnostics         PRESENCE optional },
    ...
}

InformationExchangeInitiationFailure-Extensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- INFORMATION REPORT
--
-- *****

InformationReport ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    {{InformationReport-IEs}},
    protocolExtensions   ProtocolExtensionContainer {{InformationReport-Extensions}}    OPTIONAL,
    ...
}

InformationReport-IEs PCAP-PROTOCOL-IES ::= {
    { ID    id-InformationExchangeID          CRITICALITY ignore TYPE InformationExchangeID    PRESENCE mandatory }|
    { ID    id-InformationExchangeObjectType-InfEx-Rprt CRITICALITY ignore TYPE InformationExchangeObjectType-InfEx-Rprt PRESENCE mandatory },
    ...
}

InformationReport-Extensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

InformationExchangeObjectType-InfEx-Rprt ::= CHOICE {
    referencePosition    RefPosition-InfEx-Rprt,
    ...
}

RefPosition-InfEx-Rprt ::= SEQUENCE {
    requestedDataValueInformation RequestedDataValueInformation,
    iE-Extensions          ProtocolExtensionContainer {{ RefPositionItem-InfEx-Rprt-ExtIEs }}    OPTIONAL,
    ...
}

```

```

RefPositionItem-InfEx-Rprt-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- INFORMATION EXCHANGE TERMINATION REQUEST
--
-- *****

InformationExchangeTerminationRequest ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    {{InformationExchangeTerminationRequest-IEs}},
    protocolExtensions   ProtocolExtensionContainer {{InformationExchangeTerminationRequest-Extensions}}    OPTIONAL,
    ...
}

InformationExchangeTerminationRequest-IEs PCAP-PROTOCOL-IES ::= {
    { ID    id-InformationExchangeID          CRITICALITY ignore TYPE InformationExchangeID          PRESENCE mandatory},
    ...
}

InformationExchangeTerminationRequest-Extensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- INFORMATION EXCHANGE FAILURE INDICATION
--
-- *****

InformationExchangeFailureIndication ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    {{InformationExchangeFailureIndication-IEs}},
    protocolExtensions   ProtocolExtensionContainer {{InformationExchangeFailureIndication-Extensions}}    OPTIONAL,
    ...
}

InformationExchangeFailureIndication-IEs PCAP-PROTOCOL-IES ::= {
    { ID    id-InformationExchangeID          CRITICALITY ignore          TYPE InformationExchangeID          PRESENCE mandatory }|
    { ID    id-Cause                          CRITICALITY ignore          TYPE Cause                          PRESENCE mandatory }|
    ...
}

InformationExchangeFailureIndication-Extensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--

```

```

-- ERROR INDICATION
--
-- *****
ErrorIndication ::= SEQUENCE {
    protocolIEs      ProtocolIE-Container      { {ErrorIndicationIEs} },
    protocolExtensions ProtocolExtensionContainer { {ErrorIndicationExtensions} } OPTIONAL,
    ...
}

ErrorIndicationIEs PCAP-PROTOCOL-IES ::= {
    { ID id-Cause          CRITICALITY ignore TYPE Cause          PRESENCE optional } |
    { ID id-CriticalityDiagnostics CRITICALITY ignore TYPE CriticalityDiagnostics PRESENCE optional },
    ...
}

ErrorIndicationExtensions PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- PRIVATE MESSAGE
--
-- *****

PrivateMessage ::= SEQUENCE {
    privateIEs      PrivateIE-Container  {{PrivateMessage-IEs}},
    ...
}

PrivateMessage-IEs PCAP-PRIVATE-IES ::= {
    ...
}

END

```

9.3.4 Information Element Definitions

```

-- *****
--
-- Information Element Definitions
--
-- *****

PCAP-IEs {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)

```

```

umts-Access (20) modules (3) pcap(8) version1 (1) pcap-IEs (2) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    maxNrOfErrors,
    maxSat,
    maxSatLess1,
    maxNrOfLevels,
    maxNrOfPoints,
    maxNrOfExpInfo,
    id-TypeOfError,
    id-MessageStructure
FROM PCAP-Constants

    Criticality,
    ProcedureCode,
    ProtocolIE-ID,
    TransactionID,
    TriggeringMessage
FROM PCAP-CommonDataTypes

    ProtocolExtensionContainer{ },
    PCAP-PROTOCOL-EXTENSION
FROM PCAP-Containers;

-- *****
--
-- Almanac and Satellite Health SIB
--
-- *****

AlmanacAndSatelliteHealthSIB ::= SEQUENCE {
    gpsAlmanacAndSatelliteHealth    GPS-AlmanacAndSatelliteHealth,
    satMask                          BIT STRING (SIZE (1..32)),
    lsbTOW                            BIT STRING (SIZE (8))
}

-- *****
--
-- Cause IE
--
-- *****

Cause ::= CHOICE {
    radioNetwork          CauseRadioNetwork,
    transport              CauseTransport,
    protocol               CauseProtocol,
    misc                   CauseMisc,

```

```

    ...
}
CauseRadioNetwork ::= ENUMERATED {
    invalid-reference-information,
    information-temporarily-not-available,
    information-provision-not-supported-for-the-object,
    position-calculation-error-invalid-GPS-measured-results,
    ...
}

CauseTransport ::= ENUMERATED {
    transport-resource-unavailable,
    unspecified,
    ...
}

CauseProtocol ::= ENUMERATED {
    transfer-syntax-error,
    abstract-syntax-error-reject,
    abstract-syntax-error-ignore-and-notify,
    message-not-compatible-with-receiver-state,
    semantic-error,
    unspecified,
    abstract-syntax-error-falsely-constructed-message,
    ...
}

CauseMisc ::= ENUMERATED {
    processing-overload,
    hardware-failure,
    o-and-m-intervention,
    unspecified,
    ...
}

-- *****
--
-- CriticalityDiagnostics
--
-- *****

CriticalityDiagnostics ::= SEQUENCE {
    procedureCode          ProcedureCode          OPTIONAL,
    triggeringMessage      TriggeringMessage      OPTIONAL,
    procedureCriticality   Criticality             OPTIONAL,
    transactionID         TransactionID          OPTIONAL,
    iEsCriticalityDiagnostics CriticalityDiagnostics-IE-List OPTIONAL,
    iE-Extensions         ProtocolExtensionContainer { {CriticalityDiagnostics-ExtIEs} } OPTIONAL,
    ...
}

```

```

CriticalityDiagnostics-IE-List ::= SEQUENCE (SIZE (1..maxNrOfErrors)) OF
  SEQUENCE {
    iECriticality          Criticality,
    iE-ID                 ProtocolIE-ID,
    repetitionNumber      RepetitionNumber0 OPTIONAL,
    iE-Extensions         ProtocolExtensionContainer { {CriticalityDiagnostics-IE-List-ExtIEs} } OPTIONAL,
    ...
  }

CriticalityDiagnostics-IE-List-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
  { ID id-MessageStructure      CRITICALITY ignore      EXTENSION MessageStructure      PRESENCE optional }|
  { ID id-TypeOfError          CRITICALITY ignore      EXTENSION TypeOfError          PRESENCE mandatory },
  ...
}

CriticalityDiagnostics-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
  ...
}

RepetitionNumber0 ::= INTEGER (0..255, ...)
RepetitionNumber1 ::= INTEGER (1..256, ...)

TypeOfError ::= ENUMERATED {
  not-understood,
  missing,
  ...
}

-- *****
--
-- DGPSCorrections
--
-- *****

DGPSCorrections ::=
  SEQUENCE {
    gps-TOW-sec          INTEGER (0..604799),
    statusHealth         DiffCorrectionStatus,
    dgps-CorrectionSatInfoList
      DGPS-CorrectionSatInfoList OPTIONAL,
    -- not included if satelliteHealth is equal to noData or invalidData
    iE-Extensions       ProtocolExtensionContainer { { DGPSCorrections-ExtIEs } } OPTIONAL,
    ...
  }

DGPSCorrections-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
  ...
}

DiffCorrectionStatus ::=
  ENUMERATED {
    udre-1-0, udre-0-75, udre-0-5, udre-0-3,
  }

```



```

        udre-0-2, udre-0-1, noData, invalidData }

DGPS-CorrectionSatInfoList ::= SEQUENCE (SIZE (1..maxSat)) OF
                                DGPS-CorrectionSatInfo

DGPS-CorrectionSatInfo ::= SEQUENCE {
    satID          INTEGER (0..63),
    iode           INTEGER (0..239),
    udre          UDRE,
    prc           PRC,
    rrc           RRC,
    deltaPRC2     DeltaPRC,
    deltaRRC2     DeltaRRC,
    deltaPRC3     DeltaPRC,
    deltaRRC3     DeltaRRC
}

UDRE ::= ENUMERATED {
    lessThan1,
    between1-and-4,
    between4-and-8,
    over8 }

PRC ::= INTEGER (-2047..2047)

RRC ::= INTEGER (-127..127)

DeltaPRC ::= INTEGER (-127..127)

DeltaRRC ::= INTEGER (-7..7)

-- *****
--
-- UE-PositionEstimate (i.e., Geographical Area)
--
-- *****

-- UE-PositionEstimate is based on Geographical Area Description in 23.032

UE-PositionEstimate ::= CHOICE {
    point          GA-Point,
    pointWithUnCertainty    GA-PointWithUnCertainty,
    polygon        GA-Polygon,
    pointWithUncertaintyEllipse    GA-PointWithUnCertaintyEllipse,
    pointWithAltitude    GA-PointWithAltitude,
    pointWithAltitudeAndUncertaintyEllipsoid    GA-PointWithAltitudeAndUncertaintyEllipsoid,
    ellipsoidArc      GA-EllipsoidArc,
    ...
}

```

```

GeographicalCoordinates ::= SEQUENCE {
    latitudeSign      ENUMERATED { north, south },
    latitude          INTEGER (0..8388607),
    longitude         INTEGER (-8388608..8388607),
    iE-Extensions     ProtocolExtensionContainer { {GeographicalCoordinates-ExtIEs} } OPTIONAL,
    ...
}

