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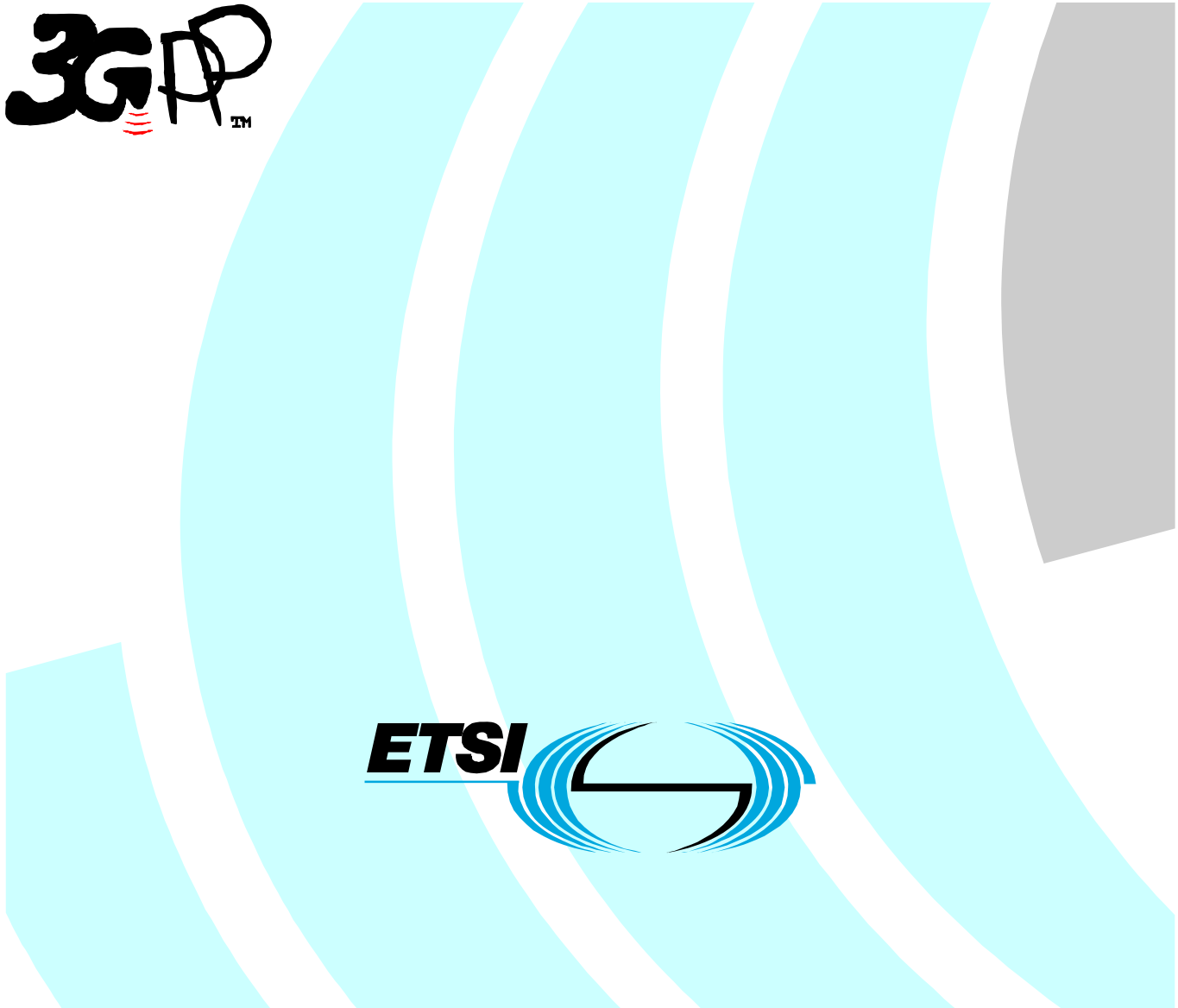
Technical Specification

Universal Mobile Telecommunications System (UMTS);
UTRAN architecture for 3G Home Node B (HNB);
Stage 2
(3GPP TS 25.467 version 9.1.0 Release 9)



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Foreword

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Contents

Foreword

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1 Scope

The present document specifies the UTRAN architecture for 3G Home NodeB (HNB).

It covers specification of the functions for UEs not supporting Closed Subscriber Groups (CSG) and UEs supporting CSGs. It also covers HNB specific requirements for O&M.

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 TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 25.468: "UTRAN Iuh Interface RUA signalling".

[3] 3GPP TS 25.469: " UTRAN Iuh Interface HNBAP signalling ".

[4] 3GPP TS 25.401: "UTRAN overall description".

[5] 3GPP TS 25.410: "UTRAN Iu Interface: general aspects and principles".

[6] IETF RFC 4960 (September 2007): "Stream Control Transmission Protocol".

[7] Broadband Forum TR-069 Amendment 2, *CPE WAN Management Protocol*, Broadband Forum Technical Report, 2007.

[8] 3GPP TS 25.444: 'Iuh data transport and transport signalling'

[9] 3GPP TS 25.413: "UTRAN Iu Interface RANAP Signalling".

[10] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service Description; Stage 2".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Home NodeB, 3G Home NodeB: These terms, their derivations and abbreviations are used synonymously throughout this document.

CSG HNB: A HNB that is a CSG Cell broadcasting a CSG Indicator and a specific CSG identity.

