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Technical Specification

**Universal Mobile Telecommunications System (UMTS);
UTRAN Iuh interface Home Node B (HNB)
Application Part (HNBAP) signalling
(3GPP TS 25.469 version 9.0.0 Release 9)**



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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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1 Scope

The present document specifies the *Home Node B Application Part (HNBAP)* between the Home Node B (HNB) and the Home Node B Gateway (HNB-GW). It fulfils the HNB- HNB-GW communication requirements specified in [3] and is defined over the Iuh – reference point. It provides control and management procedures between HNB and HNB-GW.

2 References

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

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

- [1] 3GPP TS 25.401: "UTRAN Overall Description".
- [2] 3GPP TS 25.413: 'RANAP'
- [3] 3GPP TS 25.467: 'UTRAN architecture for 3G Home NodeB'
- [4] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".
- [5] 3GPP TR 25.921: "Guidelines and Principles for Protocol Description and Error Handling".
- [6] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [7] ITU-T Recommendation X.691 (07/2002): "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".
- [8] ITU-T Recommendation X.680 (07/2002): "Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation".
- [9] ITU-T Recommendation X.681 (07/2002): "Information technology - Abstract Syntax Notation One (ASN.1): Information object specification".
- [10] 3GPP TS 25.331: 'Radio Resource Control (RRC) Protocol Specification'
- [11] IETF RFC 4960 (09/2007): "Stream Control Transmission Protocol".
- [12] 3GPP TS 23.003: "Numbering, addressing and identification".
- [13] IETF RFC 4282 (12/2005): "The Network Access Identifier".
- [14] Broadband Forum TR-069 Amendment 2, *CPE WAN Management Protocol*, Broadband Forum Technical Report, 2007.
- [15] 3GPP TS 22.220: "Service requirements for Home NodeBs and Home eNodeBs".

3 Definitions and abbreviations

3.1 Definitions

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

Elementary Procedure: HNBAP consists of Elementary Procedures (EPs). An Elementary Procedure is a unit of interaction between the HNB and HNB-GW. These EPs are defined separately and are intended to be used to build up complete sequences in a flexible manner. If the independence between some EPs is restricted, it is described under the relevant EP description. Unless otherwise stated by the restrictions, the EPs may be invoked independently of each other as stand alone procedures, which can be active in parallel.

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.
- On time supervision expiry (i.e. absence of expected response).

Class 2 EPs are considered always successful.

3.2 Abbreviations

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

| | |
|--------|--------------------------------------|
| EP | Elementary Procedure |
| ESN | Electronic Serial Number |
| HNB | Home Node B |
| HNB-GW | Home Node B Gateway |
| HNBAP | HNB Application Part |
| PDU | Protocol Data Unit |
| PER | Packed Encoding Rules |
| SAC | Service Area Code |
| SCTP | Stream Control Transmission Protocol |

4 General

The protocol described in the present document is the protocol between HNB-GW and HNB.

4.1 Procedure Specification Principles

The principle for specifying the procedure logic is to specify the functional behaviour of the HNB & HNB-GW exactly and completely..

The following specification principles have been applied for the procedure text in clause 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. HNB Registration 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. HNB REGISTRATION 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>HNB Identity</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 "Background". |

5 HNBAP Services

HNBAP provides the signalling service between the HNB and the HNB-GW that is required to fulfil the HNBAP functions in Clause 7.

6 Services expected from the Transport layer

Following service is expected from the transport layer:

- reliable and in sequence delivery of Signalling data using SCTP[11].

7 Functions of HNBAP

The HNBAP has the following functions:

- Registration
- UE Registration
- Error Handling. This function allows the reporting of general error situations, for which function specific error messages have not been defined.

These functions are implemented by one or several HNBAP elementary procedures described in the following clauses.

8 HNBAP Procedures

8.1 Elementary Procedures

In the following tables, all EPs are divided into Class 1 and Class 2 Procedures.

Table 1: Class 1

| Elementary Procedure | Initiating Message | Successful Outcome | Unsuccessful Outcome |
|----------------------|----------------------|---------------------|----------------------|
| | | Response message | Response message |
| HNB Registration | HNB REGISTER REQUEST | HNB REGISTER ACCEPT | HNB REGISTER REJECT |
| UE Registration | UE REGISTER REQUEST | UE REGISTER ACCEPT | UE REGISTER REJECT |

Table 2: Class 2

| Elementary Procedure | Message |
|----------------------|------------------|
| HNB De-Registration | HNB DE-REGISTER |
| UE De-Registration | UE DE-REGISTER |
| Error Indication | ERROR INDICATION |

8.2 HNB Registration Procedure

8.2.1 General

The purpose of the HNB Registration Procedure is to register the HNB with the HNB-GW to enable the HNB-GW to provide service and core network connectivity for the HNB. This procedure shall be the first HNBAP procedure triggered after the SCTP association has become operational.

8.2.2 Successful Operation

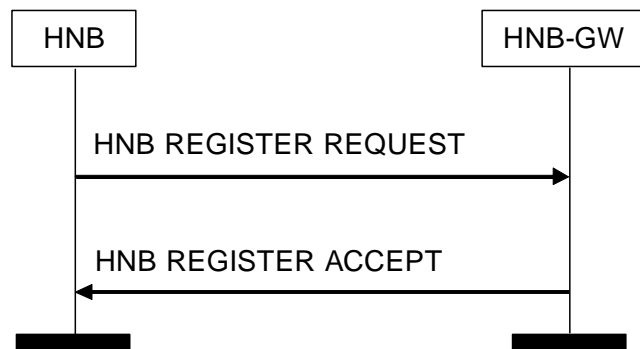


Figure 1: HNB Register Procedure: Successful Operation

The HNB shall initiate this procedure by sending a HNB REGISTER REQUEST message whenever it needs to commence operations and requiring service from the HNB-GW.

If the HNB is CSG capable and operates in a Closed access mode as defined in [15], then it shall provide the *CSG-ID IE* and may provide the *HNB Cell Access Mode IE* within the HNB REGISTER REQUEST message.

If the HNB is supporting ETWS it shall provide the *Service Area For Broadcast IE* within the HNB REGISTER REQUEST message.

If the HNB operates in a Hybrid access mode as defined in [15], then it shall provide the *CSG-ID IE* and *HNB Cell Access Mode IE* within the HNB REGISTER REQUEST message.

If the HNB operates in an Open access mode as defined in [15], then it shall provide the *HNB Cell Access Mode IE* within the HNB REGISTER REQUEST message.

If the registration is successful, the HNB-GW will respond with a HNB REGISTER ACCEPT message indicating acceptance and registration.

If the HNB-GW is capable of de-multiplexing, then the *MuxPortNumber IE* may be included in the HNB REGISTER ACCEPT message.

8.2.3 Unsuccessful Operation

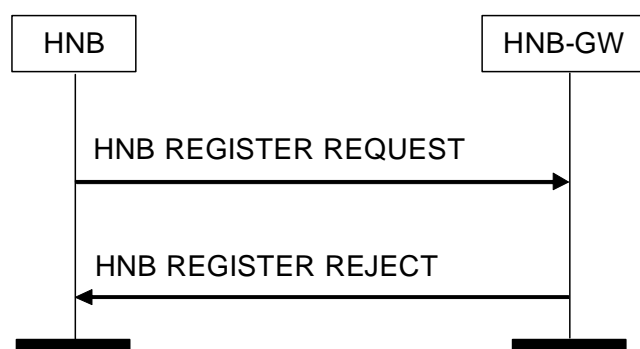


Figure 2: HNB Register Procedure: Un-Successful Operation

If the HNB-GW cannot register the HNB, the HNB-GW will respond with a HNB REGISTER REJECT message.

Typical cause values are:

Radio Network Layer Cause:

- Unauthorised Location
- Unauthorised HNB

- Overload
- HNB Parameter Mismatch
- Unspecified

If the HNB receives the 'overload' cause code in the HNB REGISTER REJECT message, the HNB shall not retry registration to the same HNB-GW for at least the duration indicated in the *Backoff Timer* IE.

8.2.4 Abnormal Conditions

If the HNB-GW receives a duplicate HNB REGISTER REQUEST (i.e. for an already registered HNB identified by the unique HNB identity), then the new HNB REGISTER REQUEST shall override the existing registration and the handling of the new HNB REGISTER REQUEST is according to section 8.2.

8.3 HNB De-registration Procedure

8.3.1 Successful Operation (HNB Originated)



Figure 3: HNB De-register Procedure: Successful Operation

The HNB will initiate this procedure whenever it needs to terminate operations.

The HNB-GW shall clear all related resources associated with the HNB.

Typical cause values are:

Radio Network Layer Cause:

- Normal
- Unspecified

8.3.2 Successful Operation (HNB-GW Originated)



Figure 4: HNB De-register Procedure: Successful Operation

The HNB-GW will initiate this procedure whenever it needs to terminate operations with a HNB.