GeographicalCoordinates-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GA-AltitudeAndDirection ::= SEQUENCE {
    directionOfAltitude  ENUMERATED {height, depth},
    altitude             INTEGER (0..32767),
    ...
}

GA-EllipsoidArc ::= SEQUENCE {
    geographicalCoordinates  GeographicalCoordinates,
    innerRadius              INTEGER (0..65535),
    uncertaintyRadius        INTEGER (0..127),
    offsetAngle              INTEGER (0..179),
    includedAngle            INTEGER (0..179),
    confidence                INTEGER (0..127),
    iE-Extensions            ProtocolExtensionContainer { { GA-EllipsoidArc-ExtIEs } } OPTIONAL,
    ...
}

GA-EllipsoidArc-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GA-Point ::= SEQUENCE {
    geographicalCoordinates  GeographicalCoordinates,
    iE-Extensions            ProtocolExtensionContainer { {GA-Point-ExtIEs} } OPTIONAL,
    ...
}

GA-Point-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GA-PointWithAltitude ::= SEQUENCE {
    geographicalCoordinates  GeographicalCoordinates,
    altitudeAndDirection    GA-AltitudeAndDirection,
    iE-Extensions            ProtocolExtensionContainer { { GA-PointWithAltitude-ExtIEs } } OPTIONAL,
    ...
}

GA-PointWithAltitude-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

```

```

}

GA-PointWithAltitudeAndUncertaintyEllipsoid ::= SEQUENCE {
    geographicalCoordinates    GeographicalCoordinates,
    altitudeAndDirection      GA-AltitudeAndDirection,
    uncertaintyEllipse         GA-UncertaintyEllipse,
    uncertaintyAltitude        INTEGER (0..127),
    confidence                  INTEGER (0..127),
    iE-Extensions              ProtocolExtensionContainer { { GA-PointWithAltitudeAndUncertaintyEllipsoid-ExtIEs } } OPTIONAL,
    ...
}

GA-PointWithAltitudeAndUncertaintyEllipsoid-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GA-PointWithUnCertainty ::=SEQUENCE {
    geographicalCoordinates    GeographicalCoordinates,
    iE-Extensions              ProtocolExtensionContainer { {GA-PointWithUnCertainty-ExtIEs} } OPTIONAL,
    uncertaintyCode            INTEGER (0..127)
}

GA-PointWithUnCertainty-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GA-PointWithUnCertaintyEllipse ::= SEQUENCE {
    geographicalCoordinates    GeographicalCoordinates,
    uncertaintyEllipse         GA-UncertaintyEllipse,
    confidence                  INTEGER (0..127),
    iE-Extensions              ProtocolExtensionContainer { { GA-PointWithUnCertaintyEllipse-ExtIEs } } OPTIONAL,
    ...
}

GA-PointWithUnCertaintyEllipse-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GA-Polygon ::= SEQUENCE (SIZE (1..maxNrOfPoints)) OF
    SEQUENCE {
        geographicalCoordinates    GeographicalCoordinates,
        iE-Extensions              ProtocolExtensionContainer { {GA-Polygon-ExtIEs} } OPTIONAL,
        ...
    }

GA-Polygon-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GA-UncertaintyEllipse ::= SEQUENCE {
    uncertaintySemi-major        INTEGER (0..127),
    uncertaintySemi-minor        INTEGER (0..127),
    orientationOfMajorAxis       INTEGER (0..179),

```

```

}
...

-- *****
--
-- GPS-AcquisitionAssistance:
--
-- *****

GPS-AcquisitionAssistance ::= SEQUENCE {
    gps-TOW-1msec          INTEGER (0..604799999),
    satelliteInformationList AcquisitionSatInfoList,
    iE-Extensions         ProtocolExtensionContainer { { GPS-AcquisitionAssistance-ExtIEs } } OPTIONAL,
    ...
}

GPS-AcquisitionAssistance-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

AcquisitionSatInfoList ::= SEQUENCE (SIZE (1..maxSat)) OF
    AcquisitionSatInfo

AcquisitionSatInfo ::= SEQUENCE {
    satID                INTEGER (0..63),
    doppler0thOrder      INTEGER (-2048..2047),
    extraDopplerInfo     ExtraDopplerInfo OPTIONAL,
    codePhase            INTEGER (0..1022),
    integerCodePhase     INTEGER (0..19),
    gps-BitNumber        INTEGER (0..3),
    codePhaseSearchWindow CodePhaseSearchWindow,
    azimuthAndElevation  AzimuthAndElevation OPTIONAL
}

ExtraDopplerInfo ::= SEQUENCE {
    doppler1stOrder      INTEGER (-42..21),
    dopplerUncertainty   DopplerUncertainty
}

DopplerUncertainty ::= ENUMERATED {
    hz12-5, hz25, hz50, hz100, hz200 }

CodePhaseSearchWindow ::= ENUMERATED {
    w1023, w1, w2, w3, w4, w6, w8,
    w12, w16, w24, w32, w48, w64,
    w96, w128, w192 }

AzimuthAndElevation ::= SEQUENCE {
    azimuth              INTEGER (0..31),

```

```

    elevation                INTEGER (0..7)
}

-- *****
--
-- GPS Almanac and Satellite Health
--
-- *****

GPS-AlmanacAndSatelliteHealth ::= SEQUENCE {
    wn-a                      BIT STRING (SIZE (8)),
    almanacSatInfoList       AlmanacSatInfoList,
    svGlobalHealth           BIT STRING (SIZE (192)) OPTIONAL,
    iE-Extensions            ProtocolExtensionContainer { { GPS-AlmanacAndSatelliteHealth-ExtIEs } } OPTIONAL,
    ...
}

GPS-AlmanacAndSatelliteHealth-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

AlmanacSatInfoList ::=
    SEQUENCE (SIZE (1..maxSat)) OF
        AlmanacSatInfo

AlmanacSatInfo ::=
    SEQUENCE {
        dataID                BIT STRING (SIZE (2)),
        satID                 INTEGER (0..63),
        e                     BIT STRING (SIZE (16)),
        t-oa                  BIT STRING (SIZE (8)),
        deltaI                BIT STRING (SIZE (16)),
        omegaDot              BIT STRING (SIZE (16)),
        satHealth             BIT STRING (SIZE (8)),
        a-Sqrt                BIT STRING (SIZE (24)),
        omega0                BIT STRING (SIZE (24)),
        m0                    BIT STRING (SIZE (24)),
        omega                 BIT STRING (SIZE (24)),
        af0                   BIT STRING (SIZE (11)),
        af1                   BIT STRING (SIZE (11))
    }

-- *****
--
-- GPS Clock And Ephemeris Parameters
--
-- *****

GPS-ClockAndEphemerisParameters ::= SEQUENCE {
    codeOnL2                 BIT STRING (SIZE (2)),

```

```

uraIndex          BIT STRING (SIZE (4)),
satHealth         BIT STRING (SIZE (6)),
iodc              BIT STRING (SIZE (10)),
l2Pflag          BIT STRING (SIZE (1)),
sflRevId         SubFrame1Reserved,
t-GD             BIT STRING (SIZE (8)),
t-oc             BIT STRING (SIZE (16)),
af2              BIT STRING (SIZE (8)),
af1              BIT STRING (SIZE (16)),
af0              BIT STRING (SIZE (22)),
c-rs             BIT STRING (SIZE (16)),
delta-n          BIT STRING (SIZE (16)),
m0              BIT STRING (SIZE (32)),
c-uc            BIT STRING (SIZE (16)),
e               BIT STRING (SIZE (32)),
c-us            BIT STRING (SIZE (16)),
a-Sqrt          BIT STRING (SIZE (32)),
t-oe           BIT STRING (SIZE (16)),
fitInterval     BIT STRING (SIZE (1)),
aodo            BIT STRING (SIZE (5)),
c-ic            BIT STRING (SIZE (16)),
omega0          BIT STRING (SIZE (32)),
c-is            BIT STRING (SIZE (16)),
i0             BIT STRING (SIZE (32)),
c-rc           BIT STRING (SIZE (16)),
omega           BIT STRING (SIZE (32)),
omegaDot        BIT STRING (SIZE (24)),
iDot           BIT STRING (SIZE (14)),
iE-Extensions   ProtocolExtensionContainer { { GPS-ClockAndEphemerisParameters-ExtIEs } } OPTIONAL,
...
}

```

```

GPS-ClockAndEphemerisParameters-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
...
}

```

```

SubFrame1Reserved ::= SEQUENCE {
    reserved1 BIT STRING (SIZE (23)),
    reserved2 BIT STRING (SIZE (24)),
    reserved3 BIT STRING (SIZE (24)),
    reserved4 BIT STRING (SIZE (16))
}

```

```

-- *****
--
-- GPS Ionospheric Model
--
-- *****

```

```

GPS-Ionospheric-Model ::= SEQUENCE {

```

```

    alfa0          BIT STRING (SIZE (8)),
    alfa1          BIT STRING (SIZE (8)),
    alfa2          BIT STRING (SIZE (8)),
    alfa3          BIT STRING (SIZE (8)),
    beta0          BIT STRING (SIZE (8)),
    beta1          BIT STRING (SIZE (8)),
    beta2          BIT STRING (SIZE (8)),
    beta3          BIT STRING (SIZE (8)),
    iE-Extensions ProtocolExtensionContainer { { GPS-Ionospheric-Model-ExtIEs } } OPTIONAL,
    ...
}

GPS-Ionospheric-Model-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- GPS Measured Results
--
-- *****

MeasuredResultsList ::= SEQUENCE (SIZE (0..maxNrOfSets)) OF
    GPS-MeasuredResults

maxNrOfSets          INTEGER ::= 3

GPS-MeasuredResults ::= SEQUENCE {
    gps-TOW-1msec      INTEGER (0..604799999),
    gps-MeasurementParamList GPS-MeasurementParamList,
    gps-TOW-rem-usec   INTEGER (0..999) OPTIONAL,
    iE-Extensions     ProtocolExtensionContainer { { GPS-MeasuredResults-ExtIEs } } OPTIONAL,
    ...
}

GPS-MeasuredResults-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GPS-MeasurementParamList ::= SEQUENCE (SIZE (1..maxSat)) OF
    GPS-MeasurementParam