Non CSG HNB: A HNB that does not broadcast either a CSG Indicator or a CSG Identity.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

CSG	Closed Subscriber Group
DSL	Digital Subcriber Line
DSL-GW	DSL GateWayGNSSGlobal Navigation Satellite System
GPS	Global Positioning System
HMS	Home NodeB Management System
HNB	3G Home NodeB
HNB-GW	3G HNB Gateway
HW	Hard Ware
IP	Internet Protocol
LAC	Local Area Code
RAC	Routing Area Code
RGW	Residential GateWay
SAC	Service Area Code
SeGW	Security GateWay
SW	SoftWare

4 Overall architecture

4.1 General

The overall UMTS architecture and UTRAN architectures are described in 25.401 and 25.410. For clarity and ease of understanding, at appropriate places references to TR-069 and associated methods are described briefly although they are beyond the scope of this specification.

The reference model shown in Figure 4.1-1 below contains the network elements that make up the HNB access network. There is one-to-many relationship between HNB-GW and HNB(s).

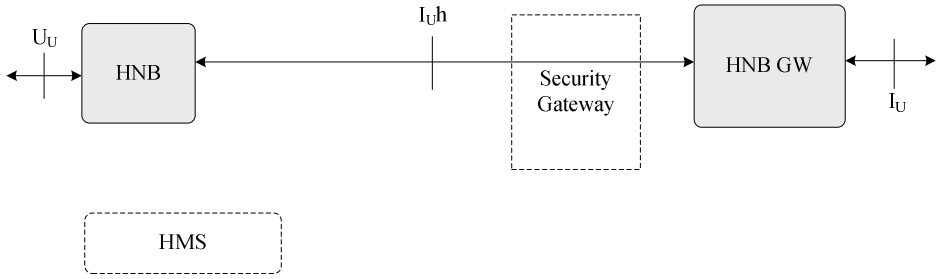


Figure 4.1-1. Iuh reference model.

The HNB GW serves the purpose of a RNC presenting itself to the CN as a concentrator of HNB connections. The Iu interface between the CN and the HNB-GW serves the same purpose as the interface between the CN and a RNC. One HNB serves only one cell.

NOTE: The Security gateway is a logically separated entity and may be implemented either as a separate physical element or integrated into, for example, a HNB-GW.

The HNB access network includes the functional entities as shown in Figure 4.1-1 and detailed below.

4.1.1 HNB Management System (HMS)

- Based on TR-069 family of standards [7]
- Facilitates HNB-GW discovery
- Provisions configuration data to the HNB
- Performs Location verification of HNB and assigns appropriate serving elements (HMS, Security Gateway and HNB-GW).

4.1.2 Security Gateway (SeGW)

- Terminates Secure tunnelling for TR-069 [7] as well as Iuh
- Authentication of HNB
- Provides the HNB with access to the HMS and HNB-GW

4.1.3 HNB Gateway (HNB-GW)

- Terminates Iuh from HNB. Appears as an RNC to the existing Core network using existing Iu interface.
- Supports HNB registration and UE registration over Iuh.

4.1.4 HNB

- Customer Premise Equipment that offers the Uu Interface to the UE
- Provides RAN connectivity using the Iuh interface
- Supports RNC like functions, the details of which are captured in table 4.2-1 below
- Supports HNB registration and UE registration over Iuh.

4.2 Functional split

The UTRAN functions in the HNB are supported by RANAP, whereas the HNB specific functions are supported by the Home NodeB Application Protocol (HNBAP) between the HNB and the HNB GW. The HNB GW provides a concentration function for the control plane and may provide a concentration function for the user plane.

This sub-clause defines the functional split between the core network and the UMTS radio access network. The functional split is shown in table 4.2-1 and 4.2-2

Table 4.2-1. Functional split for UTRAN function in the HNB access.

Function	HNB	HNB GW	CN
RAB management functions:			
RAB establishment, modification and release	X	FFS	X
RAB characteristics mapping I_u transmission bearers	X	X	
RAB characteristics mapping U_u bearers	X		
RAB queuing, pre-emption and priority	X		X
Radio Resource Management functions:			
Radio Resource admission control	X		
Broadcast Information	X	X Note 5	X
Iu link Management functions:			
Iu signalling link management	X	X	X
ATM VC management		X	X
AAL2 establish and release		X	X
AAL5 management		X	X
GTP-U Tunnels management	X	X	X
TCP Management	X (FFS)	(X) Note 1	X
Buffer Management	X	X	
Iu U-plane (RNL) Management:			
Iu U-plane frame protocol management			X
Iu U-plane frame protocol initialization	X		
Mobility management functions:			
Location information reporting	X		X
Handover and Relocation			
Inter RNC hard HO, Iur not used or not available	X	FFS Note 3	X
Serving RNS Relocation (intra/inter MSC)	X (FFS)		X
Inter system hard HO (UMTS-GSM)	X	FFS Note 3	X
Inter system Change (UMTS-GSM)	X	FFS	X
Paging Triggering	X		X
Paging Optimization		X	
GERAN System Information Retrieval	X		X
Security Functions:			
Data confidentiality			
Radio interface ciphering	X		
Ciphering key management			X
User identity confidentiality	X		X
Data integrity			
Integrity checking	X		
Integrity key management			X
Service and Network Access functions:			
CN Signalling data	X		X
Data Volume Reporting	X		
UE Tracing	X		X
Location reporting	X	FFS Note 2	X
Iu Co-ordination functions:			
Paging co-ordination	X		X
NAS Node Selection Function		X	
MOCN Rerouting Function		X Note 3	X

Note 1: If TCP is terminated for Iu-BC in the HNB GW
Note 2: Whether it is possible (and may be necessary) to provide location information from the HNB GW (e.g. GW may have logic to derive location based on the public IP address of the HNB GW, etc). is FFS
Note 3: Support for relocation from the macro network to HNB is FFS.
Note 4: Support for MOCN feature is FFS.
Note 5: HNB GW is able to perform the filtering of SABP messages i.e. determines from the SAI list to which HNB the SABP message needs to be sent and then distributes the SABP messages to the appropriate HNBs. This is an optional function in HNB GW.