The HNB-GW shall clear all related resources associated with the HNB.

Typical cause values are:

Radio Network Layer Cause:

- Overload
- Unspecified

If the HNB receives the 'overload' cause code in the HNB DE-REGISTER message, the HNB shall not retry registration to the same HNB-GW for at least the duration indicated in the *Backoff Timer* IE.

8.3.3 Abnormal Conditions

-

8.4 UE Registration

8.4.1 General

The UE Registration procedure provides means for the HNB to convey UE identification data to the HNB-GW in order to perform access control for the UE in the HNB-GW. The UE Registration also establishes a UE specific context identifier to be used between HNB and HNB-GW. The procedure is triggered when the UE attempts to access the HNB via an initial NAS message and there is no context in the HNB allocated for that UE.

8.4.2 Successful Operation

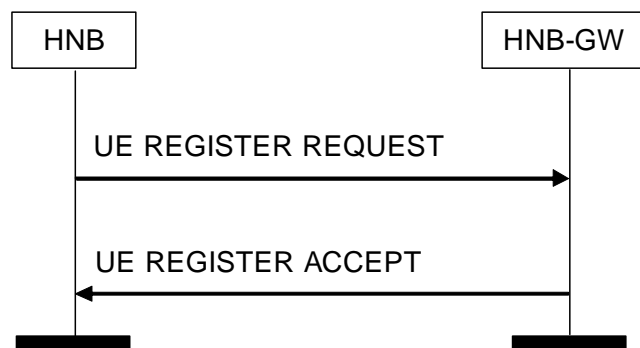


Figure 5: UE Register Procedure: Successful Operation

The HNB shall initiate the procedure by sending a UE REGISTER REQUEST message to the HNB-GW including UE specific data. The HNB shall always include the UE permanent identity (i.e. IMSI) if it does not serve a CSG cell or for registration of UEs without CSG capability except if the *Registration Cause* indicates 'emergency call'.

The HNB-GW shall perform access control for the UE on the specific HNB and if successful respond with a UE REGISTER ACCEPT message including the *Context-ID* IE.

The UE REGISTER ACCEPT message may include the *CSG Membership Status* IE for the UE registering to the cell.

The HNB-GW shall not perform access control if the *Registration Cause* indicates 'emergency call'.

8.4.3 Unsuccessful Operation

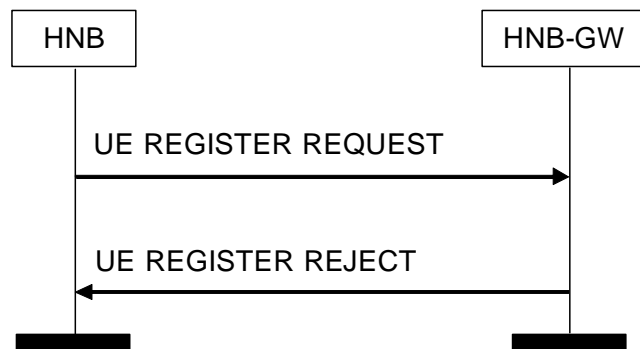


Figure 6: UE Register Procedure: Unsuccessful Operation

If the HNB-GW is unable to accept the UE registration it shall reject the procedure with a UE REGISTER REJECT message.

Typical Cause values:

Radio Network Layer Cause:

- Invalid UE identity
- UE not allowed on this HNB
- HNB not registered (FFS)
- Unspecified

8.4.4 Abnormal Conditions

-

8.5 UE De-Registration

8.5.1 General

The purpose of the UE De-Registration Procedure is to disconnect a UE context in the HNB-GW

8.5.2 Successful Operation (HNB Originated)



Figure 7 UE De-Register Procedure: HNB Originated Successful Operation

The HNB shall initiate the procedure by sending a UE DE-REGISTER message. When receiving the UE DE-REGISTER message the HNB-GW shall release the resources associated with that UE including the Context-ID.

Typical Cause values:

Radio Network Layer Cause:

- Connection with UE lost
- UE RRC Release
- Unspecified
- UE relocated

8.5.3 Successful Operation (HNB-GW Originated)

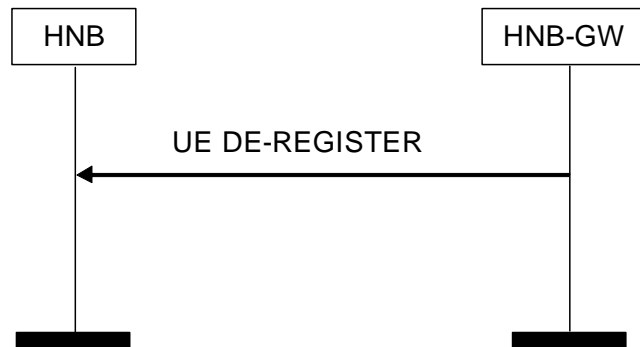


Figure 8 UE De-Register Procedure: HNB-GW Originated Successful Operation

The HNB-GW shall initiate the procedure by sending a UE DE-REGISTER message. When receiving the UE DE-REGISTER message the HNB shall release the included Context-ID.

Typical Cause values:

Radio Network Layer Cause:

- UE Registered in another HNB
- Unspecified
- UE not allowed on this HNB

8.5.4 Abnormal Conditions

--

8.6 Error Indication

8.6.1 General

The Error Indication procedure is initiated by either HNB or HNB-GW to report detected errors in one incoming message, provided they cannot be reported by an appropriate failure message.

8.6.2 Successful Operation

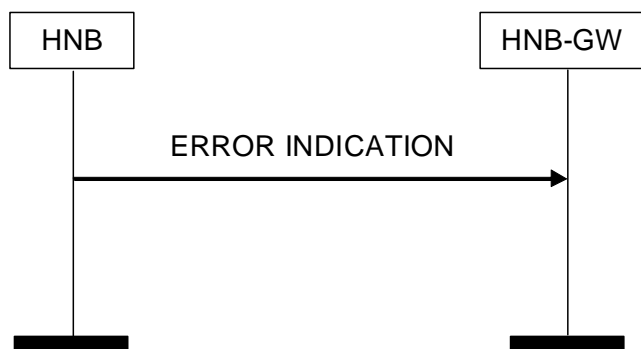


Figure 9 Error Indication HNB Originated, Successful Operation

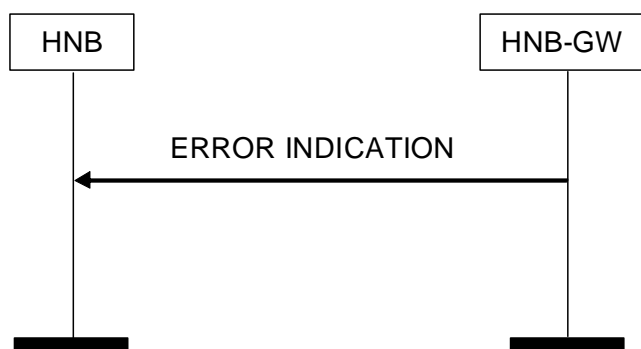


Figure 10 Error Indication HNB-GW Originated, Successful Operation

9 Elements for HNBAP Communication

9.1 Message Functional Definition and Content

9.1.1 General

Section 9.1 presents the contents of HNBAP 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 [5].

For each message there is, a table listing the signalling elements in their order of appearance in the transmitted message.

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 table 3

Table 3: Meaning of abbreviations used in HNBAP messages

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

9.1.2.2 Criticality

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

Table 4: 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 subclause 10.3.2, if applicable.

9.1.3 HNB REGISTER REQUEST

This message is sent by the HNB to the HNB-GW to register the HNB at the HNB-GW.

Direction: HNB → HNB-GW

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|----------------------------|----------|-------|-----------------------|-----------------------|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | reject |
| HNB Identity | M | | 9.2.2 | | YES | reject |
| HNB Location Information | M | | 9.2.3 | | YES | reject |
| PLMN-ID | M | | 9.2.14 | | YES | reject |
| Cell-ID | M | | 9.2.25 | | YES | reject |
| LAC | M | | 9.2.11 | | YES | reject |
| RAC | M | | 9.2.12 | | YES | reject |
| SAC | M | | 9.2.13 | | YES | reject |
| CSG-ID | O | | 9.2.27 | | YES | reject |
| Service Area For Broadcast | O | | 9.2.13 | | YES | ignore |
| HNB Cell Access Mode | O | | 9.2.31 | | YES | reject |

9.1.4 HNB REGISTER ACCEPT

This message is sent by the HNB-GW to the HNB as a successful response to a HNB REGISTER REQUEST message.

Direction: HNB-GW → HNB

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|-----------------|----------|-------|-----------------------|---|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | reject |
| RNC-ID | M | | 9.2.26 | | YES | reject |
| Mux Port Number | O | | 9.2.29 | The mux port number at which HNB-GW expects to receive multiplexed packets. | YES | Ignore |

9.1.5 HNB REGISTER REJECT

This message is sent by the HNB-GW to the HNB as unsuccessful response to a HNB REGISTER REQUEST message.