GPS-MeasurementParam ::= SEQUENCE {
    satelliteID        INTEGER (0..63),
    c-N0                INTEGER (0..63),
    doppler             INTEGER (-32768..32768),
    wholeGPS-Chips      INTEGER (0..1023),
    fractionalGPS-Chips INTEGER (0..1023),
    multipathIndicator  MultipathIndicator,
    pseudorangeRMS-Error INTEGER (0..63)
}

```

```

MultipathIndicator ::=
    ENUMERATED {
        nm,
        low,
        medium,
        high }

-- *****
--
-- GPS Navigation Model
--
-- *****

GPS-NavigationModel ::=
    SEQUENCE {
        navigationModelSatInfoList    NavigationModelSatInfoList
    }

NavigationModelSatInfoList ::=
    SEQUENCE (SIZE (1..maxSat)) OF
        NavigationModelSatInfo

NavigationModelSatInfo ::=
    SEQUENCE {
        satID                INTEGER (0..63),
        satelliteStatus      SatelliteStatus,
        gps-clockAndEphemerisParms    GPS-ClockAndEphemerisParameters OPTIONAL,
        -- This IE is not present if satelliteStatus is es-SN
        iE-Extensions        ProtocolExtensionContainer { { NavigationModelSatInfo-ExtIEs } }    OPTIONAL,
        ...
    }

NavigationModelSatInfo-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

SatelliteStatus ::=
    ENUMERATED {
        ns-NN,
        es-SN,
        es-NN,
        reserved }

-- *****
--
-- GPS Real Time Integrity
--
-- *****

GPS-RealTimeIntegrity ::= CHOICE {
    badSatellites        BadSatList,
    noBadSatellites      NoBadSatellites
}

```



```

}
BadSatList ::=
    SEQUENCE (SIZE (1..maxSat)) OF
        INTEGER (0..63)

NoBadSatellites ::= NULL

-- *****
--
-- GPS Reference Time
--
-- *****

GPS-ReferenceTime ::=
    SEQUENCE {
        gps-Week                INTEGER (0..1023),
        gps-TOW-lmsec           INTEGER (0..604799999),
        gps-TOW-rem-usec        INTEGER (0..999) OPTIONAL,
        gps-TOW-AssistList      GPS-TOW-AssistList OPTIONAL,
        iE-Extensions           ProtocolExtensionContainer { { GPS-ReferenceTime-ExtIEs } } OPTIONAL,
        ...
    }

GPS-ReferenceTime-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

GPS-TOW-AssistList ::=
    SEQUENCE (SIZE (1..maxSat)) OF
        GPS-TOW-Assist

GPS-TOW-Assist ::=
    SEQUENCE {
        satID                    INTEGER (0..63),
        tlm-Message               BIT STRING (SIZE (14)),
        antiSpoof                 ENUMERATED {present, notPresent},
        alert                     ENUMERATED {present, notPresent},
        tlm-Reserved              BIT STRING (SIZE (2))
    }

-- *****
--
-- GPS Transmission TOW
--
-- *****

GPS-Transmission-TOW ::= INTEGER (0..604799)

-- *****
--
-- GPS UTC Model

```

```

--
-- *****
GPS-UTC-Model ::= SEQUENCE {
    a1 BIT STRING (SIZE (24)),
    a0 BIT STRING (SIZE (32)),
    t-ot BIT STRING (SIZE (8)),
    delta-t-LS BIT STRING (SIZE (8)),
    wn-t BIT STRING (SIZE (8)),
    wn-lsf BIT STRING (SIZE (8)),
    dn BIT STRING (SIZE (8)),
    delta-t-LSF BIT STRING (SIZE (8)),
    iE-Extensions ProtocolExtensionContainer { { GPS-UTCmodel-ExtIEs } } OPTIONAL,
    ...
}

GPS-UTCmodel-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- GPS UTRAN Time Relationship Uncertainty
-- nsec=nanosecond, usec=microsecond, msec=millisecond, sec=second
--
-- *****

GPS-UTRAN-TRU ::= ENUMERATED {
    nsec-50,
    nsec-500,
    usec-1,
    usec-10,
    msec-1,
    msec-10,
    msec-100,
    unreliable }

-- *****
--
-- Information Exchange ID
--
-- *****

InformationExchangeID ::= INTEGER (0..1048575)

-- *****
--
-- Information Report Characteristics
--

```

```

-- *****
InformationReportCharacteristics ::= SEQUENCE {
    type                InformationReportCharacteristicsType,
    periodicity         InformationReportPeriodicity    OPTIONAL,
    -- present if type indicates periodic
    ...
}

InformationReportCharacteristicsType ::= ENUMERATED {
    onDemand,
    periodic,
    onModification,
    ...
}

InformationReportPeriodicity ::= CHOICE {
    min                INTEGER (1..60,...),
    -- Unit min, Step lmin
    hour              INTEGER (1..24,...),
    -- Unit hour, Step lhour
    ...
}

-- *****
--
-- Information Type
--
-- *****

InformationType ::= CHOICE {
    implicitInformation    MethodType,
    explicitInformation    ExplicitInformationList,
    ...
}

ExplicitInformationList ::= SEQUENCE (SIZE (1..maxNrOfExpInfo)) OF ExplicitInformation

ExplicitInformation ::= CHOICE {
    almanacAndSatelliteHealth    AlmanacAndSatelliteHealth,
    utcModel                    UtcModel,
    ionosphericModel            IonosphericModel,
    navigationModel            NavigationModel,
    dgpsCorrections            DgpsCorrections,
    referenceTime                ReferenceTime,
    acquisitionAssistance        AcquisitionAssistance,
    realTimeIntegrity            RealTimeIntegrity,
    almanacAndSatelliteHealthSIB    AlmanacAndSatelliteHealthSIB-InfoType,
    ...
}

```

```

AlmanacAndSatelliteHealth ::= NULL

UtcModel ::= SEQUENCE {
    transmissionTOWIndicator    TransmissionTOWIndicator,
    ...
}

IonosphericModel ::= SEQUENCE {
    transmissionTOWIndicator    TransmissionTOWIndicator,
    ...
}

NavigationModel ::= SEQUENCE {
    transmissionTOWIndicator    TransmissionTOWIndicator,
    navModelAdditionalData      NavModelAdditionalData    OPTIONAL,
    ...
}

NavModelAdditionalData ::= SEQUENCE {
    gps-Week                    INTEGER (0..1023),
    gps-TOE                     INTEGER (0..167),
    t-TOE-limit                 INTEGER (0..10),
    satRelatedDataList          SatelliteRelatedDataList,
    ...
}

SatelliteRelatedDataList ::= SEQUENCE (SIZE (0..maxSatLess1)) OF SatelliteRelatedData

SatelliteRelatedData ::= SEQUENCE {
    satID                       INTEGER (0..63),
    iode                        INTEGER (0..239)
}

DgpsCorrections ::= NULL

ReferenceTime ::= NULL

AcquisitionAssistance ::= NULL

RealTimeIntegrity ::= NULL

AlmanacAndSatelliteHealthSIB-InfoType ::= SEQUENCE {
    transmissionTOWIndicator    TransmissionTOWIndicator,
    ...
}

TransmissionTOWIndicator ::= ENUMERATED {
    requested,
    not-Requested
}

```

```

-- *****
--
-- Message Structure
--
-- *****

MessageStructure ::= SEQUENCE (SIZE (1..maxNrOfLevels)) OF
    SEQUENCE {
        iE-ID                ProtocolIE-ID,
        repetitionNumber     RepetitionNumber1 OPTIONAL,
        iE-Extensions        ProtocolExtensionContainer { {MessageStructure-ExtIEs} } OPTIONAL,
        ...
    }

MessageStructure-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- Method Type
--
-- *****

MethodType ::= ENUMERATED {
    ue-assisted,
    ue-based
}

-- *****
--
-- Requested Data Value
--
-- *****

RequestedDataValue ::= SEQUENCE {
    gpsAlmanacAndSatelliteHealth    GPS-AlmanacAndSatelliteHealth    OPTIONAL,
    gps-UTC-Model                   GPS-UTC-Model                   OPTIONAL,
    gps-Ionospheric-Model           GPS-Ionospheric-Model           OPTIONAL,
    gps-NavigationModel             GPS-NavigationModel             OPTIONAL,
    dgpsCorrections                 DGPSCorrections                 OPTIONAL,
    referenceTime                   GPS-ReferenceTime               OPTIONAL,
    gps-AcquisitionAssistance       GPS-AcquisitionAssistance       OPTIONAL,
    gps-RealTime-Integrity          GPS-RealTimeIntegrity           OPTIONAL,
    almanacAndSatelliteHealthSIB    AlmanacAndSatelliteHealthSIB    OPTIONAL,
    gps-Transmission-TOW           GPS-Transmission-TOW           OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { { RequestedDataValue-ExtIEs} } OPTIONAL,
    ...
}

```

```

--at least one of the above IEs shall be present in the requested data value

RequestedDataValue-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- Requested Data Value Information
--
-- *****

RequestedDataValueInformation ::= CHOICE {
    informationAvailable      InformationAvailable,
    informationNotAvailable   InformationNotAvailable
}

InformationAvailable ::= SEQUENCE {
    requestedDataValue      RequestedDataValue,
    iE-Extensions          ProtocolExtensionContainer { { InformationAvailable-ExtIEs } } OPTIONAL,
    ...
}

InformationAvailable-ExtIEs PCAP-PROTOCOL-EXTENSION ::= {
    ...
}

InformationNotAvailable ::= NULL

END

```

9.3.5 Common Definitions

```

-- *****
--
-- Common definitions
--
-- *****

PCAP-CommonDataTypes {
    itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
    umts-Access (20) modules (3) pcap(8) version1 (1) pcap-CommonDataTypes (3) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- *****
--

```

```

-- Extension constants
--
-- *****
maxPrivateIEs          INTEGER ::= 65535
maxProtocolExtensions  INTEGER ::= 65535
maxProtocolIEs        INTEGER ::= 65535
-- *****
--
-- Common Data Types
--
-- *****
Criticality           ::= ENUMERATED { reject, ignore, notify }