Table 4.2-2. Functional split for HNB function in the HNB access.

Function	HNB	HNB GW	CN
HNB Registration Note 1			
HNB Registration Function	X	X	
HNB-GW Discovery Function	X		
HNB de-registration Function	X	X	
UE Registration for HNB Note 1			
UE Registration Function for HNB	X	X	
UE de-registration Function for HNB	X	X	
Iuh user-plane Management functions			
Iuh User plane transport bearer handling	X	X	
Functions for multiplexing CS user plane on the Uplink	X	X	
Enhanced Interference Management			
Mitigation of Interference from HNB to Macro	X		
UE Access Control			
IDLE mode access control	XNote2	X	X
Connected mode Access Control (inbound relocation to HNB cells)		X	X
CSG ID validation	X	X	
Note 1: Protocol support for this group of functions is provided by the HNB Application Protocol. Note 2: Access control at the HNB is optional.			

5 UTRAN functions for HNB access

5.1 UE Registration

5.1.1 General

The UE Registration Function for HNB 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 informs the HNB-GW of the specific HNB where the UE is located.

The following sections illustrate the case when the HNB registers a specific UE with the HNB-GW. The registration is triggered when the UE attempts to access the HNB via an initial NAS message (e.g.., Location Updating Request) and there is no context in the HNB allocated for that UE.

5.1.2 UE Registration: case of non CSG UEs or non CSG HNBs

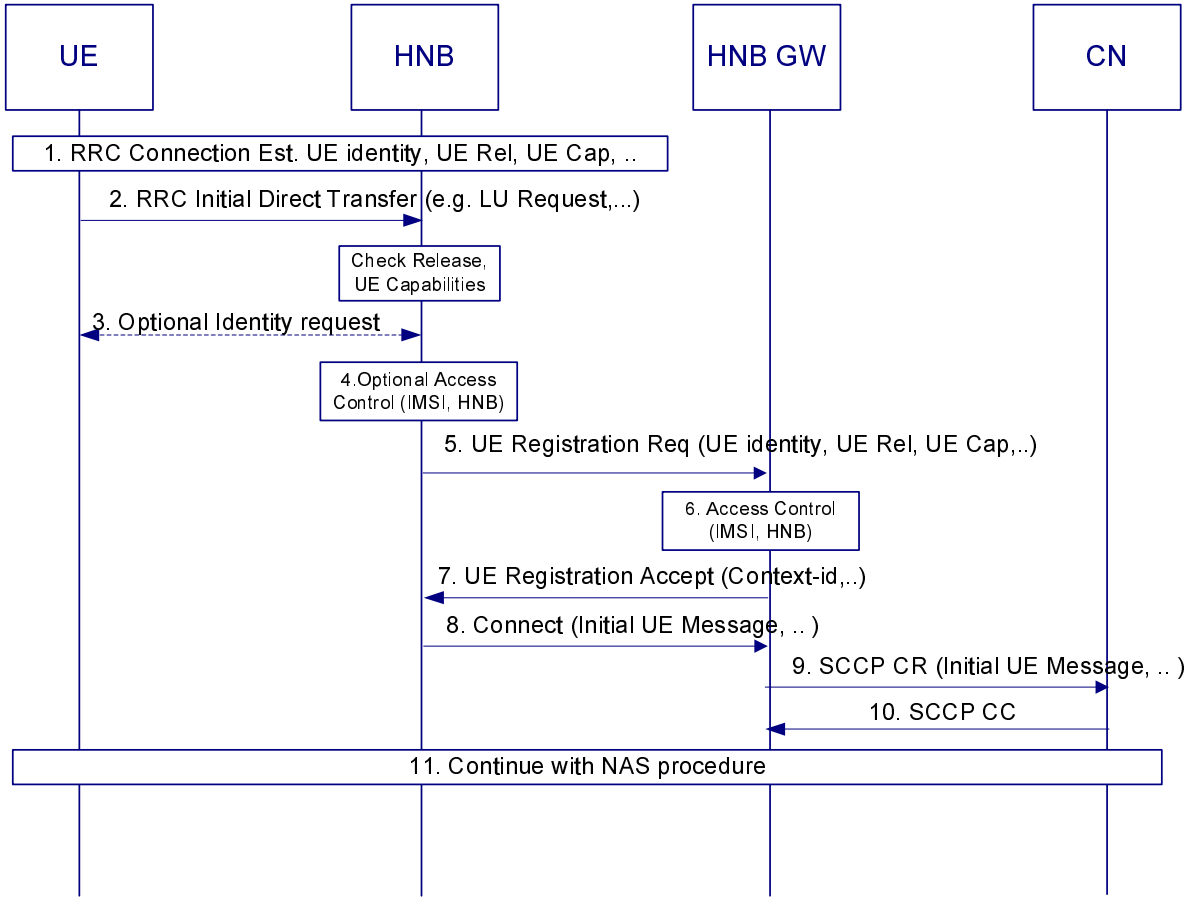


Figure 5.1.2-1. UE Registration for non CSG UEs or non CSG HNBs.

1. Upon camping on the HNB, the UE initiates an initial NAS procedure (e.g. LU Procedure) by establishing an RRC connection with the HNB. UE identity, UE capabilities, e.g. "Access stratum release indicator" or 'UE feature capability indicator' (FFS) and Establishment Cause, are reported to the HNB as part of the RRC Connection establishment procedure.

2. The UE then transmits a RRC Initial Direct Transfer message carrying the initial NAS message (e.g. Location Updating Request message) with some form of UE identity .