Direction: HNB-GW → HNB

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|-------------------------|--------------|-------|-----------------------|-----------------------|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | reject |
| Cause | M | | 9.2.15 | | YES | ignore |
| Criticality Diagnostics | O | | 9.2.16 | | YES | ignore |
| Backoff Timer | C-ifOverload | | 9.2.28 | | YES | reject |

| Condition | Explanation |
|------------|--|
| IfOverload | This IE shall be present if the Cause IE is set to "Overload". |

9.1.6 UE REGISTER REQUEST

This message is sent by the HNB to the HNB-GW to register a UE at HNB-GW for service.

Direction: HNB → HNB-GW

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|--------------------|----------|-------|-----------------------|-----------------------|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | reject |
| UE Identity | M | | 9.2.17 | | YES | reject |
| Registration Cause | M | | 9.2.21 | | YES | ignore |
| UE Capabilities | M | | 9.2.24 | | YES | reject |

9.1.7 UE REGISTER ACCEPT

This message is sent by the HNB-GW to the HNB as a successful response to a UE REGISTER REQUEST message.

Direction: HNB-GW → HNB

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|-----------------------|----------|-------|-----------------------|-----------------------|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | reject |
| UE Identity | M | | 9.2.17 | | YES | reject |
| Context-ID | M | | 9.2.9 | | YES | reject |
| CSG Membership Status | O | | 9.2.30 | | YES | reject |

9.1.8 UE REGISTER REJECT

This message is sent by the HNB-GW to the HNB as unsuccessful response to a UE REGISTER REQUEST message.

Direction: HNB-GW → HNB

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|-------------------------|----------|-------|-----------------------|-----------------------|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | reject |
| UE Identity | M | | 9.2.17 | | YES | reject |
| Cause | M | | 9.2.15 | | YES | ignore |
| Criticality Diagnostics | O | | 9.2.16 | | YES | ignore |

9.1.9 HNB DE-REGISTER

This message is sent by the HNB to the HNB-GW or HNB-GW to HNB to deregister the HNB,

Direction: HNB → HNB-GW or HNB-GW → HNB

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|---------------|------------------|-------|-----------------------|-----------------------|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | reject |
| Cause | M | | 9.2.15 | | YES | ignore |
| Backoff Timer | C- ifOverload | | 9.2.28 | | YES | reject |

| Condition | Explanation |
|------------|--|
| IfOverload | This IE shall be present if the Cause IE is set to "Overload". |

9.1.10 UE DE-REGISTER

This message is sent by the HNB to the HNB-GW or HNB-GW to HNB to de-register a UE.

Direction: HNB → HNB-GW, HNB-GW → HNB

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|--------------|----------|-------|-----------------------|-----------------------|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | reject |
| Context-ID | M | | 9.2.9 | | YES | reject |
| Cause | M | | 9.2.15 | | YES | ignore |

9.1.11 ERROR INDICATION

This message is sent by the HNB to HNB-GW or HNB-GW to HNB and is used to indicate that some errors have been detected.

Direction: HNB → HNB-GW, HNB-GW → HNB

| PARAMETER | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|-------------------------|----------|-------|-----------------------|-----------------------|-------------|----------------------|
| Message Type | M | | 9.2.1 | | YES | ignore |
| Cause | M | | 9.2.15 | | YES | ignore |
| Criticality Diagnostics | O | | 9.2.16 | | YES | ignore |

9.2 Information Element Definitions

9.2.0 General

Section 9.2 presents the HNBAP 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.

When specifying information elements which are to be represented by bit strings, if not otherwise specifically stated in the semantics description of the concerned IE or elsewhere, the following principle applies with regards to the ordering of bits:

- The first bit (leftmost bit) contains the most significant bit (MSB);
- The last bit (rightmost bit) contains the least significant bit (LSB);
- When importing bit strings from other specifications, the first bit of the bit string contains the first bit of the concerned information;

9.2.1 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 |
|---------------------|----------|-------|---|-----------------------|
| Message Type | | | | |
| >Procedure Code | M | | ENUMERATED (HNB register, UE Register, UE De-Register, HNB De-Register Error Indication, ...) | |
| >Type of Message | M | | ENUMERATED (Initiating Message, Successful Outcome, Unsuccessful Outcome, Outcome) | |

9.2.2 HNB Identity

HNB Identity IE is sent from the HNB to the HNB-GW and identifies the HNB.

| IE/GROUP NAME | Presence | Range | IE Type and Reference | Semantics Description |
|---------------|----------|-------|-----------------------------|-----------------------|
| HNB Identity | | | OCTET STRING (SIZE(1..255)) | See note below. |

Note:

The octet string shall take form of an Network Access Identifier (NAI) as defined in IETF RFC4282 [13]. The format of the HNB-Identity will be:

0<IMSI>@<realm>

Or

1<OUI>-<SerialNumber>@<realm>

Where <IMSI> is a 16 digit number coded as specified in 23.003[12];

and <OUI> and <SerialNumber> are coded as specified in TR-069[14].

9.2.3 HNB Location Information

HNB Location Information IE is sent from the HNB to HNB-GW to provide information on the location of the HNB.

| IE/GROUP NAME | PRESENCE | RANGE | IE Type and Reference | Semantics Description | Criticality | Assigned Criticality |
|---------------------------------|----------|-------|-----------------------|-----------------------|-------------|----------------------|
| <i>HNB Location Information</i> | | | | | - | - |
| > Macro Coverage | O | | 9.2.7 | | - | - |
| > Geographic Location | O | | 9.2.4 | | - | - |
| > HNB Internet Information | O | | IP Address 9.2.8 | | YES | reject |

9.2.4 Geographical Location

This IE identifies the Ellipsoid point with altitude as in ref [4].

| IE/GROUP NAME | PRESENCE | RANGE | IE type and reference | Semantics description |
|--------------------------|----------|-------|-----------------------|-----------------------|
| Geographical Coordinates | M | | 9.2.5 | |
| Altitude and Direction | M | | 9.2.6 | |

9.2.5 Geographical Coordinates

This IE contains the geographical coordinates of an ellipsoid point.

| 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: $N \leq 2^{23} X / 90 < N+1$ 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: $N \leq 2^{24} X / 360 < N+1$ X being the longitude in degree (-180°..+180°) |

9.2.6 Altitude and Direction

This IE contains the altitude and direction of an ellipsoid point.

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|-------------------------------|----------|-------|---------------------------------|--|
| Altitude and direction | | | | |
| >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). |

9.2.7 Macro Coverage Information

The *Macro Coverage Information* IE identifies the macro cell used by the HNB for location. This may be e.g. a GERAN Cell ID or a UTRAN Cell ID .

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|-------------------------------|----------|-------|-----------------------|----------------------------|
| Choice Cell Identifier | | | | |
| >GERAN Cell ID Information | | | | |
| >>PLMN-ID | M | | 9.2.14 | |
| >>LAC | M | | 9.2.11 | 0000 and FFFE not allowed. |
| >>CI | M | | OCTET STRING (2) | |
| >UTRAN Cell ID Information | | | | |
| >>LAC | M | | 9.2.11 | |
| >>RAC | M | | 9.2.12 | |
| >>PLMN-ID | M | | 9.2.14 | |
| >>Cell-ID | M | | 9.2.25 | |

9.2.8 IP Address

This IE defines a IP address.

| IE/GROUP NAME | Presence | Range | IE Type and Reference | Semantics Description |
|--------------------------|----------|-------|-----------------------|-----------------------|
| CHOICE <i>IP Address</i> | | | | |
| >Internet Address ipv4 | M | | OCTET STRING(4) | |
| >Internet Address ipv6 | M | | OCTET STRING(16) | |

9.2.9 Context-ID

Context ID IE uniquely identifies a particular UE in the HNB and HNB-GW. This unique Context ID is used for PS and CS domain.

| IE/GROUP NAME | PRESENCE | RANGE | IE Type and | Semantics Description |
|---------------|----------|-------|----------------|-----------------------|
| Context-ID | | | BIT STRING(24) | |

9.2.10 IMSI

The IMSI is used to uniquely identify a UE.

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|---------------|----------|-------|----------------------------|--|
| IMSI | | | OCTET STRING (SIZE (3..8)) | <ul style="list-style-type: none"> - digits 0 to 9, encoded 0000 to 1001, - 1111 used as filler digit, two digits per octet, - bit 4 to 1 of octet n encoding digit 2n-1 - bit 8 to 5 of octet n encoding digit 2n <p>-Number of decimal digits shall be from 6 to 15 starting with the digits from the PLMN identity.</p> <p>When the IMSI is made of an odd number of digits, the filler digit shall be added at the end to make an even number of digits of length 2N. The filler digit shall then be consequently encoded as bit 8 to 5 of octet N.</p> |

9.2.11 LAC

This element is used to identify a Location Area.

| IE/GROUP NAME | PRESENC E | RANGE | IE Type and Reference | Semantics Description |
|---------------|-----------|-------|-----------------------|-----------------------|
| LAC | | | OCTET STRING(2) | |

9.2.12 RAC

This element is used to identify a Routing Area within a Location Area. It is used for PS services.

| IE/GROUP NAME | Presence | Range | IE Type and Reference | Semantics Description |
|---------------|----------|-------|-----------------------|-----------------------|
| RAC | | | OCTET STRING(1) | |

9.2.13 SAC

The SAC identifies the Service Area.