Presence              ::= ENUMERATED { optional, conditional, mandatory }

PrivateIE-ID         ::= CHOICE {
    local              INTEGER (0..65535),
    global              OBJECT IDENTIFIER
}

ProcedureCode         ::= INTEGER (0..255)

ProtocolExtensionID  ::= INTEGER (0..65535)

ProtocolIE-ID        ::= INTEGER (0..maxProtocolIEs)

TransactionID        ::= CHOICE {
    shortTID           INTEGER (0..127),
    longTID            INTEGER (0..32767)
}

TriggeringMessage    ::= ENUMERATED { initiating-message, successful-outcome, unsuccessful-outcome, outcome }

END

```

9.3.6 Constant Definitions

```

-- *****
--
-- Constant definitions
--
-- *****

PCAP-Constants {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) pcap(8) version1 (1) pcap-Constants (4) }

```

```

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    ProcedureCode,
    ProtocolIE-ID
FROM PCAP-CommonDataTypes;

-- *****
--
-- Elementary Procedures
--
-- *****

id-PositionCalculation          ProcedureCode ::= 1
id-InformationExchangeInitiation ProcedureCode ::= 2
id-InformationReporting         ProcedureCode ::= 3
id-InformationExchangeTermination ProcedureCode ::= 4
id-InformationExchangeFailure   ProcedureCode ::= 5
id-ErrorIndication             ProcedureCode ::= 6
id-privateMessage              ProcedureCode ::= 7

-- *****
--
-- Lists
--
-- *****

maxNrOfErrors          INTEGER ::= 256
maxSat                 INTEGER ::= 16
maxSatLess1           INTEGER ::= 15
maxNrOfLevels          INTEGER ::= 256
maxNrOfPoints          INTEGER ::= 15
maxNrOfExpInfo         INTEGER ::= 32

-- *****
--
-- IEs
--
-- *****

id-Cause                ProtocolIE-ID ::= 1
id-CriticalityDiagnostics ProtocolIE-ID ::= 2
id-GPS-UTRAN-TRU       ProtocolIE-ID ::= 3
id-InformationExchangeID ProtocolIE-ID ::= 4
id-InformationExchangeObjectType-InfEx-Rprt ProtocolIE-ID ::= 5
id-InformationExchangeObjectType-InfEx-Rqst ProtocolIE-ID ::= 6
id-InformationExchangeObjectType-InfEx-Rsp  ProtocolIE-ID ::= 7
id-InformationReportCharacteristics         ProtocolIE-ID ::= 8

```



```

id-InformationType          ProtocolIE-ID ::= 9
id-MeasuredResultsList     ProtocolIE-ID ::= 10
id-MessageStructure        ProtocolIE-ID ::= 19
id-MethodType              ProtocolIE-ID ::= 11
id-RefPosition-InfEx-Rqst  ProtocolIE-ID ::= 12
id-RefPosition-InfEx-Rsp   ProtocolIE-ID ::= 13
id-RefPosition-Inf-Rprt    ProtocolIE-ID ::= 14
id-RequestedDataValue      ProtocolIE-ID ::= 15
id-RequestedDataValueInformation ProtocolIE-ID ::= 16
id-TransactionID           ProtocolIE-ID ::= 17
id-UE-PositionEstimate     ProtocolIE-ID ::= 18
id-TypeOfError             ProtocolIE-ID ::= 21

```

```
END
```

9.3.7 Container Definitions

```

-- *****
--
-- Container definitions
--
-- *****

PCAP-Containers {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) pcap(8) version1 (1) pcap-Containers (5) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- *****
--
-- IE parameter types from other modules.
--
-- *****

IMPORTS
    Criticality,
    Presence,
    PrivateIE-ID,
    ProtocolExtensionID,
    ProtocolIE-ID,
    maxPrivateIEs,
    maxProtocolExtensions,
    maxProtocolIEs
FROM PCAP-CommonDataTypes;

-- *****
--

```

```

-- Class Definition for Protocol IEs
--
-- *****
PCAP-PROTOCOL-IES ::= CLASS {
    &id          ProtocolIE-ID          UNIQUE,
    &criticality Criticality,
    &Value,
    &presence    Presence
}
WITH SYNTAX {
    ID          &id
    CRITICALITY &criticality
    TYPE        &Value
    PRESENCE    &presence
}

-- *****
--
-- Class Definition for Protocol Extensions
--
-- *****

PCAP-PROTOCOL-EXTENSION ::= CLASS {
    &id          ProtocolExtensionID UNIQUE,
    &criticality Criticality,
    &Extension,
    &presence    Presence
}
WITH SYNTAX {
    ID          &id
    CRITICALITY &criticality
    EXTENSION   &Extension
    PRESENCE    &presence
}

-- *****
--
-- Class Definition for Private IEs
--
-- *****

PCAP-PRIVATE-IES ::= CLASS {
    &id          PrivateIE-ID,
    &criticality Criticality,
    &Value,
    &presence    Presence
}
WITH SYNTAX {
    ID          &id
    CRITICALITY &criticality
    TYPE        &Value
    PRESENCE    &presence
}

```

```

}

-- *****
--
-- Container for Protocol IES
--
-- *****

ProtocolIE-Container {PCAP-PROTOCOL-IES : IESSetParam} ::=
  SEQUENCE (SIZE (0..maxProtocolIEs)) OF
    ProtocolIE-Field {{IESSetParam}}

ProtocolIE-Field {PCAP-PROTOCOL-IES : IESSetParam} ::= SEQUENCE {
  id                PCAP-PROTOCOL-IES.&id                ({IESSetParam}),
  criticality       PCAP-PROTOCOL-IES.&criticality       ({IESSetParam}@id)},
  value            PCAP-PROTOCOL-IES.&Value            ({IESSetParam}@id)}
}

-- *****
--
-- Container Lists for Protocol IE Containers
--
-- *****

ProtocolIE-ContainerList {INTEGER : lowerBound, INTEGER : upperBound, PCAP-PROTOCOL-IES : IESSetParam} ::=
  SEQUENCE (SIZE (lowerBound..upperBound)) OF
    ProtocolIE-Container {{IESSetParam}}

-- *****
--
-- Container for Protocol Extensions
--
-- *****

ProtocolExtensionContainer {PCAP-PROTOCOL-EXTENSION : ExtensionSetParam} ::=
  SEQUENCE (SIZE (1..maxProtocolExtensions)) OF
    ProtocolExtensionField {{ExtensionSetParam}}

ProtocolExtensionField {PCAP-PROTOCOL-EXTENSION : ExtensionSetParam} ::= SEQUENCE {
  id                PCAP-PROTOCOL-EXTENSION.&id                ({ExtensionSetParam}),
  criticality       PCAP-PROTOCOL-EXTENSION.&criticality       ({ExtensionSetParam}@id)},
  extensionValue    PCAP-PROTOCOL-EXTENSION.&Extension         ({ExtensionSetParam}@id)}
}

-- *****
--
-- Container for Private IES
--
-- *****

PrivateIE-Container {PCAP-PRIVATE-IES : IESSetParam} ::=
  SEQUENCE (SIZE (1.. maxPrivateIEs)) OF
    PrivateIE-Field {{IESSetParam}}

```