3. The HNB checks the UE capabilities provided in step 1, and if these indicate that CSG is not supported, or the HNB itself does not support CSG, and if the identity of the UE (provided during RRC Connection Establishment) is unknown at the HNB being accessed, i.e. no Context id exists for the UE, the HNB initiates UE registration towards the HNB-GW (step 5-7). Before starting the UE Registration procedure, the HNB triggers the Identification procedure (step 3) asking the UE for its IMSI, unless that identity has not been provided during the RRC Connection Establishment or unless it is an emergency call. If the HNB has a context id for the UE, the UE registration procedure is not performed nor is the Identification procedure.

4. The HNB may optionally perform access control based on the provided IMSI and the provided access control list

5. The HNB attempts to register the UE on the HNB-GW by transmitting the UE REGISTER REQUEST. The message contains at a minimum:

   - **UE Identity**: a unique identity for the UE provided in step 1 or 3.

   - **UE Capabilities**: derived from that provided in step 1.

   - **Registration Cause**: the indication about a UE registration for an emergency call.

NOTE: The UE Identity provided in the HNBAP UE REGISTER REQUEST message is unauthenticated.

6. The HNB-GW checks the UE capabilities and the Registration Cause. If these indicate that CSG is not supported and that it is not an Emergency Call, or if the HNB does not support CSG, the HNB-GW shall perform access control (step 6) for the particular UE attempting to utilize the specific HNB.

7. If the HNB-GW accepts the UE registration attempt it shall allocate a context-id for the UE and respond with an HNBAP UE REGISTER ACCEPT message, including the context-id, to the HNB. If the HNB-GW chooses not to accept the incoming UE registration request then the HNB-GW shall respond with an HNBAP UE REGISTER REJECT message. The HNB behaviour for reject handling shall further be determined by the cause specified in the HNBAP UE REGISTER REJECT message (FFS).

8. The HNB then sends an RUA CONNECT message containing the RANAP Initial UE message.

9. The reception of the RUA CONNECT message at the HNB-GW triggers the setup of an SCCP connection by the HNB-GW towards the CN. The HNB-GW then forwards the RANAP Initial UE Message to the CN.

10. The CN responds with an SCCP Connection Confirm message.

10a. The HNB-GW shall additionally utilize a CN assisted method if available (e.g. using IMSI provided in the COMMON ID message), to alleviate the security risks associated with spoofing of IMSI and can subsequently trigger a UE deregistration upon detection of such an event.

11. The UE continues with the NAS procedure (e.g. Location Updating procedure) towards the CN, via the HNB and the HNB-GW.

5.1.3 UE Registration: case of CSG UEs and CSG or Hybrid HNBs

This call flow assumes that the Core Network is able to perform access control on the basis of Closed Subscriber Groups.

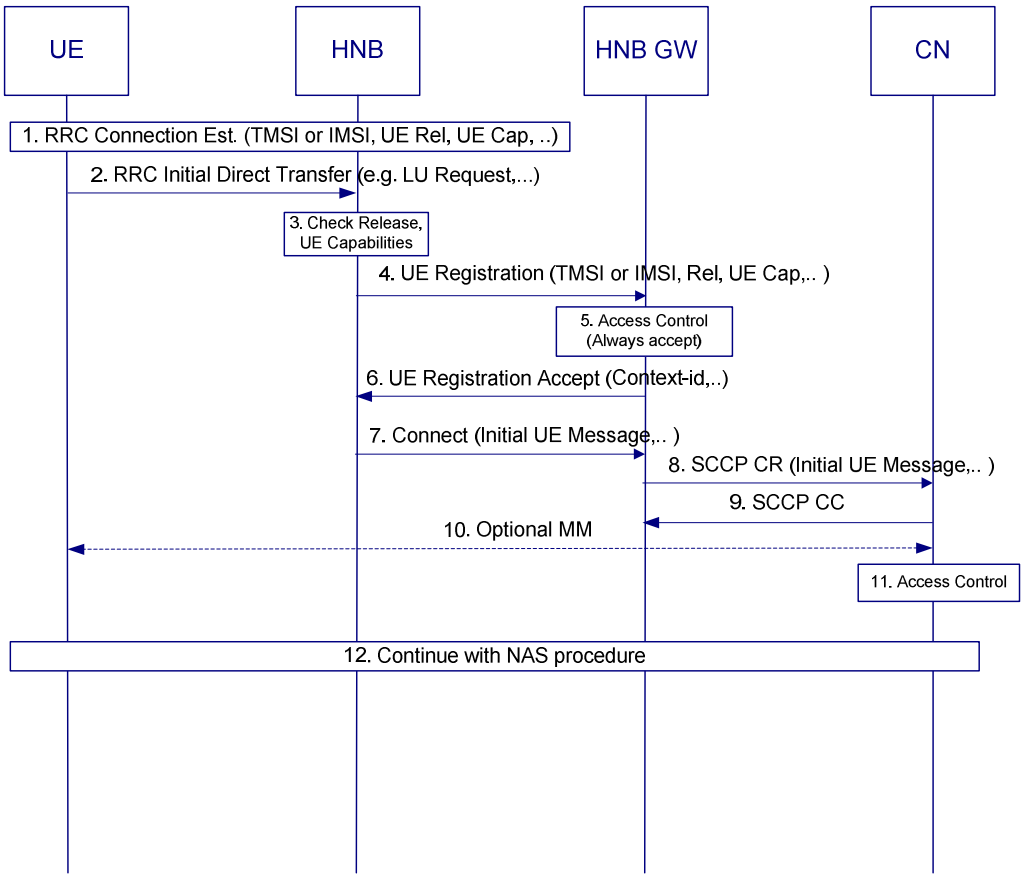


Figure 5.1.3-1. UE Registration for CSG UEs and CSG HNBs.