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|---------------|----------|-------|------------------------|-----------------------|
| SAC | | | OCTET STRING (SIZE(2)) | |

9.2.14 PLMN-ID

The PLMN-ID identifies a Public Land Mobile Network.

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|---------------|----------|-------|----------------------------|---|
| PLMN-ID | | | OCTET STRING (SIZE (3)) | <ul style="list-style-type: none"> - digits 0 to 9, encoded 0000 to 1001, - 1111 used as filler digit, two digits per octet, - bits 4 to 1 of octet n encoding digit 2n-1- bits 8 to 5 of octet n encoding digit 2n <p>-The PLMN identity consists of 3 digits from MCC followed by either</p> <ul style="list-style-type: none"> - a filler digit plus 2 digits from MNC (in case of 2 digit MNC) or - 3 digits from MNC (in case of a 3 digit MNC). |

9.2.15 Cause

Cause IE indicates the reason for a particular error event for the HNBAP protocol.

| IE/Group Name | Presence | Range | IE Type and Reference | Semantics Description |
|-----------------------------|----------|-------|---|-----------------------|
| CHOICE Cause Group | | | | |
| >Radio Network Layer | | | | |
| >>Radio Network Layer Cause | M | | ENUMERATED (overload, unauthorised-Location, unauthorised-HNB, HNB Parameter mismatch, Invalid UE identity, UE not allowed on this HNB, UE unauthorised, Connection with UE lost, UE RRC Release, HNB not registered, unspecified, Normal, UE relocated, UE Registered in another HNB, ...,) | |
| >Transport Layer | | | | |
| >>Transport Layer Cause | M | | ENUMERATED (Transport Resource Unavailable, Unspecified, ...) | |
| >Protocol | | | | |
| >>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), ...) | |
| >Misc | | | | |
| >>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. Cause values for information "not valid" indicates that the information is not valid in the context that it was received.

| Radio Network Layer cause | Meaning |
|------------------------------|--|
| Overload | The HNB-GW cannot handle the HNB due to overload. |
| Unauthorised-Location | The HNB-GW cannot register the HNB because the location information provided is not valid. |
| Unauthorised-HNB | The HNB-GW cannot register the HNB because its supplied information is not considered valid |
| HNB Parameter Mismatch | The HNB-GW cannot register the HNB because of mismatch in parameters between HNB and HNB-GW |
| Invalid UE identity | The UE ID supplied for UE registration is not valid |
| UE not allowed on this HNB | The UE is identified as not being allowed to use services on this HNB. (temporary rejection) |
| UE not authorised | The UE is identified as not being allowed to use services on a HNB (permanent rejection). |
| Connection with UE lost | The connection to a Registered UE has been lost |
| UE RRC release | The Registered UE"s RRC is released (e.g. due to IMSI detach NAS procedure) |
| HNB not registered | The HNB is not registered on this gateway |
| Unspecified | Sent when none of the above cause values applies but still the cause is Radio Network layer related. |
| UE relocated | The UE has been relocated to a neighbouring cell |
| UE Registered in another HNB | The UE has already registered in another HNB on same HNB-GW. |
| Normal | No error has occurred |

9.2.16 Criticality Diagnostics

For further details on how to use the *Criticality Diagnostics* IE, see annex A.

The *Criticality Diagnostics* IE is sent by the RNC or the CN when parts of a received message have not been comprehended or were missing, or if the message contained logical errors. When applicable, it contains information about which IEs that were not comprehended or were missing.

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|--|----------|----------------------|---|--|
| Criticality Diagnostics | | | | |
| >Procedure Code | O | | INTEGER (0..255) | Procedure Code is to be used if Criticality Diagnostics is part of Error Indication procedure, and not within the response message of the same procedure that caused the error |
| >Triggering Message | O | | ENUMERATED (initiating message, successful outcome, unsuccessful outcome) | The Triggering Message is used only if the Criticality Diagnostics is part of Error Indication procedure. |
| >Procedure Criticality | O | | ENUMERATED(reject, ignore, notify) | This Procedure Criticality is used for reporting the Criticality of the Triggering message (Procedure). |
| Information Element Criticality Diagnostics | | 0 to <maxnof errors> | | |
| >IE Criticality | M | | ENUMERATED(reject, ignore, notify) | The IE Criticality is used for reporting the criticality of the triggering IE. The value "ignore" shall not be used. |
| >IE ID | M | | INTEGER (0..65535) | The IE Id of the not understood or missing |

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|--------------------------------|----------|-------|--|-----------------------|
| Criticality Diagnostics | | | | |
| | | | | IE |
| >Type of Error | M | | ENUMERATED(not understood, missing, ...) | |

| Range bound | Explanation |
|---------------|--|
| Maxnooferrors | Maximum no. of IE errors allowed to be reported with a single message. The value for maxnooferrors is 256. |

9.2.17 UE Identity

This is a unique identifier for the UE.

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|----------------------------|----------|-------|-----------------------------|-----------------------|
| CHOICE UE Identity | | | | |
| > IMSI | | | 9.2.10 | |
| > TMSI and LAI (GSM-MAP) | | | | |
| >>TMSI | M | | 9.2.19 | |
| >>LAI | M | | 9.2.20 | |
| >P- TMSI and RAI (GSM-MAP) | | | | |
| >>P-TMSI | M | | 9.2.22 | |
| >>RAI (GSM-MAP) | M | | 9.2.23 | |
| > IMEI | | | 9.2.18 | |
| > ESN (DS-41) | | | BIT STRING (SIZE (32)) | |
| > IMSI (DS-41) | | | OCTET STRING (SIZE (5..7)) | |
| >IMSI and ESN (DS-41) | | | | |
| >> ESN (DS-41) | M | | BIT STRING(SIZE (32)) | |
| >> IMSI (DS-41) | M | | OCTET STRING (SIZE (5..7)) | |
| >TMSI (DS-41) | | | OCTET STRING (SIZE (2..17)) | |

9.2.18 IMEI

This IE contains an International Mobile Equipment Identity.

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|---------------|----------|-------|-----------------------|-----------------------|
| IMEI | | | BIT STRING(60) | |

9.2.19 TMSI (GSM-MAP)

This IE contains a Temporary Mobile Subscriber Identity, used towards a GSM-MAP type of PLMN.

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|--------------------------------|----------|-------|--------------------|---|
| TMSI (GSM-MAP) | | | BIT STRING (32) | The first/leftmost bit of the bit string contains the most significant bit of the TMSI. |

9.2.20 LAI

Location Area Identification identifies uniquely a location area for a GSM-MAP type of PLMN.

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|--------------------------------|----------|-------|--------------------|-----------------------|
| PLMN-ID | M | | 9.2.14 | |
| LAC | M | | 9.2.11 | |

9.2.21 Registration Cause

Indicates if a UE registration is for an emergency call.

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|--------------------------------|----------|-------|--|-----------------------|
| Registration cause | | | Enumerated { emergency call, normal, ... } | |

9.2.22 P-TMSI (GSM-MAP)

This IE contains a Packet Temporary Mobile Subscriber Identity (P-TMSI), used towards a GSM-MAP type of PLMN.

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|--------------------------------|----------|-------|--------------------|---|
| P-TMSI | | | BIT STRING (32) | The first/leftmost bit of the bit string contains the most significant bit of the P-TMSI. |

9.2.23 Routing Area Identification

Identifies uniquely a routing area for a GSM-MAP type of PLMN.

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|--------------------------------|----------|-------|--------------------|-----------------------|
| LAI | M | | 9.2.20 | |
| RAC | M | | 9.2.12 | |

9.2.24 UE Capabilities

Identifies UE capabilities and release.

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|-----------------------------------|----------|-------|--|-----------------------------|
| UE Capabilities | | | | |
| >Access Stratum Release Indicator | M | | Enumerated { R99, Rel-4, Rel-5, Rel-6, Rel-7, Rel-8, ... } | Values as defined in [10] |
| >CSG Capability | M | | Enumerated {CSG capable, Not CSG capable, ... } | Indicates a CSG capable UE. |

9.2.25 Cell-ID

Identifies uniquely a cell within a PLMN.