```
PrivateIE-Field {PCAP-PRIVATE-IES : IESSetParam} ::= SEQUENCE {
  id                PCAP-PRIVATE-IES.&id                ({{IESSetParam}}),
  criticality       PCAP-PRIVATE-IES.&criticality       ({{IESSetParam}}{@id}),
  value            PCAP-PRIVATE-IES.&Value            ({{IESSetParam}}{@id})
}
END
```

9.4 Message Transfer Syntax

PCAP shall use the ASN.1 Basic Packed Encoding Rules (BASIC-PER) Aligned Variant as transfer syntax, as specified in ref. [7].

10 Handling of Unknown, Unforeseen and Erroneous Protocol Data

10.1 General

Protocol Error cases can be divided into three classes:

- Transfer Syntax Error.
- Abstract Syntax Error.
- Logical Error.

Protocol errors can occur in the following functions within a receiving node:

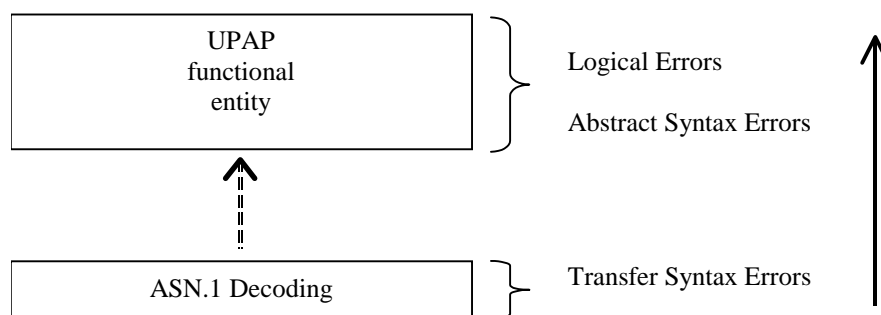


Figure 22: Protocol Errors in PCAP

10.2 Transfer Syntax Error

A Transfer Syntax Error occurs when the receiver is not able to decode the received physical message. Transfer syntax errors are always detected in the process of ASN.1 decoding. If a Transfer Syntax Error occurs, the receiver should initiate Error Indication procedure with appropriate cause value for the Transfer Syntax protocol error.

10.3 Abstract Syntax Error

10.3.1 General

An Abstract Syntax Error occurs when the receiving functional PCAP entity:

1. receives IEs or IE groups that cannot be understood (unknown IE id);
2. receives IEs for which the logical range is violated (e.g.: ASN.1 definition: 0 to 15, the logical range is 0 to 10 (values 11 to 15 are undefined), and 12 will be received; this case will be handled as an abstract syntax error using criticality information sent by the originator of the message);
3. does not receive IEs or IE groups but according to the specified presence of the concerning object, the IEs or IE groups should have been present in the received message.
4. receives IEs or IE groups that are defined to be part of that message in wrong order or with too many occurrences of the same IE or IE group

Cases 1 and 2 (not comprehended IE/IE group) are handled based on received Criticality information. Case 3 (missing IE/IE group) is handled based on Criticality information and Presence information for the missing IE/IE group specified in the version of the specification used by the receiver. Case 4 (IEs or IE groups in wrong order or with too many occurrences) results in rejecting the procedure.

If an Abstract Syntax Error occurs, the receiver shall read the remaining message and shall then for each detected Abstract Syntax Error that belong to cases 1-3 act according to the Criticality Information and Presence Information for the IE/IE group due to which Abstract Syntax Error occurred in accordance with subclauses 10.3.4 and 10.3.5. The handling of case 4 is specified in subclause 10.3.6.

10.3.2 Criticality Information

In the PCAP messages there is criticality information set for individual IEs and/or IE groups. This criticality information instructs the receiver how to act when receiving an IE or an IE group that is not comprehended, i.e. the entire item (IE or IE group) which is not (fully or partially) comprehended shall be treated in accordance with its own criticality information as specified in chapter 10.3.4.

In addition, the criticality information is used in case of the missing IE/IE group abstract syntax error (see subclause 10.3.5).

The receiving node shall take different actions depending on the value of the Criticality Information. The three possible values of the Criticality Information for an IE/IE group are:

- Reject IE.
- Ignore IE and Notify Sender.
- Ignore IE.

The following rules restrict when a receiving entity may consider an IE, an IE group, or an EP not comprehended (not implemented), and when action based on criticality information is applicable:

1. IE or IE group: When one new or modified IE or IE group is implemented for one EP from a standard version, then other new or modified IEs or IE groups specified for that EP in that standard version shall be considered comprehended by a receiving entity (some may still remain unsupported).

Note that this restriction is not applicable to a sending entity for constructing messages.

2. EP: The comprehension of different EPs within a standard version or between different standard versions is not mandated. Any EP that is not supported may be considered not comprehended, even if another EP from that standard version is comprehended, and action based on criticality shall be applied.

10.3.3 Presence Information

For many IEs/IE groups which are optional according to the ASN.1 transfer syntax, PCAP specifies separately if the presence of these IEs/IE groups is optional or mandatory with respect to RNS application by means of the presence field of the concerning object of class PCAP-PROTOCOL-IES, PCAP -PROTOCOL-IES-PAIR, PCAP -PROTOCOL-EXTENSION or PCAP -PRIVATE-IES.

The presence field of the indicated classes supports three values:

1. Optional;
2. Conditional;
3. Mandatory.

If an IE/IE group is not included in a received message and the presence of the IE/IE group is mandatory or the presence is conditional and the condition is true according to the version of the specification used by the receiver, an abstract syntax error occurs due to a missing IE/IE group.

10.3.4 Not comprehended IE/IE group

10.3.4.1 Procedure Code

The receiving node shall treat the different types of received criticality information of the *Procedure Code* according to the following:

Reject IE:

- If a message is received with a *Procedure Code* marked with "*Reject IE*" which the receiving node does not comprehend, the receiving node shall reject the procedure using the Error Indication procedure.

Ignore IE and Notify Sender:

- If a message is received with a *Procedure Code* marked with "*Ignore IE and Notify Sender*" which the receiving node does not comprehend, the receiving node shall ignore the procedure and initiate the Error Indication procedure.

Ignore IE:

- If a message is received with a *Procedure Code* marked with "*Ignore IE*" which the receiving node does not comprehend, the receiving node shall ignore the procedure.

10.3.4.2 IEs other than the Procedure Code

The receiving node shall treat the different types of received criticality information of an IEs/IE group other than the *Procedure Code* according to the following:

Reject IE:

- If a message *initiating* a procedure is received containing one or more IEs/IE group marked with "*Reject IE*" which the receiving node does not comprehend; none of the functional requests of the message shall be executed. The receiving node shall reject the procedure and report the rejection of one or more IEs/IE group using the message normally used to report unsuccessful outcome of the procedure.
- If a message *initiating* a procedure that does not have a message to report unsuccessful outcome is received containing one or more IEs/IE groups marked with "*Reject IE*" which the receiving node does not comprehend, the receiving node shall initiate the Error Indication procedure.
- If a *response* message is received containing one or more IEs marked with "*Reject IE*", that the receiving node does not comprehend, the receiving node shall initiate local error handling.

Ignore IE and Notify Sender:

- If a message *initiating* a procedure is received containing one or more IEs/IE groups marked with "*Ignore IE and Notify Sender*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups, continue with the procedure as if the not comprehended IEs/IE groups were not received (except for the reporting) using the understood IEs/IE groups, and report in the response message of the procedure that one or more IEs/IE groups have been ignored.
- if a message *initiating* a procedure that does not have a message to report the outcome of the procedure is received containing one or more IEs/IE groups marked with "*Ignore IE and Notify Sender*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups, continue with the procedure as if the not comprehended IEs/IE groups were not received (except for the reporting) using the understood IEs/IE groups, and initiate the Error Indication procedure to report that one or more IEs/IE groups have been ignored.
- If a *response* message is received containing one or more IEs/IE groups marked with "*Ignore IE and Notify Sender*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups and initiate the Error Indication procedure.

Ignore IE:

- If a message *initiating* a procedure is received containing one or more IEs/IE groups marked with "*Ignore IE*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups and continue with the procedure as if the not comprehended IEs/IE groups were not received using the understood IEs/IE groups.

10.3.5 Missing IE or IE group

The receiving node shall treat the missing IE/IE group according to the criticality information for the missing IE/IE group in the received message specified in the version of this specification used by the receiver:

Reject IE:

- if a received message *initiating* a procedure is missing one or more IEs/IE groups with specified criticality "*Reject IE*"; none of the functional requests of the message shall be executed. The receiving node shall reject the procedure and report the missing IEs/IE groups using the message normally used to report unsuccessful outcome of the procedure.
- if a received message *initiating* a procedure that does not have a message to report unsuccessful outcome is missing one or more IEs/IE groups with specified criticality "*Reject IE*", the receiving node shall initiate the Error Indication procedure.
- if a received *response* message is missing one or more IEs/IE groups with specified criticality "*Reject IE*", the receiving node shall initiate local error handling.

Ignore IE and Notify Sender:

- if a received message *initiating* a procedure is missing one or more IEs/IE groups with specified criticality "*Ignore IE and Notify Sender*", the receiving node shall continue with the procedure based on the other IEs/IE groups present in the message and report in the response message of the procedure that one or more IEs/IE groups were missing.
- if a received message *initiating* a procedure that does not have a message to report the outcome of the procedure is missing one or more IEs/IE groups with specified criticality "*Ignore IE and Notify Sender*", the receiving node shall continue with the procedure based on the other IEs/IE groups present in the message and initiate the Error Indication procedure to report that one or more IEs/IE groups were missing.
- if a received *response* message is missing one or more IEs/IE groups with specified criticality "*Ignore IE and Notify Sender*", the receiving node shall initiate the Error Indication procedure.

Ignore IE:

- if a received message *initiating* a procedure is missing one or more IEs/IE groups with specified criticality "*Ignore IE*", the receiving node shall continue with the procedure based on the other IEs/IE groups present in the message.

10.3.6 IEs or IE groups received in wrong order or with too many occurrences

If a message with IEs or IE groups in wrong order or with too many occurrences is received, the receiving node shall behave according to the following:

- If a message *initiating* a procedure is received containing IEs or IE groups in wrong order or with too many occurrences, none of the functional requests of the message shall be executed. The receiving node shall reject the procedure and report the cause value "Abstract Syntax Error (Falsely Constructed Message)" using the message normally used to report unsuccessful outcome of the procedure.
- If a message *initiating* a procedure that does not have a message to report unsuccessful outcome is received containing IEs or IE groups in wrong order or with too many occurrences, the receiving node shall initiate the Error Indication procedure, and use cause value "Abstract Syntax Error (Falsely Constructed Message)".

- If a *response* message is received containing IEs or IE groups in wrong order or with too many occurrences, the receiving node shall initiate local error handling.

10.4 Logical Error

Logical error situations occur when a message is comprehended correctly, but the information contained within the message is not valid (i.e. semantic error), or describes a procedure which is not compatible with the state of the receiver. In these conditions, the following behaviour shall be performed (unless otherwise specified) as defined by the class of the elementary procedure, irrespective of the criticality information of the IEs/IE groups containing the erroneous values.

Class 1:

Where the logical error occurs in a request message of a class 1 procedure, and the procedure has a failure message, the failure message shall be sent with an appropriate cause value. Typical cause values are:

- Semantic Error.
- Message not compatible with receiver state.

Where the logical error is contained in a request message of a class 1 procedure, and the procedure does not have a failure message, the Error Indication procedure shall be initiated with an appropriate cause value. The *Procedure Code* IE and the *Triggering Message* IE within the *Criticality Diagnostics* IE shall then be included in order to identify the message containing the logical error.

Where the logical error exists in a response message of a class 1 procedure, local error handling shall be initiated.

Class 2:

Where the logical error occurs in a message of a class 2 procedure, the Error Indication procedure shall be initiated with an appropriate cause value. The *Procedure Code* IE and the *Triggering Message* IE within the *Criticality Diagnostics* IE shall then be included in order to identify the message containing the logical error.

Annex A (informative): Change history

Change history					
TSG RAN#	Version	CR	Tdoc RAN	New Version	Subject/Comment

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New

Annex B (informative)

Guidelines for Usage of the Criticality Diagnostics IE

B.1 EXAMPLE MESSAGE Layout

Assume the following message format:

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M				YES	reject
Transaction ID	M				-	
A	M				YES	reject
B	M				YES	reject
>E		1..<maxE>			EACH	ignore
>>F		1..<maxF>			-	
>>>G		0..3, ...			EACH	ignore
>>H		1..<maxH>			EACH	ignore
>>>G		0..3, ...			EACH	ignore and notify
>>G	M				YES	reject
>>J		1..<maxJ>			-	
>>>G		0..3, ...			EACH	reject
C	M				YES	reject
>K		1..<maxK>			EACH	ignore and notify
>>L		1..<maxL>			-	
>>>M	O				-	
D	M				YES	reject