1. Upon camping on the HNB, the UE initiates an initial NAS procedure (e.g. LU Procedure) by establishing an RRC connection with the HNB. UE identity and UE capabilities, e.g. "Access stratum release indicator" or 'UE

feature capability indicator' (FFS), are reported to the HNB as part of the RRC Connection establishment procedure.

2. The UE then transmits a RRC Initial Direct Transfer message carrying the initial NAS message (e.g. Location Updating Request message) with some form of identity (e.g. IMSI or TMSI, ..).

3. The HNB checks the UE capabilities provided in step 1, and if these indicate that CSG is supported and if the identity of the UE (provided during RRC Connection Establishment) is unknown at the HNB being accessed, i.e. no Context id exist for the UE, the HNB initiates UE registration towards the HNB-GW (steps 4-6). If the HNB has a context id for the UE, UE registration procedure is not performed. No Identification procedure is triggered, independent of the identity reported by the UE during the RRC Connection Establishment.

4. The HNB attempts to register the UE on the HNB-GW by transmitting the UE REGISTER REQUEST. The message contains:

   - **UE Identity**: a unique identifier for the UE and provided in step 1.

   - UE capabilities: derived from that provided in step 1.

   - **Registration Cause**: the indication about a UE registration for an emergency call.

NOTE: The UE IMSI/TMSI provided in the UE REGISTER message is unauthenticated.

5. The HNB-GW checks UE capabilities and if these indicate that CSG is supported and if the HNB supports CSG, the HNB-GW shall accept the UE registration and allocate a context-id for the UE.

6. The HNB-GW responds with a UE REGISTER ACCEPT message back to the HNB including a context-id allocated to the UE

7. The HNB then sends a RUA CONNECT message containing the RANAP Initial UE message. The RANAP Initial UE message may contain the Cell Access Mode.

8. The reception of the RUACONNECT message at the HNB-GW triggers the setup of an SCCP connection by the HNB-GW towards the CN. The HNB-GW then forwards the Initial UE Message including the CSG id of the HNB.

9. The CN responds with an SCCP Connection Confirm message.

10. The CN may optionally perform Mobility Management procedures, e.g. Authentication procedure.

11. The CN performs access control of the UE.

12. After being granted access the UE then continues with the NAS procedure (e.g. Location Updating procedure) towards the CN, via the HNB and the HNB-GW. During such procedures the CN may send to the HNB the UE membership status for the accessed cell in the COMMON ID message.

5.1.4 HNB-GW triggered UE Registration

The following section describes the mechanism, which is used to manage UE registration and associated context IDs for the scenarios based on HNB-GW triggered setup of UE-associated Signaling Connection.

In this mechanism, the RUA Connect message is used for transporting the first RANAP message resulting in network triggered setup of UE-associated Signaling Connection (e.g. RANAP Relocation Request).

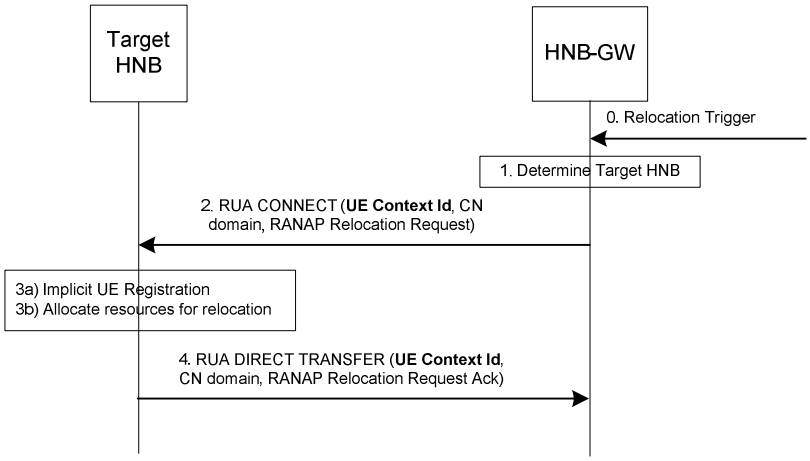


Figure 5.4.1-1. HNB-GW Triggered UE Registration

The above call flow assumes that the HNB-GW receives a trigger for inbound relocation for a UE (e.g. RANAP Relocation Request message from the CN) as shown in step 0.

1. The HNB-GW receives a RANAP message and determines the target HNB

2. The HNB-GW sends the RANAP message encapsulated in the RUA Connect message to the target HNB. The RUA Connect Message may contain the *CSG Membership Status* IE

3. The HNB-GW and the target HNB perform an implicit registration (i.e. HNB-GW establishes a UE specific Context Identifier to be used between the HNB and the HNB-GW) for the incoming UE session. The HNB also allocates the appropriate resource for handling the request in the RANAP message.

4. The RANAP reply message from the HNB to the HNB-GW is encapsulated in the RUA *Direct Transfer* message.

5.2 HNB Registration

5.2.1 General

The following section illustrates the case when the HNB registers with the HNB-GW. The HNB registration procedure serves the following purposes:

- It informs the HNB-GW that a HNB is now available at a particular IP address.