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|--------------------------------|----------|-------|------------------------|---|
| Cell-ID | | | INTEGER (0..268435455) | This information element identifies a cell uniquely within UTRAN. |

9.2.26 RNC-ID

Uniquely identifies the HNB-GW towards the CN on a particular Iu interface.

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|--------------------------------|----------|-------|--------------------|--|
| RNC-ID | | | INTEGER (0..65535) | Values greater than 4095 are extended (16bit) RNC Ids. |

9.2.27 CSG-ID

Indicates the CSG-ID of a particular HNB, as defined in [12]

| Information Element/Group name | Need | Multi | Type and reference | Semantics description |
|--------------------------------|------|-------|-----------------------|-----------------------|
| CSG-ID | | | BIT STRING (SIZE(27)) | |

9.2.28 Backoff Timer

The *Backoff Timer* IE indicates in seconds the minimum duration for which the HNB registration shall not be retried.

| Information Element/Group name | Need | Multi | Type and reference | Semantics description |
|--------------------------------|------|-------|--------------------|--|
| Backoff Timer | | | INTEGER (0..3600) | Value "0" indicates no specified time. |

9.2.29 Mux Port Number

The mux port number on which the HNB-GW expects the multiplexed packets from the HNB

| Information Element/Group name | Presence | Range | Type and reference | Semantics description |
|--------------------------------|----------|-------|-----------------------|-----------------------|
| Mux port number | | | INTEGER (1024..65535) | |

9.2.30 CSG Membership Status

This element indicates the Membership status of the UE to a particular CSG.

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|-----------------------|----------|-------|-------------------------------------|-----------------------|
| CSG Membership Status | M | | ENUMERATED (member, not-member,...) | |

9.2.31 HNB Cell Access Mode

This information element indicates whether the cell of the HNB operates in a Closed, Hybrid, or Open Access mode as defined in [15].

| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
|----------------------|----------|-------|---------------------------------------|-----------------------|
| HNB Cell Access Mode | M | | ENUMERATED(closed, hybrid, open, ...) | |

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

9.3.0 General

HNBAP ASN.1 definition conforms with [8] and [9].

The ASN.1 definition specifies the structure and content of HNBAP messages. HNBAP 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 HNBAP 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 HNBAP 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 subclause 10.3.6.

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
--
-- *****
HNBAP-PDU-Descriptions {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) hnbap(6) version1 (1) hnbap-PDU-Descriptions (0)}

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

IMPORTS
    Criticality,
    ProcedureCode
FROM HNBAP-CommonDataTypes

    HNBRegisterRequest,
    HNBRegisterAccept,
    HNBRegisterReject,
    HNBDe-Register,
    UERegisterRequest,
    UERegisterAccept,
    UERegisterReject,
    UEDe-Register,
    ErrorIndication,
    PrivateMessage

FROM HNBAP-PDU-Contents
    id-HNBRegister,
    id-UERegister,
    id-UEDe-Register,
    id-HNBDe-Register,
    id-ErrorIndication,
    id-privateMessage
FROM HNBAP-Constants;

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

HNBAP-ELEMENTARY-PROCEDURE ::= CLASS {
```



```

    &InitiatingMessage      ,
    &SuccessfulOutcome      OPTIONAL,
    &UnsuccessfulOutcome    OPTIONAL,
    &procedureCode          ProcedureCode  UNIQUE,
    &criticality            Criticality    DEFAULT ignore
}

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

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

HNBAP-PDU ::= CHOICE {
    initiatingMessage      InitiatingMessage,
    successfulOutcome      SuccessfulOutcome,
    unsuccessfulOutcome    UnsuccessfulOutcome,
    ...
}

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

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

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

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

HNBAP-ELEMENTARY-PROCEDURES HNBAP-ELEMENTARY-PROCEDURE ::= {

```

```

    HNBAP-ELEMENTARY-PROCEDURES-CLASS-1 |
    HNBAP-ELEMENTARY-PROCEDURES-CLASS-2 ,
    ...
}

HNBAP-ELEMENTARY-PROCEDURES-CLASS-1 HNBAP-ELEMENTARY-PROCEDURE ::= {
    hNBRegister |
    uERegister,
    ...
}

HNBAP-ELEMENTARY-PROCEDURES-CLASS-2 HNBAP-ELEMENTARY-PROCEDURE ::= {
    uEDe-Register |
    hNBDe-Register |
    errorIndication |
    privateMessage,
    ...
}

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

hNBRegister HNBAP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      HNBRegisterRequest
    SUCCESSFUL OUTCOME      HNBRegisterAccept
    UNSUCCESSFUL OUTCOME    HNBRegisterReject
    PROCEDURE CODE          id-HNBRegister
    CRITICALITY              reject
}

uERegister HNBAP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UERegisterRequest
    SUCCESSFUL OUTCOME      UERegisterAccept
    UNSUCCESSFUL OUTCOME    UERegisterReject
    PROCEDURE CODE          id-UERegister
    CRITICALITY              reject
}

uEDe-Register HNBAP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UEDe-Register
    PROCEDURE CODE          id-UEDe-Register
    CRITICALITY              ignore
}

hNBDe-Register HNBAP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      HNBDe-Register
    PROCEDURE CODE          id-HNBDe-Register
    CRITICALITY              ignore
}

```

```

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

```

```

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

```

END

9.3.3 PDU Definitions

```

-- *****
--
-- PDU definitions for HNBAP.
--
-- *****

HNBAP-PDU-Contents {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) hnbap(6) version1 (1) hnbap-PDU-Contents (1) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

IMPORTS
    Cause,
    CriticalityDiagnostics,
    CSGMembershipStatus,
    HNB-Location-Information,
    HNB-Identity,
    Context-ID,
    UE-Identity,
    LAC,
    RAC,
    SAC,
    CN-DomainIndicator,
    IP-Address,
    Registration-Cause,
    UE-Capabilities,
    PLMNIdentity,

```

```

CellIdentity,
RNC-ID,
CSG-ID,
HNB-Cell-Access-Mode,
BackoffTimer,
MuxPortNumber

```

FROM HNBAP-IEs

```

ProtocolExtensionContainer{},
ProtocolIE-ContainerList{},
ProtocolIE-Container{},
ProtocolIE-Single-Container{},
PrivateIE-Container{},
HNBAP-PRIVATE-IES,
HNBAP-PROTOCOL-EXTENSION,
HNBAP-PROTOCOL-IES

```

FROM HNBAP-Containers

```

id-Cause,
id-CriticalityDiagnostics,
id-CSGMembershipStatus,
id-HNB-Location-Information,
id-HNB-Identity,
id-Context-ID,
id-PLMNIdentity,
id-UE-Identity,
id-LAC,
id-RAC,
id-SAC,
id-UE-Capabilities,
id-Registration-Cause,
id-CellIdentity,
id-RNC-ID,
id-CSG-ID,
id-HNB-Cell-Access-Mode,
id-BackoffTimer,
id-Service-Area-For-Broadcast,
id-MuxPortNumber

```

FROM HNBAP-Constants;

```

-- *****
--
-- HNB Register REQUEST
--
-- *****

```

HNBRegisterRequest ::= SEQUENCE {

```

    protocolIEs      ProtocolIE-Container    { {HNBRegisterRequestIEs} },
    protocolExtensions ProtocolExtensionContainer { {HNBRegisterRequestExtensions} } OPTIONAL,
    ...
}

HNBRegisterRequestIEs HNBAP-PROTOCOL-IES ::= {
  { ID id-HNB-Identity          CRITICALITY reject  TYPE HNB-Identity          PRESENCE mandatory } |
  { ID id-HNB-Location-Information CRITICALITY reject  TYPE HNB-Location-Information PRESENCE mandatory } |
  { ID id-PLMNIdentity          CRITICALITY reject  TYPE PLMNIdentity          PRESENCE mandatory } |
  { ID id-CellIdentity          CRITICALITY reject  TYPE CellIdentity          PRESENCE mandatory } |
  { ID id-LAC                   CRITICALITY reject  TYPE LAC                   PRESENCE mandatory } |
  { ID id-RAC                   CRITICALITY reject  TYPE RAC                   PRESENCE mandatory } |
  { ID id-SAC                   CRITICALITY reject  TYPE SAC                   PRESENCE mandatory } |
  { ID id-CSG-ID                CRITICALITY reject  TYPE CSG-ID                PRESENCE optional } ,
  ...
}

HNBRegisterRequestExtensions HNBAP-PROTOCOL-EXTENSION ::= {
  { ID id-Service-Area-For-Broadcast CRITICALITY ignore EXTENSION SAC PRESENCE optional } |
  { ID id-HNB-Cell-Access-Mode      CRITICALITY reject  EXTENSION HNB-Cell-Access-Mode PRESENCE optional },
  ...
}

-- *****
--
-- HNB Register Accept
--
-- *****

HNBRegisterAccept ::= SEQUENCE {
  protocolIEs      ProtocolIE-Container    { {HNBRegisterResponseIEs} },
  protocolExtensions ProtocolExtensionContainer { {HNBRegisterResponseExtensions} } OPTIONAL,
  ...
}