Note 1. The IEs F, J, and L do not have assigned criticality. The IEs F, J, and L are consequently realised as the ASN.1 type SEQUENCE OF of "ordinary" ASN.1 type, e.g. INTEGER. On the other hand, the repeatable IEs with assigned criticality are realised as the ASN.1 type SEQUENCE OF of an IE object, e.g. ProtocolIE-Single-Container.

For the corresponding ASN.1 layout, see subclause B.4.

B.2 Example on a Received EXAMPLE MESSAGE

Assume further more that a received message based on the above tabular format is according to the figure below.

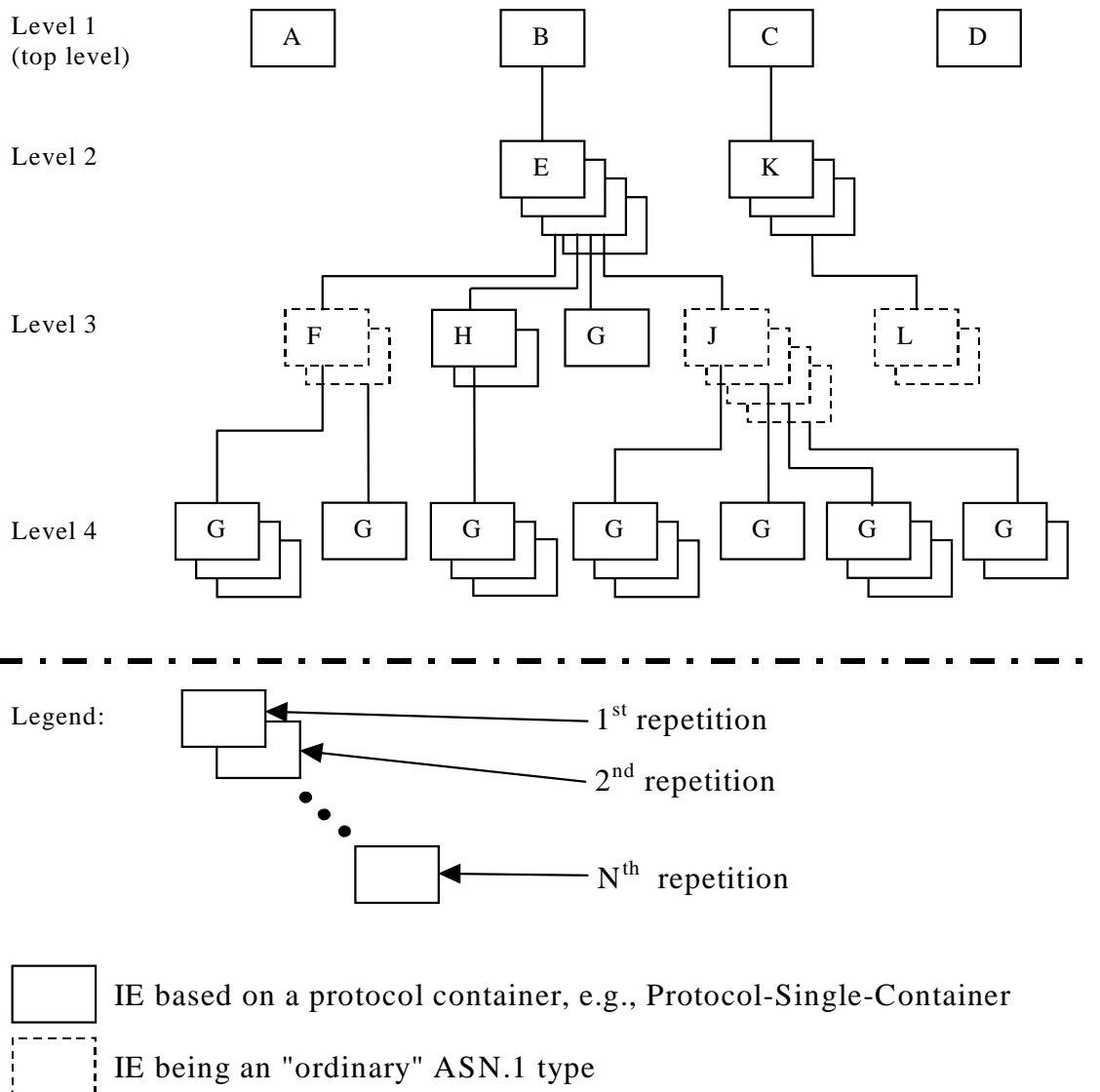


Figure B.1: Example of content of a received NBAP message based on the EXAMPLE MESSAGE

B.3 Content of Criticality Diagnostics

B.3.1 Example 1

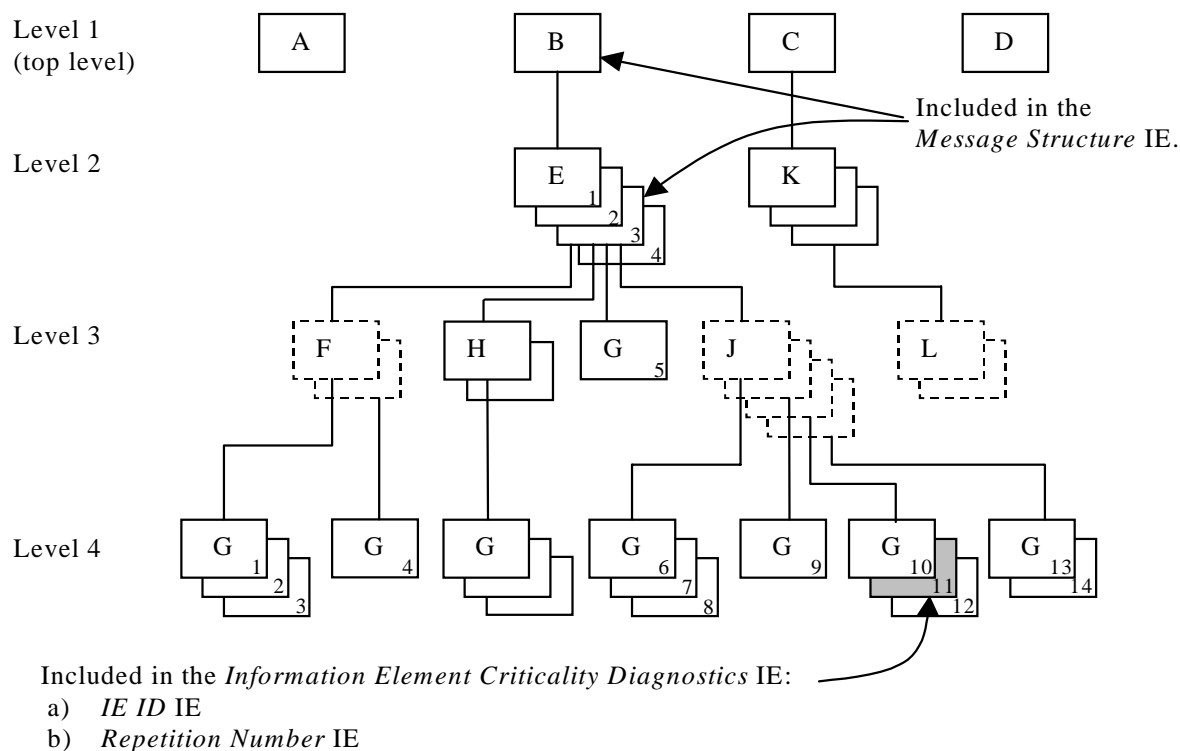


Figure B.2: Example of a received NBAP message containing a not comprehended IE

If there is an error within the instance marked as grey in the IE G in the IE J shown in the figure B.2 above, this will be reported within the *Information Element Criticality Diagnostics IE* within the *Criticality Diagnostics IE* as follows:

IE name	Value	Comment
IE Criticality	reject	Criticality for IE on the reported level, i.e. level 4.
IE ID	id-G	IE ID from the reported level, i.e. level 4.
Repetition Number	11	Repetition number on the reported level, i.e. level 4. (Since the IE E (level 2) is the lowest level included in the <i>Message Structure IE</i> this is the eleventh occurrence of IE G within the IE E (level 2).
Type of Error	not understood	
<i>Message Structure, first repetition</i>		
>IE ID	id-B	IE ID from level 1.
<i>Message Structure, second repetition</i>		
>IE ID	id-E	IE ID from the lowest level above the reported level, i.e. level 2.
>Repetition Number	3	Repetition number from the lowest level above the reported level, i.e. level 2.

Note 2. The IE J on level 3 cannot be included in the *Message Structure IE* since they have no criticality of their own.

Note 3. The repetition number of the reported IE indicates the number of repetitions of IE G received up to the detected erroneous repetition, counting all occurrences of the IE G below the same instance of the previous level with assigned criticality (instance 3 of IE E on level 2).

B.3.2 Example 2

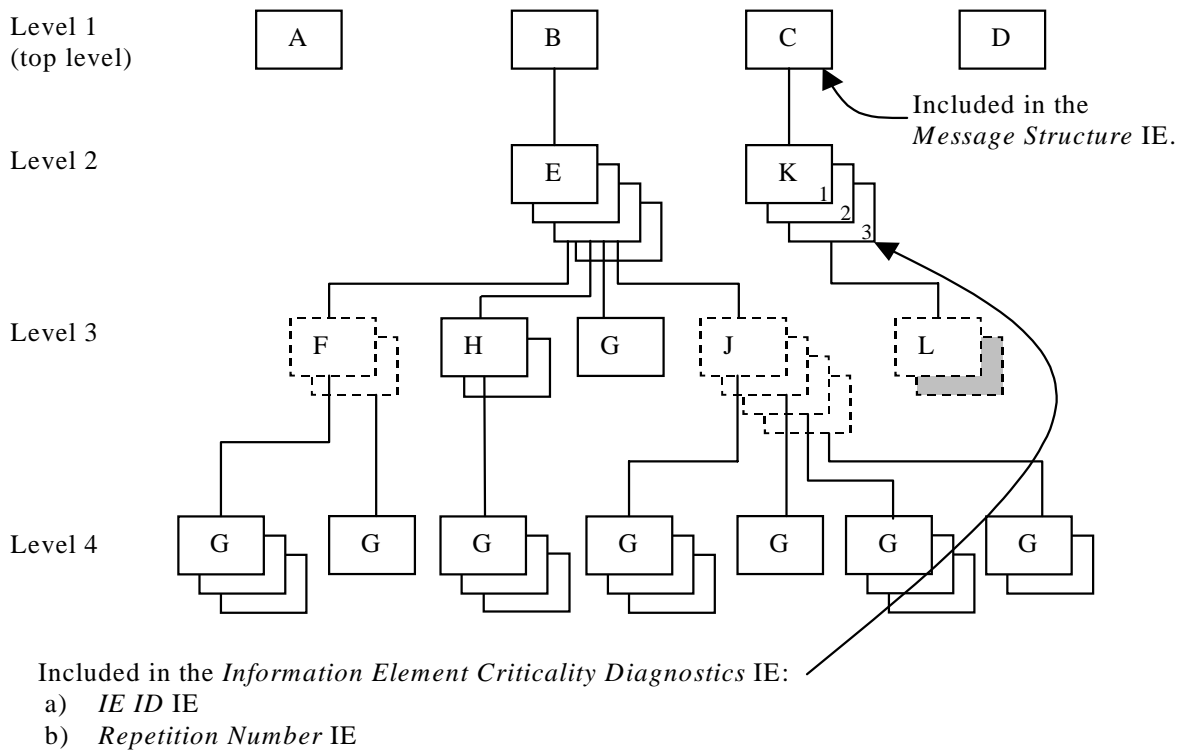


Figure B.3: Example of a received NBAP message containing a not comprehended IE

If there is an error within the second instance (marked as grey) in the sequence (IE L in the tabular format) on level 3 below IE K in the structure shown in the figure B.3 above, this will be reported within the *Information Element Criticality Diagnostics* IE within the *Criticality Diagnostics* IE as follows:

IE name	Value	Comment
IE Criticality	ignore and notify	Criticality for IE on the reported level, i.e. level 2.
IE ID	id-K	IE ID from the reported level, i.e. level 2.
Repetition Number	3	Repetition number on the reported level, i.e. level 2.
Type of Error	not understood	
<i>Message Structure, first repetition</i>		
>IE ID	id-C	IE ID from the lowest level above the reported level, i.e. level 1.

Note 4. The IE L on level 3 cannot be reported individually included in the *Message Structure* IE since it has no criticality of its own.

B.3.3 Example 3

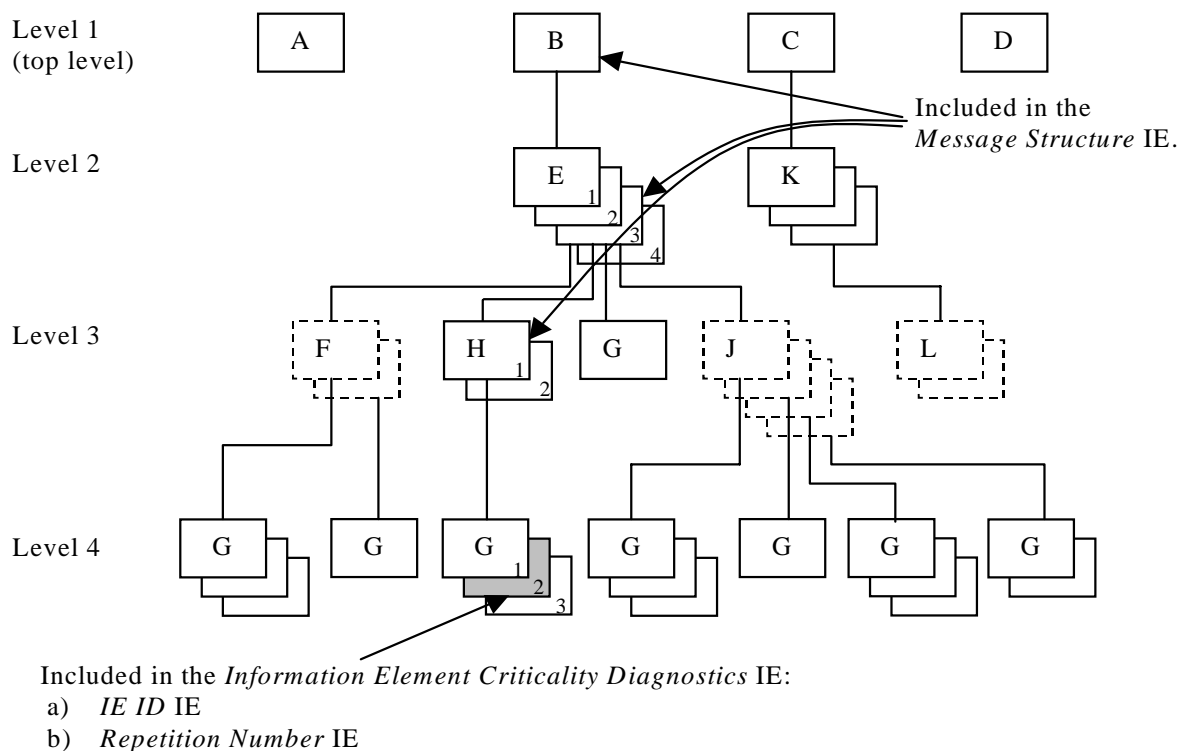


Figure B.4: Example of a received NBAP message containing a not comprehended IE

If there is an error within the instance marked as grey in the IE G in the IE H shown in the figure B.4 above, this will be reported within the *Information Element Criticality Diagnostics IE* within the *Criticality Diagnostics IE* as follows:

IE name	Value	Comment
IE Criticality	reject	Criticality for IE on the reported level, i.e. level 4.
IE ID	id-G	IE ID from the reported level, i.e. level 4.
Repetition Number	2	Repetition number on the reported level, i.e. level 4.
Type of Error	not understood	
<i>Message Structure, first repetition</i>		
>IE ID	id-B	IE ID from level 1.
<i>Message Structure, second repetition</i>		
>IE ID	id-E	IE ID from level 2.
>Repetition Number	3	Repetition number from level 2.
<i>Message Structure, third repetition</i>		
>IE ID	id-H	IE ID from the lowest level above the reported level, i.e. level 3.
>Repetition Number	1	Repetition number from the lowest level above the reported level, i.e. level 3.

Note 5. The repetition number of level 4 indicates the number of repetitions of IE G received up to the detected erroneous repetition, counted below the same instance of the previous level with assigned criticality (instance 1 of IE H on level 3).

B.3.4 Example 4

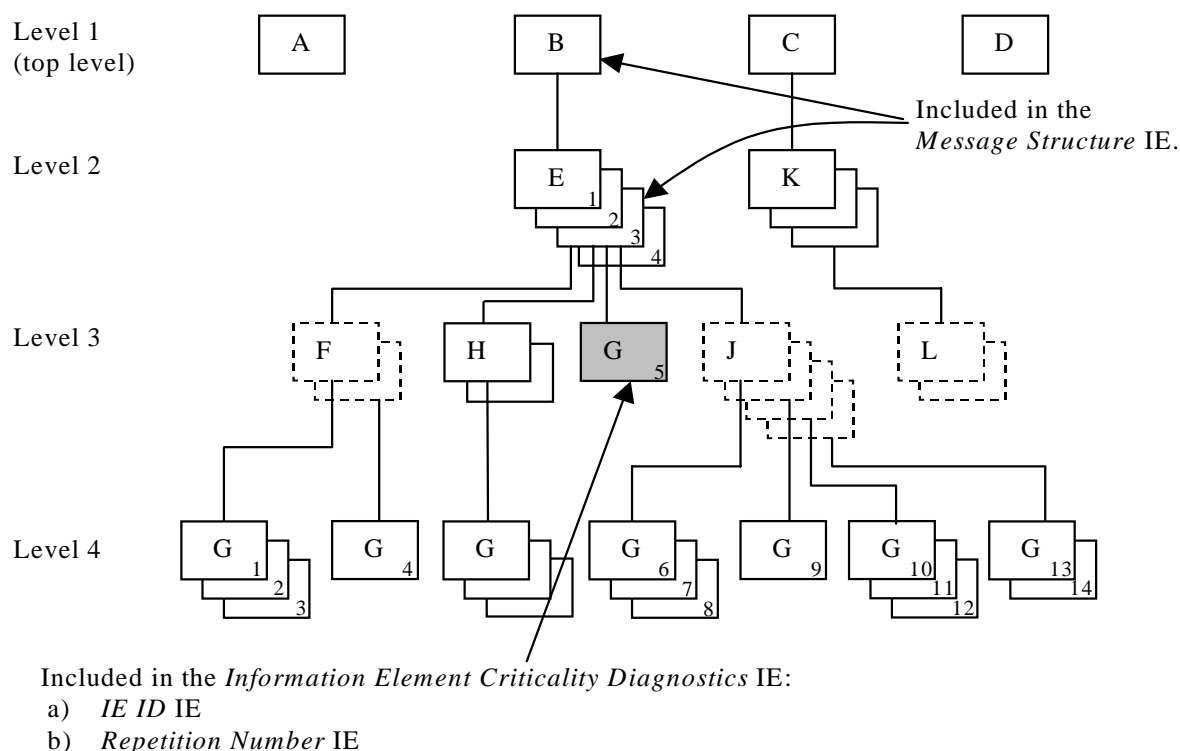


Figure B.5: Example of a received NBAP message containing a not comprehended IE

If there is an error within the instance marked as grey in the IE G in the IE E shown in the figure B.5 above, this will be reported within the *Information Element Criticality Diagnostics* IE within the *Criticality Diagnostics* IE as follows:

IE name	Value	Comment
IE Criticality	reject	Criticality for IE on the reported level, i.e. level 3.
IE ID	id-G	IE ID from the reported level, i.e. level 3.
Repetition Number	5	Repetition number on the reported level, i.e. level 3. (Since the IE E (level 2) is the lowest level included in the <i>Message Structure</i> IE this is the fifth occurrence of IE G within the IE E (level 2).
Type of Error	not understood	
<i>Message Structure, first repetition</i>		
>IE ID	id-B	IE ID from level 1.
<i>Message Structure, second repetition</i>		
>IE ID	id-E	IE ID from the lowest level above the reported level, i.e. level 2.
>Repetition Number	3	Repetition number from the lowest level above the reported level, i.e. level 2.

Note 6. The repetition number of the reported IE indicates the number of repetitions of IE G received up to the detected erroneous repetition, counting all occurrences of the IE G below the same instance of the previous level with assigned criticality (instance 3 of IE E on level 2).

B.3.5 Example 5

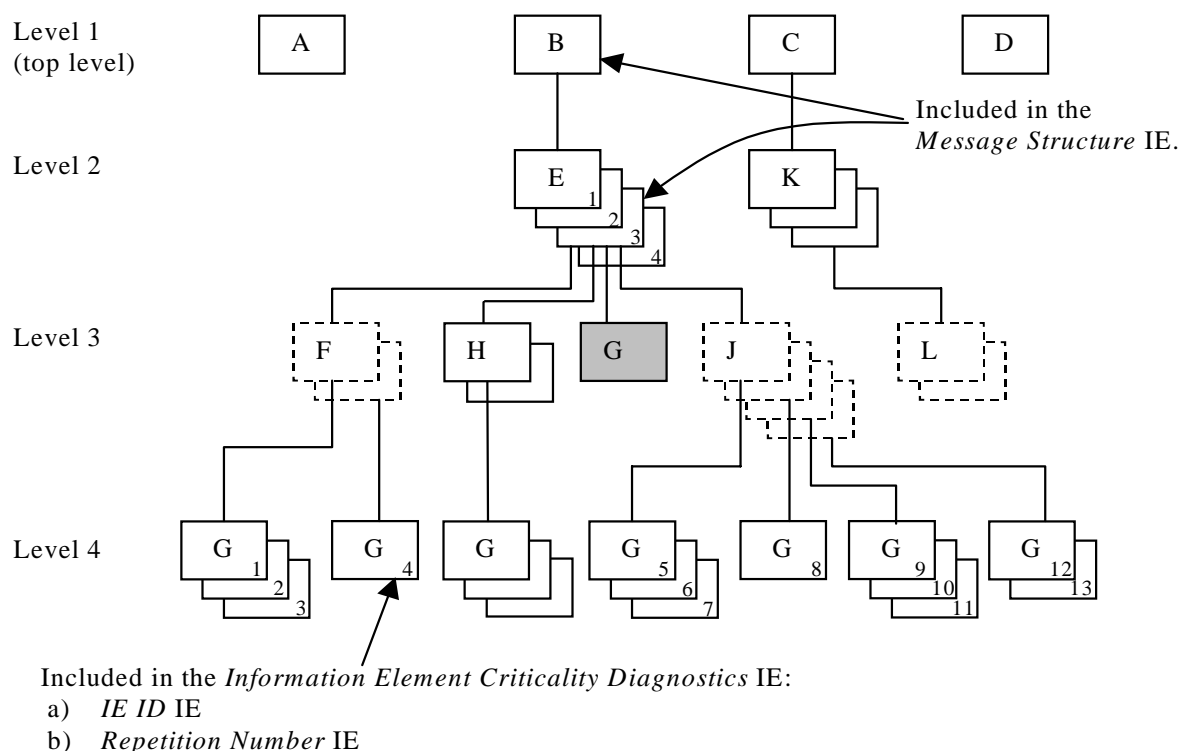


Figure B.6: Example of a received NBAP message with a missing IE

If the instance marked as grey in the IE G in the IE E shown in the figure B.6 above, is missing this will be reported within the *Information Element Criticality Diagnostics* IE within the *Criticality Diagnostics* IE as follows:

IE name	Value	Comment
IE Criticality	reject	Criticality for IE on the reported level, i.e. level 3.
IE ID	id-G	IE ID from the reported level, i.e. level 3.
Repetition Number	4	Repetition number up to the missing IE on the reported level, i.e. level 3. (Since the IE E (level 2) is the lowest level included in the <i>Message Structure</i> IE there have been four occurrences of IE G within the IE E (level 2) up to the missing occurrence.
Type of Error	missing	
<i>Message Structure, first repetition</i>		
>IE ID	id-B	IE ID from level 1.
<i>Message Structure, second repetition</i>		
>IE ID	id-E	IE ID from the lowest level above the reported level, i.e. level 2.
>Repetition Number	3	Repetition number from the lowest level above the reported level, i.e. level 2.

Note 7. The repetition number of the reported IE indicates the number of repetitions of IE G received up to but not including the missing occurrence, counting all occurrences of the IE G below the same instance of the previous level with assigned criticality (instance 3 of IE E on level 2).

B.4 ASN.1 of EXAMPLE MESSAGE