5.2.2 HNB Registration procedure

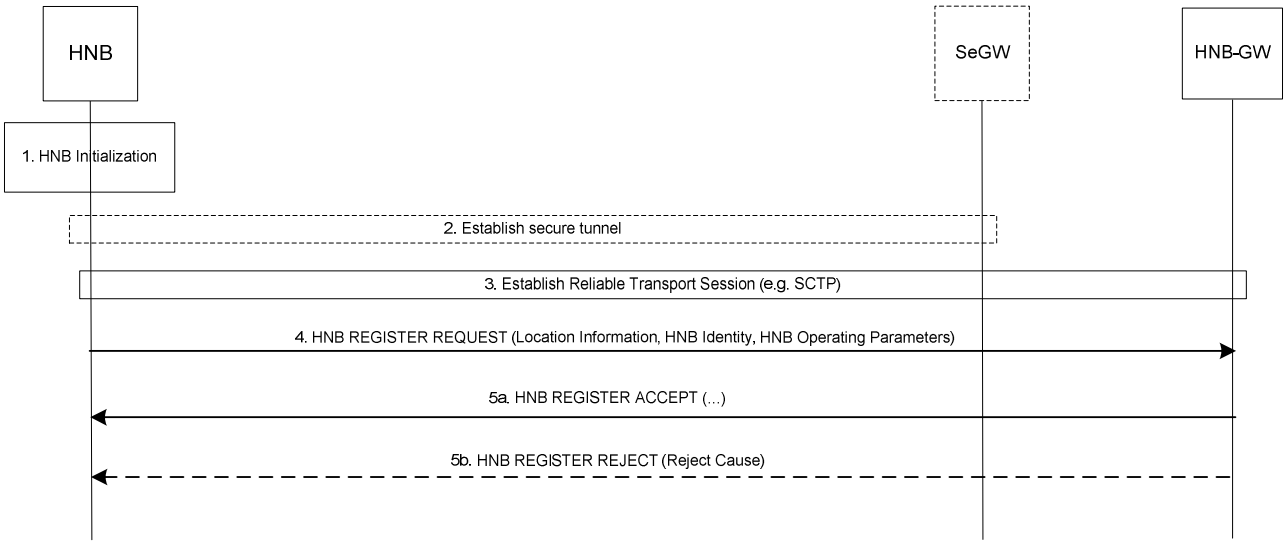


Figure 5.2.2-1. HNB Registration procedure.

1. HNB initialization is performed to obtain HNB configuration from the HNB Management System (HMS). Similarly, HNB-GW discovery is performed to obtain the initial serving HNB-GW information.

2. The HNB establishes a secure tunnel to the SeGW of the serving HNB-GW.

NOTE: This step may be omitted if the secure tunnel happens to be the same tunnel that is already established to contact the HMS.

3. The HNB sets up an SCTP transport session to a well-defined port on the serving HNB-GW.

4. The HNB then attempts to register with the serving HNB-GW using an HNB REGISTER REQUEST message. The message contains:

   a. **HNB Location Information**: The HNB provides location information via use of one or more of the following mechanisms:

      i. detected macro-cell coverage information (e.g. GERAN and/or UTRAN cell information)

      ii. geographical co-ordinates (e.g. via use of GPS, etc)

      iii. Internet connectivity information (e.g. IP address), provided, the resulting location information is at least as accurate as location determination based on macro-cell coverage information, whether or not there is macro cell-coverage available at the location of the HNB (e.g. as determined by point i above).

   b. **HNB Identity**: the HNB has a globally unique and permanent identity.

   c. **HNB Operating Parameters**: Such as the selected LAC, RAC, SAC, PLMN Id, Cell Id, etc.

5a. The HNB-GW may use the information from the HNB REGISTER REQUEST message to perform access control of the HNB (e.g. whether a particular HNB is allowed to operate in a given location, etc). If the HNB-GW accepts the registration attempt it shall respond with a HNB REGISTER ACCEPT message. If the HNB-GW has capability to de-multiplex, the HNB-GW may include a mux port in the HNB REGISTER ACCEPT message.

5b. Alternatively, the HNB-GW may reject the registration request (e.g. due to network congestion, blacklisted HNB, unauthorized HNB location, etc). In this case, the HNB-GW shall respond with an HNB REGISTER REJECT indicating the reject cause.

NOTE: The HNB shall start broadcasting only after successful registration with the HNB-GW.

5.3 HNB-GW Discovery Function

5.3.1 General

The HNB-GW Discovery Function provides the means to determine the address of the Serving HNB-GW for a particular HNB. The HNB will use the Serving HNB GW address to register with the Serving HNB-GW.