HNBRegisterResponseIEs HNBAP-PROTOCOL-IES ::= {
  { ID id-RNC-ID                CRITICALITY reject  TYPE RNC-ID                PRESENCE mandatory },
  ...
}

HNBRegisterResponseExtensions HNBAP-PROTOCOL-EXTENSION ::= {
-- Extension for Release 9 to support CS Multiplexing --
  {ID id-MuxPortNumber          CRITICALITY ignore  EXTENSION MuxPortNumber          PRESENCE optional},
  ...
}

-- *****
--
-- HNB Register REJECT
--
-- *****

HNBRegisterReject ::= SEQUENCE {

```

```

    protocolIEs      ProtocolIE-Container      { {HNBRegisterRejectIEs} },
    protocolExtensions ProtocolExtensionContainer { {HNBRegisterRejectExtensions} } OPTIONAL,
    ...
}

HNBRegisterRejectIEs HNBAP-PROTOCOL-IES ::= {
    { ID id-Cause          CRITICALITY ignore  TYPE Cause          PRESENCE mandatory } |
    { ID id-CriticalityDiagnostics CRITICALITY ignore  TYPE CriticalityDiagnostics PRESENCE optional } |
    { ID id-BackoffTimer    CRITICALITY reject  TYPE BackoffTimer      PRESENCE conditional },
    -- This IE shall be present if the Cause IE is set to "Overload".
    ...
}

HNBRegisterRejectExtensions HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- HNB De- Register
--
-- *****

HNBDe-Register ::= SEQUENCE {
    protocolIEs      ProtocolIE-Container      { {HNBDe-RegisterIEs} },
    protocolExtensions ProtocolExtensionContainer { {HNBDe-RegisterExtensions} } OPTIONAL,
    ...
}

HNBDe-RegisterIEs HNBAP-PROTOCOL-IES ::= {
    { ID id-Cause          CRITICALITY ignore  TYPE Cause          PRESENCE mandatory } |
    { ID id-BackoffTimer    CRITICALITY reject  TYPE BackoffTimer      PRESENCE conditional },
    -- This IE shall be present if the Cause IE is set to "Overload".
    ...
}

HNBDe-RegisterExtensions HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- UE Register REQUEST
--
-- *****

UERegisterRequest ::= SEQUENCE {
    protocolIEs      ProtocolIE-Container      { {UERegisterRequestIEs} },
    protocolExtensions ProtocolExtensionContainer { {UERegisterRequestExtensions} } OPTIONAL,
    ...
}

```

```

UERRegisterRequestIEs HNBAP-PROTOCOL-IES ::= {
  { ID id-UE-Identity          CRITICALITY reject  TYPE UE-Identity          PRESENCE mandatory } |
  { ID id-Registration-Cause   CRITICALITY ignore TYPE Registration-Cause   PRESENCE mandatory } |
  { ID id-UE-Capabilities      CRITICALITY reject  TYPE UE-Capabilities          PRESENCE mandatory },
  ...
}

UERRegisterRequestExtensions HNBAP-PROTOCOL-EXTENSION ::= {
  ...
}

-- *****
--
-- UE Register ACCEPT
--
-- *****

UERRegisterAccept ::= SEQUENCE {
  protocolIEs          ProtocolIE-Container      { {UERRegisterAcceptIEs} },
  protocolExtensions  ProtocolExtensionContainer { {UERRegisterAcceptExtensions} } OPTIONAL,
  ...
}

UERRegisterAcceptIEs HNBAP-PROTOCOL-IES ::= {
  { ID id-UE-Identity          CRITICALITY reject  TYPE UE-Identity          PRESENCE mandatory } |
  { ID id-Context-ID          CRITICALITY ignore   TYPE Context-ID          PRESENCE mandatory },
  ...
}

UERRegisterAcceptExtensions HNBAP-PROTOCOL-EXTENSION ::= {
  { ID id-CSGMembershipStatus  CRITICALITY reject  EXTENSION CSGMembershipStatus  PRESENCE optional },
  ...
}

-- *****
--
-- UE Register REJECT
--
-- *****

UERRegisterReject ::= SEQUENCE {
  protocolIEs          ProtocolIE-Container      { {UERRegisterRejectIEs} },
  protocolExtensions  ProtocolExtensionContainer { {UERRegisterRejectExtensions} } OPTIONAL,
  ...
}

UERRegisterRejectIEs HNBAP-PROTOCOL-IES ::= {
  { ID id-UE-Identity          CRITICALITY reject  TYPE UE-Identity          PRESENCE mandatory } |
  { ID id-Cause                CRITICALITY ignore   TYPE Cause                PRESENCE mandatory } |
  { ID id-CriticalityDiagnostics CRITICALITY ignore   TYPE CriticalityDiagnostics PRESENCE optional },
  ...
}

```

```

UERegisterRejectExtensions HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- UE De-Register
--
-- *****

UEDe-Register ::= SEQUENCE {
    protocolIEs          ProtocolIE-Container    { {UEDe-RegisterIEs} },
    protocolExtensions   ProtocolExtensionContainer { {UEDe-RegisterExtensions} }    OPTIONAL,
    ...
}

UEDe-RegisterIEs HNBAP-PROTOCOL-IES ::= {
    { ID id-Context-ID          CRITICALITY reject  TYPE Context-ID          PRESENCE mandatory } |
    { ID id-Cause              CRITICALITY ignore  TYPE Cause                    PRESENCE mandatory } ,
    ...
}

UEDe-RegisterExtensions HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

-- *****
--
-- ERROR INDICATION
--
-- *****

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

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

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

-- *****
--

```



```

-- PRIVATE MESSAGE
--
-- *****
PrivateMessage ::= SEQUENCE {
    privateIEs      PrivateIE-Container  {{PrivateMessage-IEs}},
    ...
}
PrivateMessage-IEs HNBAP-PRIVATE-IES ::= {
    ...
}
END

```

9.3.4 Information Element Definitions

```

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

HNBAP-IEs {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) hnbap(6) version1 (1) hnbap-IEs (2) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    maxNrOfErrors,
    maxUEs,
    id-HNB-Internet-Information

FROM HNBAP-Constants

    Criticality,
    ProcedureCode,
    ProtocolIE-ID,
    TriggeringMessage
FROM HNBAP-CommonDataTypes

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

--A
Access-stratum-release-indicator ::= ENUMERATED {r99,
rel-4, rel-5, rel-6, rel-7, rel-8,

```

```
        ...}

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

--B
BackoffTimer ::= INTEGER(0..3600)

--C
Cause ::= CHOICE {
    radioNetwork            CauseRadioNetwork,
    transport               CauseTransport,
    protocol                CauseProtocol,
    misc                    CauseMisc,
    ...
}
CauseRadioNetwork ::= ENUMERATED {
    overload,
    unauthorised-Location,
    unauthorised-HNB,
    hNB-parameter-mismatch,
    invalid-UE-identity,
    uE-not-allowed-on-this-HNB,
    uE-unauthorised,
    connection-with-UE-lost,
    ue-RRC-telease,
    hNB-not-registered,
    unspecified,
    normal,
    uE-relocated,
    ue-registered-in-another-HNB,
    ...
}

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,
    ...
}

CellIdentity ::=          BIT STRING (SIZE (28))

Context-ID ::= BIT STRING (SIZE(24))

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

CriticalityDiagnostics-IE-List-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

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

CSG-ID          ::= BIT STRING (SIZE (27))

CSG-Indicator   ::= ENUMERATED {
    csg-capable,
    not-csg-capable,
    ...
}

CSGMembershipStatus ::= ENUMERATED {
    member,
    non-member,
    ...
}

CGI ::= SEQUENCE {
    pLMNidentity      PLMNidentity,

```

```

    LAC                LAC,
    cI                 CI,
    iE-Extensions      ProtocolExtensionContainer { {CGI-ExtIEs} } OPTIONAL
}

CGI-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

CI                ::= OCTET STRING (SIZE (2))

CN-DomainIndicator ::= ENUMERATED {
    cs-domain,
    ps-domain
}
--D
--E
ESN                ::= BIT STRING (SIZE(32))
--F
--G
GeographicalLocation ::= SEQUENCE {
    geographicalCoordinates    GeographicalCoordinates,
    altitudeAndDirection      AltitudeAndDirection,
    iE-Extensions              ProtocolExtensionContainer { { GeographicLocation-ExtIEs} } OPTIONAL,
    ...
}

GeographicLocation-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

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

GeographicalCoordinates-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}
--H

HNB-Cell-Access-Mode ::= ENUMERATED {
    closed,
    hybrid,
    open,
    ...
}

HNB-Location-Information ::= SEQUENCE {

```

```

macroCoverageInfo      MacroCoverageInformation  OPTIONAL,
geographicalCoordinates GeographicalLocation    OPTIONAL,
iE-Extensions          ProtocolExtensionContainer { { HNB-Location-Information-ExtIEs } }  OPTIONAL,
    ...
}