```

ExampleMessage ::= SEQUENCE {
    ProtocolIEs          ProtocolIE-Container          {{ExampleMessage-IEs}},
    ProtocolExtensions  ProtocolExtensionContainer    {{ExampleMessage-Extensions}}  OPTIONAL,
    ...
}

ExampleMessage-IEs NBAP-PROTOCOL-IES ::= {
    { ID id-A  CRITICALITY reject  TYPE A  PRESENCE mandatory } |
    { ID id-B  CRITICALITY reject  TYPE B  PRESENCE mandatory } |
    { ID id-C  CRITICALITY reject  TYPE C  PRESENCE mandatory } |
    { ID id-D  CRITICALITY reject  TYPE D  PRESENCE mandatory } ,
    ...
}

B ::= SEQUENCE {
    e          E-List,
    iE-Extensions  ProtocolExtensionContainer { {B-ExtIEs} }  OPTIONAL,
    ...
}

B-ExtIEs NBAP-PROTOCOL-EXTENSION ::= {
    ...
}

E-List ::= SEQUENCE (SIZE (1..maxE)) OF ProtocolIE-Single-Container { {E-IEs} }

E-IEs NBAP-PROTOCOL-IES ::= {
    { ID id-E  CRITICALITY ignore  TYPE E  PRESENCE mandatory }
}

E ::= SEQUENCE {
    f          F-List,
    h          H-List,
    g          G-List1,
    j          J-List,
    iE-Extensions  ProtocolExtensionContainer { {E-ExtIEs} }  OPTIONAL,
    ...
}

E-ExtIEs NBAP-PROTOCOL-EXTENSION ::= {
    ...
}

F-List ::= SEQUENCE (SIZE (1..maxF)) OF F

F ::= SEQUENCE {
    g          G-List2 OPTIONAL,
    iE-Extensions  ProtocolExtensionContainer { {F-ExtIEs} }  OPTIONAL,
    ...
}

F-ExtIEs NBAP-PROTOCOL-EXTENSION ::= {
    ...
}

G-List2 ::= SEQUENCE (SIZE (1..3, ...)) OF ProtocolIE-Single-Container { {G2-IEs} }

G2-IEs NBAP-PROTOCOL-IES ::= {
    { ID id-G  CRITICALITY ignore  TYPE G  PRESENCE mandatory }
}

H-List ::= SEQUENCE (SIZE (1..maxH)) OF ProtocolIE-Single-Container { {H-IEs} }

H-IEs NBAP-PROTOCOL-IES ::= {
    { ID id-H  CRITICALITY ignore  TYPE H  PRESENCE mandatory }
}

H ::= SEQUENCE {
    g          G-List3 OPTIONAL,
    iE-Extensions  ProtocolExtensionContainer { {H-ExtIEs} }  OPTIONAL,
    ...
}

H-ExtIEs NBAP-PROTOCOL-EXTENSION ::= {

```

```

}
...
}
G-List3 ::= SEQUENCE (SIZE (1..3, ...)) OF ProtocolIE-Single-Container { {G3-IEs} }

G3-IEs NBAP-PROTOCOL-IES ::= {
  { ID id-G    CRITICALITY notify  TYPE G  PRESENCE mandatory }
}

G-List1 ::= ProtocolIE-Single-Container { {G1-IEs} }

G1-IEs NBAP-PROTOCOL-IES ::= {
  { ID id-G    CRITICALITY reject  TYPE G  PRESENCE mandatory }
}

J-List ::= SEQUENCE (SIZE (1..maxJ)) OF J

J ::= SEQUENCE {
  g          G-List4 OPTIONAL,
  iE-Extensions ProtocolExtensionContainer { {J-ExtIEs} } OPTIONAL,
  ...
}

J-ExtIEs NBAP-PROTOCOL-EXTENSION ::= {
  ...
}

G-List4 ::= SEQUENCE (SIZE (1..3, ...)) OF ProtocolIE-Single-Container { {G4-IEs} }

G4-IEs NBAP-PROTOCOL-IES ::= {
  { ID id-G    CRITICALITY reject  TYPE G  PRESENCE mandatory }
}

C ::= SEQUENCE {
  k          K-List,
  iE-Extensions ProtocolExtensionContainer { {C-ExtIEs} } OPTIONAL,
  ...
}

C-ExtIEs NBAP-PROTOCOL-EXTENSION ::= {
  ...
}

K-List ::= SEQUENCE (SIZE (1..maxK)) OF ProtocolIE-Single-Container { {K-IEs} }

K-IEs NBAP-PROTOCOL-IES ::= {
  { ID id-K    CRITICALITY notify  TYPE K  PRESENCE mandatory }
}

K ::= SEQUENCE {
  l          L-List,
  iE-Extensions ProtocolExtensionContainer { {K-ExtIEs} } OPTIONAL,
  ...
}

K-ExtIEs NBAP-PROTOCOL-EXTENSION ::= {
  ...
}

L-List ::= SEQUENCE (SIZE (1..maxL)) OF L

L ::= SEQUENCE {
  m          M OPTIONAL,
  iE-Extensions ProtocolExtensionContainer { {L-ExtIEs} } OPTIONAL,
  ...
}

L-ExtIEs NBAP-PROTOCOL-EXTENSION ::= {
  ...
}

ExampleMessage-Extensions NBAP-PROTOCOL-EXTENSION ::= {
  ...
}

```

Presentation of Specification to TSG or WG

Presentation to: TSG-RAN Meeting #12
Document for presentation: TR 25.453 Version 2.0.0
Presented for: Approval

Abstract of document:

This TS represents the PCAP signalling specification for the Iupc interface

Changes since last presentation to TSG-RAN Meeting:

This is the first presentation of the TS

Outstanding Issues:

None

Contentious Issues:

None