5.4 HNB de-registration Function

5.4.1 General

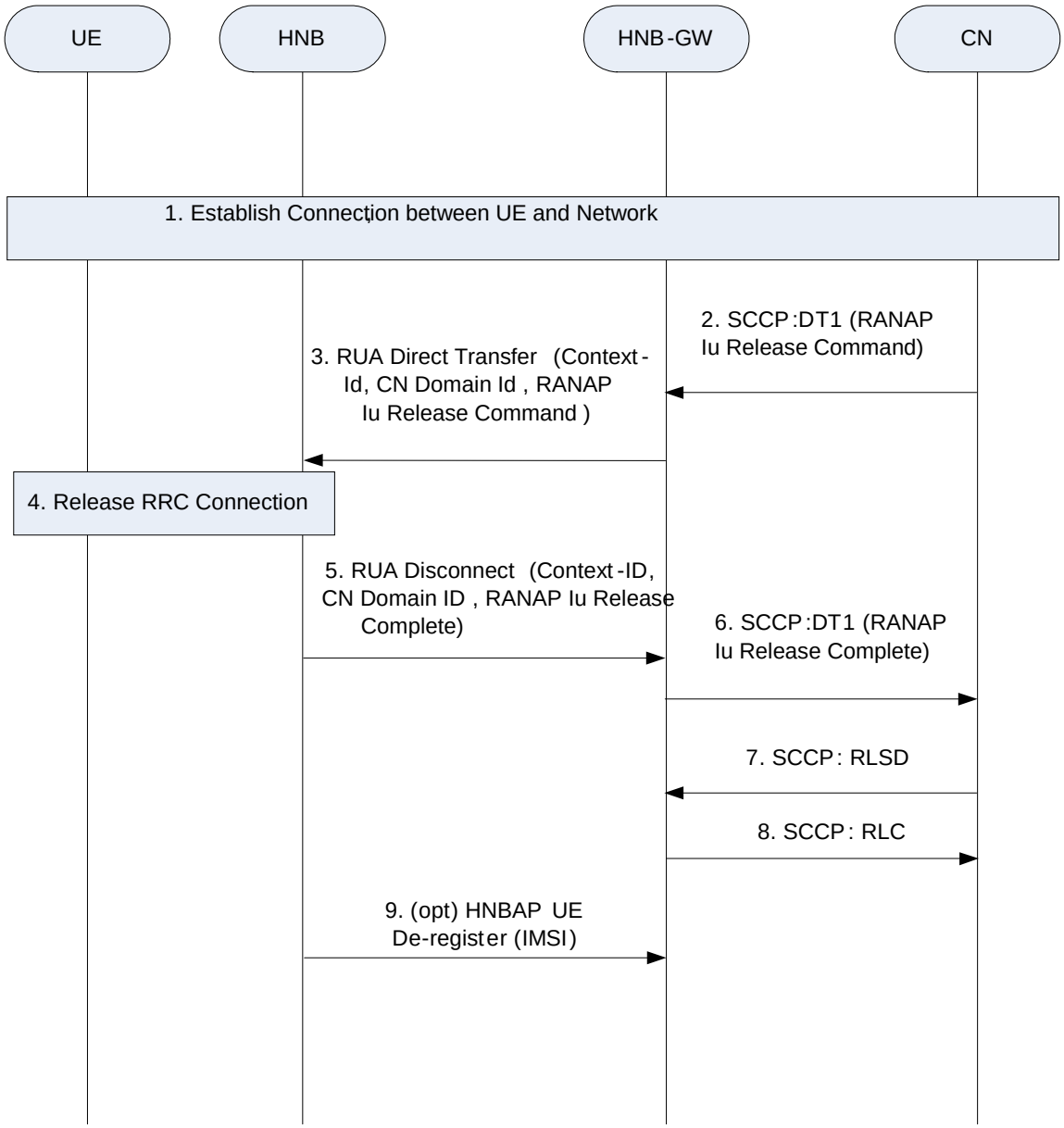
The HNB de-registration Function provides the means to terminate the HNB operation. The HNB de-registration can be initiated by either the HNB or the HNB-GW.

5.5 Iuh Disconnect

5.5.1 General

The following section illustrates the scenario where an UE-associated signaling connection is released across the Iuh. In this scenario the HNB is responsible for initiating the release of the UE-associated signaling connection via the RUA disconnect message. The HNB-GW is then responsible for co-ordinating the release of the UE-associated signaling connection with the corresponding Iu connection, which will be triggered by the CN.

5.5.2 Iuh Disconnect procedure



1. Establish connection between UE and network. Procedure in Section 5.1.
2. CN sends a RANAP Release Iu connection command message to the HNB-GW
3. HNB-GW forwards this message to the relevant HNB
4. HNB triggers the release of the RRC connection to the UE. In this case a single Iu connection had been established for the UE
5. HNB sends a Disconnect message to the HNB-GW to indicate that this is the end of this particular UE-associated signaling connection and includes the RANAP Release Iu Connection Complete message.
6. HNB-GW forwards the RANAP message onto the CN.
7. CN triggers the release of the associated SCCP connection
8. HNB-GW confirms that the SCCP connection is released
9. Optionally the HNB can de-register the UE context from the HNB-GW.

5.6 Paging Optimization Function

5.6.1 General

The paging optimization function provides the means to decrease the impact of a paging load over Iuh (for example, via the use of knowledge about the UE Registration or its CSG Id List in the PAGING message).

5.7 HNB to HNB Mobility

5.7.1 General

The following sub-sections describe the mechanism for handling the intra HNB-GW intra CSG mobility signaling that is HNB-GW coordinated. Specifically the mechanism reuses RANAP messages to signal relocation between the source HNB and the target HNB via the HNB-GW. The RANAP messages are exchanged over the Iuh interface from the source HNB to the HNB-GW and from the HNB-GW to the target HNB using appropriate RUA encapsulation.