HNB-Location-Information-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
-- Extension for release-8 to support IP address for location verification --
{ID id-HNB-Internet-Information CRITICALITY reject  EXTENSION IP-Address  PRESENCE optional  },
    ...
}

HNB-Identity ::= SEQUENCE {
    hNB-Identity-Info      HNB-Identity-Info,
    iE-Extensions          ProtocolExtensionContainer { { HNB-Identity-ExtIEs } }  OPTIONAL,
    ...
}

HNB-Identity-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

HNB-Identity-Info ::= OCTET STRING (SIZE (1..255))

--I

IMEI ::= BIT STRING (SIZE(60))

IMSI ::= OCTET STRING (SIZE (3..8))
-- Reference: 23.003
IMSIDS41 ::= OCTET STRING (SIZE (5..7))

IMSIESN ::= SEQUENCE {
    iMSIDS41      IMSIDS41,
    eSN           ESN
}

IP-Address ::=SEQUENCE {
    ipaddress      CHOICE {
        ipv4info      Ipv4Address,
        ipv6info      Ipv6Address,
        ...
    },
    iE-Extensions  ProtocolExtensionContainer { { IP-Address-ExtIEs } }  OPTIONAL,
    ...
}

IP-Address-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

```

```

Ipv4Address      ::= OCTET STRING (SIZE (4))
Ipv6Address      ::= OCTET STRING (SIZE (16))

--J
--K
--L
LAC              ::= OCTET STRING(SIZE(2))

LAI              ::= SEQUENCE {
  pLMNID         PLMNidentity,
  lAC            LAC,
  ...
}

-- M

MacroCoverageInformation ::= SEQUENCE {
  cellIdentity      MacroCellID,
  iE-Extensions    ProtocolExtensionContainer { { MacroCoverageInformation-ExtIEs } } OPTIONAL,
  ...
}

MacroCoverageInformation-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
  ...
}

MacroCellID ::= CHOICE {
  uTRANCellID      UTRANCellID,
  gERANCellID      CGI,
  ...
}

MuxPortNumber ::= INTEGER (1024..65535)

--N
--O
--P
PLMNidentity     ::= OCTET STRING (SIZE (3))

PTMSI           ::= BIT STRING (SIZE(32))

PTMSIRAI        ::= SEQUENCE {
  pTMSI          PTMSI,
  rAI            RAI,
  ...
}

--Q

```

```

--R
RAC ::= OCTET STRING(SIZE(1))

RAI ::= SEQUENCE {
    LAI LAI,
    rAC RAC,
    ...
}

Registration-Cause ::= ENUMERATED {
    emergency-call,
    normal,
    ...
}

RNC-ID ::= INTEGER(0..65535)

--S

SAC ::= OCTET STRING(SIZE(2))

--T

TMSILAI ::= SEQUENCE {
    tMSI BIT STRING(SIZE (32)),
    LAI LAI
}

TMSIDS41 ::= OCTET STRING (SIZE (2..17))

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

--U

UE-Capabilities ::= SEQUENCE {
    access-stratum-release-indicator Access-stratum-release-indicator,
    csg-indicator CSG-Indicator,
    IE-Extensions ProtocolExtensionContainer { { UE-Capabilities-ExtIEs } } OPTIONAL,
    ...
}

UE-Capabilities-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
    ...
}

UTRANCellID ::= SEQUENCE {
    LAC LAC,
    rAC RAC,
    pLMNidentity PLMNidentity,
    uTRANcellID CellIdentity,
    IE-Extensions ProtocolExtensionContainer { { UTRANCellID-ExtIEs } } OPTIONAL
}

```

```
UTRANCellID-ExtIEs HNBAP-PROTOCOL-EXTENSION ::= {
  ...
}
```

```
UE-Identity ::= CHOICE {
  IMSI          IMSI,
  tMSILAI       TMSILAI,
  pTMSIRAI      PTMSIRAI,
  iMEI          IMEI,
  eSN           ESN,
  iMSIDS41      IMSIDS41,
  iMSIESN       IMSIESN,
  tMSIDS1       TMSIDS41,
  ...
}
```

```
--V
--W
--X
--Y
--Z
```

```
END
```

9.3.5 Common Definitions

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

HNBAP-CommonDataTypes {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) hnbap(6) version1 (1) hnbap-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)

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

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

END

```

9.3.6 Constant Definitions

```

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

HNBAP-Constants {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) hnbap(6) version1 (1) hnbap-Constants (4) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    ProcedureCode,
    ProtocolIE-ID
FROM HNBAP-CommonDataTypes;

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

```

```

--
id-HNBRegister          ProcedureCode ::= 1
id-HNBDe-Register      ProcedureCode ::= 2
id-UERegister          ProcedureCode ::= 3
id-UEDe-Register       ProcedureCode ::= 4
id-ErrorIndication     ProcedureCode ::= 5
id-privateMessage      ProcedureCode ::= 6

-- *****
--
-- Lists
--
-- *****
maxNrOfErrors          INTEGER ::= 256
maxUEs                 INTEGER ::= 64

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

id-Cause                ProtocolIE-ID ::= 1
id-CriticalityDiagnostics ProtocolIE-ID ::= 2
id-HNB-Identity         ProtocolIE-ID ::= 3
id-Context-ID          ProtocolIE-ID ::= 4
id-UE-Identity         ProtocolIE-ID ::= 5
id-LAC                 ProtocolIE-ID ::= 6
id-RAC                 ProtocolIE-ID ::= 7
id-HNB-Location-Information ProtocolIE-ID ::= 8
id-PLMNIdentity        ProtocolIE-ID ::= 9
id-SAC                 ProtocolIE-ID ::= 10
id-CellIdentity        ProtocolIE-ID ::= 11
id-Registration-Cause  ProtocolIE-ID ::= 12
id-UE-Capabilities     ProtocolIE-ID ::= 13
id-RNC-ID              ProtocolIE-ID ::= 14
id-CSG-ID              ProtocolIE-ID ::= 15
id-BackoffTimer        ProtocolIE-ID ::= 16
id-HNB-Internet-Information ProtocolIE-ID ::= 17
id-HNB-Cell-Access-Mode ProtocolIE-ID ::= 18
id-MuxPortNumber       ProtocolIE-ID ::= 19
id-Service-Area-For-Broadcast ProtocolIE-ID ::= 20
id-CSGMembershipStatus ProtocolIE-ID ::= 21

END

```

9.3.7 Container Definitions

```

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

HNBAP-Containers {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
umts-Access (20) modules (3) hnbap(6) version1 (1) hnbap-Containers (5) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

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

-- *****
--
-- Class Definition for Protocol IEs
--
-- *****

HNBAP-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
--

```

```

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

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

HNBAP-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 {HNBAP-PROTOCOL-IES : IEsSetParam} ::=
    SEQUENCE (SIZE (0..maxProtocolIEs)) OF
        ProtocolIE-Field {{IEsSetParam}}

ProtocolIE-Single-Container {HNBAP-PROTOCOL-IES : IEsSetParam} ::=
    ProtocolIE-Field {{IEsSetParam}}

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

-- *****

```

```

--
-- Container Lists for Protocol IE Containers
--
-- *****
ProtocolIE-ContainerList {INTEGER : lowerBound, INTEGER : upperBound, HNBAP-PROTOCOL-IES : IESSetParam} ::=
  SEQUENCE (SIZE (lowerBound..upperBound)) OF
    ProtocolIE-Container {{IESSetParam}}

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

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

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

-- *****
--
-- Container for Private IEs
--
-- *****

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

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

END

```

9.4 Message Transfer Syntax

HNBAP 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:

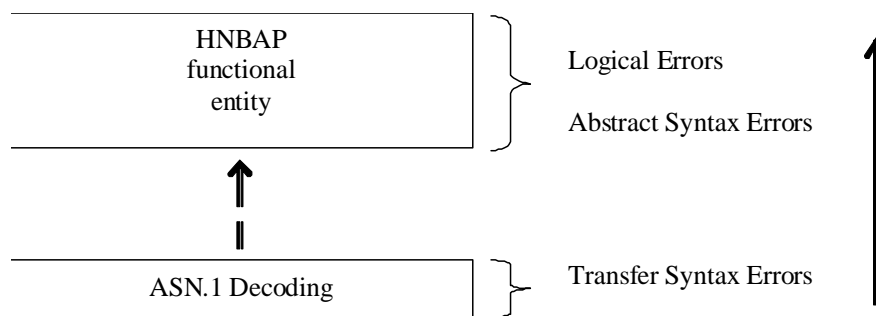


Figure 11: Protocol Errors in HNBAP

The information stated in subclauses 10.2, 10.3 and 10.4, to be included in the message used when reporting an error, is what at minimum shall be included. Other optional information elements within the message may also be included, if available. This is also valid for the case when the reporting is done with a response message. The latter is an exception to what is stated in subclause 4.1.

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 HNBAP 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;
5. receives IEs or IE groups but according to the conditional presence of the concerning object and the specified condition, the IEs or IE groups should not have been present in the received message.

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) and Case 5 (erroneously present conditional IEs or IE groups) result 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 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 cases 4 and 5 is specified in subclause 10.3.6.

10.3.2 Criticality Information

In the HNBAP 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 subclause 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 the receiving entity (some may still remain unsupported).
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, HNBAP 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 HNBAP-PROTOCOL-IES, HNBAP-PROTOCOL-IES-PAIR, HNBAP-PROTOCOL-EXTENSION or HNBAP-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.

When using the Error Indication procedure to reject a procedure or to report an ignored procedure it shall include the *Procedure Code IE*, the *Triggering Message IE*, and the *Procedure Criticality IE* in the *Criticality Diagnostics IE*.

10.3.4.1A Type of Message

When the receiving node cannot decode the *Type of Message IE*, the Error Indication procedure shall be initiated with an appropriate cause value.

10.3.4.2 IEs other than the Procedure Code and Type of Message

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

Reject IE:

- If a message *initiating* a procedure is received containing one or more IEs/IE groups 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 groups using the message normally used to report unsuccessful outcome of the procedure. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the message used to report the unsuccessful outcome of the procedure, the receiving node shall instead terminate the procedure and initiate the Error Indication 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 terminate the procedure and initiate the Error Indication procedure.
- If a *response* message is received containing one or more IEs marked with "*Reject IE*" which the receiving node does not comprehend, the receiving node shall consider the procedure as unsuccessfully terminated and 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. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the response message, the receiving node shall instead terminate the procedure and initiate the Error Indication procedure.
- 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 IE/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.

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 only the understood IEs/IE groups.
- If a *response* message 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.

When reporting not comprehended IEs/IE groups marked with "*Reject IE*" or "*Ignore IE and Notify Sender*" using a response message defined for the procedure, the *Information Element Criticality Diagnostics* IE shall be included in the *Criticality Diagnostics* IE for each reported IE/IE group. In the *Information Element Criticality Diagnostics* IE the *Repetition Number* IE shall be included and in addition, if the not comprehended IE/IE group is not at message hierarchy level 1 (top level; see annex A) also the *Message Structure* IE shall be included.

When reporting not comprehended IEs/IE groups marked with "*Reject IE*" or "*Ignore IE and Notify Sender*" using the Error Indication procedure, the *Procedure Code* IE, the *Triggering Message* IE, *Procedure Criticality* IE, and the *Information Element Criticality Diagnostics* IE shall be included in the *Criticality Diagnostics* IE for each reported IE/IE group. In the *Information Element Criticality Diagnostics* IE the *Repetition Number* IE shall be included and in addition, if the not comprehended IE/IE group is not at message hierarchy level 1 (top level; see annex A) also the *Message Structure* IE shall be included.

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 the present document 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. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the message used to report the unsuccessful outcome of the procedure, the receiving node shall instead terminate the procedure and initiate the Error Indication 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 terminate the procedure and 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 consider the procedure as unsuccessfully terminated and 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 ignore that those IEs are missing and 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. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the response message, the receiving node shall instead terminate the procedure and initiate the Error Indication procedure.
- 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 ignore that those IEs are missing and 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 ignore that those IEs are missing and 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.

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

When reporting missing IEs/IE groups with specified criticality "*Reject IE*" or "*Ignore IE and Notify Sender*" using a response message defined for the procedure, the *Information Element Criticality Diagnostics* IE shall be included in the *Criticality Diagnostics* IE for each reported IE/IE group. In the *Information Element Criticality Diagnostics* IE the *Repetition Number* IE shall be included and in addition, if the missing IE/IE group is not at message hierarchy level 1 (top level; see annex A) also the *Message Structure* IE shall be included.

When reporting missing IEs/IE groups with specified criticality "*Reject IE*" or "*Ignore IE and Notify Sender*" using the Error Indication procedure, the *Procedure Code* IE, the *Triggering Message* IE, *Procedure Criticality* IE, and the *Information Element Criticality Diagnostics* IE shall be included in the *Criticality Diagnostics* IE for each reported IE/IE group. In the *Information Element Criticality Diagnostics* IE the *Repetition Number* IE shall be included and in addition, if the missing IE/IE group is not at message hierarchy level 1 (top level; see annex A) also the *Message Structure* IE shall be included.

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

If a message with IEs or IE groups in wrong order or with too many occurrences is received or if IEs or IE groups with a conditional presence are present when the condition is not met (i.e. erroneously present), 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 or erroneously present, 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. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the message used to report the unsuccessful outcome of the procedure, the receiving node shall instead terminate the procedure and initiate the Error Indication 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 or erroneously present, the receiving node shall terminate the procedure and 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 or erroneously present, the receiving node shall consider the procedure as unsuccessfully terminated and initiate local error handling.

When determining the correct order only the IEs specified in the specification version used by the receiver shall be considered.

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 IE's/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 message to report this unsuccessful outcome, this 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 message to report this unsuccessful outcome, the procedure shall be terminated and 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, the procedure shall be considered as unsuccessfully terminated and local error handling shall be initiated.

Class 2:

Where the logical error occurs in a message of a class 2 procedure, the procedure shall be terminated and 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.

10.5 Exceptions

The error handling for all the cases described hereafter shall take precedence over any other error handling described in the other subclauses of clause 10.

- If any type of error (Transfer Syntax Error, Abstract Syntax Error or Logical Error) is detected in the ERROR INDICATION message, it shall not trigger the Error Indication procedure in the receiving Node but local error handling.
- In case a response message or Error Indication message needs to be returned, but the information necessary to determine the receiver of that message is missing, the procedure shall be considered as unsuccessfully terminated and local error handling shall be initiated.
- If an error that terminates a procedure occurs, the returned cause value shall reflect the error that caused the termination of the procedure even if one or more abstract syntax errors with criticality 'ignore and notify' have earlier occurred within the same procedure.

Annex A (informative): Change History

| TSG # | TSG Doc. | CR | Rev | Subject/Comment | New |
|---------|-----------|------|-----|--|-------|
| 42 | RP-080834 | | | Approved at TSG-RAN42 and placed under change control | 8.0.0 |
| 43 | RP-090244 | 0001 | | Add Object Identifier for HNBAP ASN.1 | 8.1.0 |
| 43 | RP-090081 | 0005 | 1 | Clarification on Uniqueness of Context ID | 8.1.0 |
| 43 | RP-090244 | 0007 | 1 | Update to HNB deregistration cause codes and descriptions | 8.1.0 |
| 43 | RP-090081 | 0008 | 1 | Update to HNB initiated UE deregistration cause code and description | 8.1.0 |
| 43 | RP-090082 | 0009 | 2 | Abnormal condition handling associated with HNB registration | 8.1.0 |
| 43 | RP-090082 | 0012 | 2 | Clarification on access control and inclusion of IMSI for UE registration. | 8.1.0 |
| 43 | RP-090244 | 0013 | 1 | Adding Cause Values for UE Deregistration | 8.1.0 |
| 43 | RP-090244 | 0014 | 1 | Updating of CSG Identity Length | 8.1.0 |
| 43 | RP-090082 | 0016 | 1 | Clarification on the HNB Identity | 8.1.0 |
| 43 | RP-090244 | 0018 | | Correction of wrong reference in TMSI-IE description | 8.1.0 |
| 43 | RP-090082 | 0019 | 2 | CSG-ID optional in HNB register request | 8.1.0 |
| 43 | RP-090082 | 0020 | 1 | Backoff timer for HNB registration | 8.1.0 |
| 44 | RP-090626 | 0022 | 2 | Correction to HNB Identity definition | 8.2.0 |
| 45 | RP-090769 | 0031 | 2 | ASN.1 correction for HNB Location Information IE | 8.3.0 |
| 46 | RP-091184 | 0033 | | Correction to ASN.1 references | 8.4.0 |
| 46 | RP-091184 | 0034 | 1 | Addition of cause value for Invalid UE identity | 8.4.0 |
| 12/2009 | - | - | - | Creation of version 9.0.0 based on version 8.4.0 | 9.0.0 |
| 46 | RP-091191 | 0027 | 4 | CS Mux port exchange | 9.0.0 |
| 46 | RP-091191 | 0030 | 4 | Support for multiple access mode HNBs | 9.0.0 |
| 46 | RP-091191 | 0037 | 1 | Introducing changes for supporting ETWS in Home Node B in 25.469 | 9.0.0 |
| 46 | RP-091191 | 0039 | 1 | Hybrid access signalling during UE and HNB registration | 9.0.0 |

History

| Document history | | |
|-------------------------|--------------|-------------|
| V9.0.0 | January 2010 | Publication |
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