5.7.2 Connected mode mobility from one HNB to another HNB (Intra HNB-GW, Intra CSG)

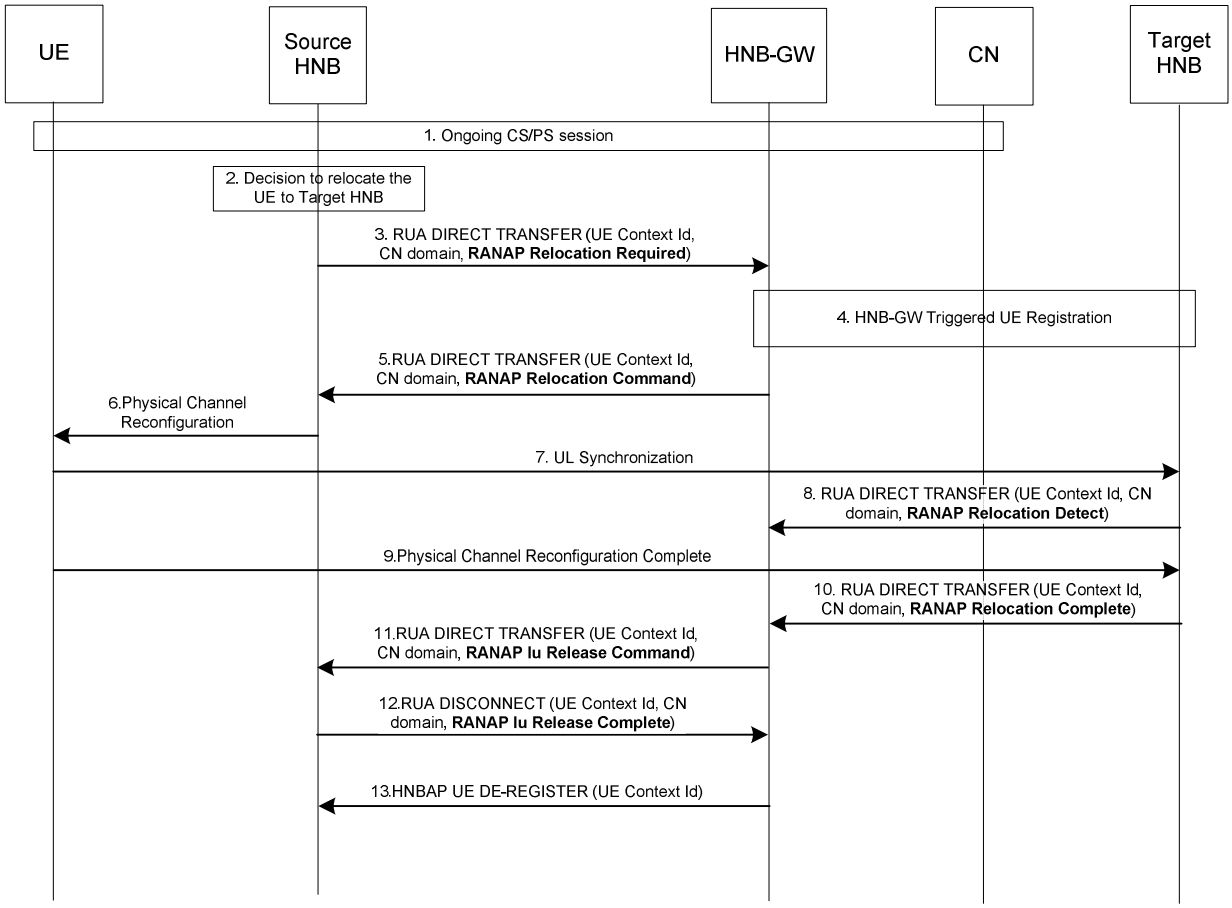


Figure 5.7.2-1: Intra HNB-GW Connected mode mobility between HNBs

1. The UE has established an active CS/PS session to the CN via the source HNB and HNB-GW.

2. At some point, the source HNB makes a decision to relocate the UE session.

3. The source HNB triggers relocation of the UE session by sending the RANAP *Relocation Required* message encapsulated in the RUA *Direct Transfer* message to the HNB-GW. The target RNC-Id and target Cell-Identity

information along with relocation information are included by the source HNB in the RANAP *Relocation Required* message.

4. Steps for

HNB-GW Triggered UE Registration are executed between the HNB-GW and the HNB.

5. The HNB-GW constructs the appropriate RANAP *Relocation Command* message and routes the RANAP message encapsulated in the RUA *Direct Transfer* message to the source HNB.

6-10. the rest of the relocation procedure continues as shown in the corresponding steps in the above figure.

11. The HNB-GW upon getting an indication that the UE has been successfully relocated to the target HNB triggers the Iu release procedure towards the source HNB by sending a RUA encapsulated RANAP *Iu Release Command* message.

12. The source HNB acknowledges the Iu release procedure to the HNB-GW by sending a RUA encapsulated RANAP *Iu Release Complete* message.

Note: Steps 2 to 12, as appropriate, are repeated for the second CN domain when present with the following exception. There is only one Context Id allocated to the UE regardless of the number of signaling domains relocated.

13. The HNB-GW deregisters the UE from the source HNB. The source HNB releases the resources assigned to the UE and deletes all stored context information associated with the UE.

5.8 CS user plane multiplexing

If the HNB-GW had signalled on the HNB REGISTER ACCEPT a mux port and if the HNB has capability to support CS user plane multiplexing, the HNB may send the multiplexed packets to the mux port at the HNB-GW.

The HNB, for the same UE, shall not send multiplexed packets over multiple ports. i.e, once the HNB chooses to multiplex CS user plane packets for a given UE on the uplink, it shall send those multiplexed packets only to the assigned mux port on the HNB-GW. For those UEs whose CS user plane packets are not being multiplexed, the HNB shall send packets only to the port number assigned via RAB assignment request.

When the HNB-GW receives multiplexed packet, it shall de-multiplex before sending them to the CN.

5.9 Inbound Mobility to HNB

5.9.1 General

The following sub-sections describe the mechanism for handling the inbound mobility to HNB.

5.9.2 Connected Mode Inbound Mobility for CSG UEs to CSG HNBs or to Hybrid Cells

The following figure and accompanying steps describe the inbound mobility procedure for Rel-9 CSG UEs, when the Source RAN supplies to the Core Network a CSG id associated with the target HNB. The following is assumed:

- UE is Rel-9 CSG capable and SIB-reading capable.
- UE is able to provide in the RRC measurement report the cell identity and the CSG-Id (if requested) of the target HNB.
- The Source RAN is able to determine the Cell Access Mode of the target HNB.
- Core network is Release-9 CSG capable and is able to perform CSG membership verification for relocated CSG UE.
- The HNB-GW is able to route the incoming relocation to the appropriate target HNB using the target cell identity provided in RANAP RELOCATION REQUEST (i.e. Target Cell Id is unique for a HNB in a given HNB-GW)

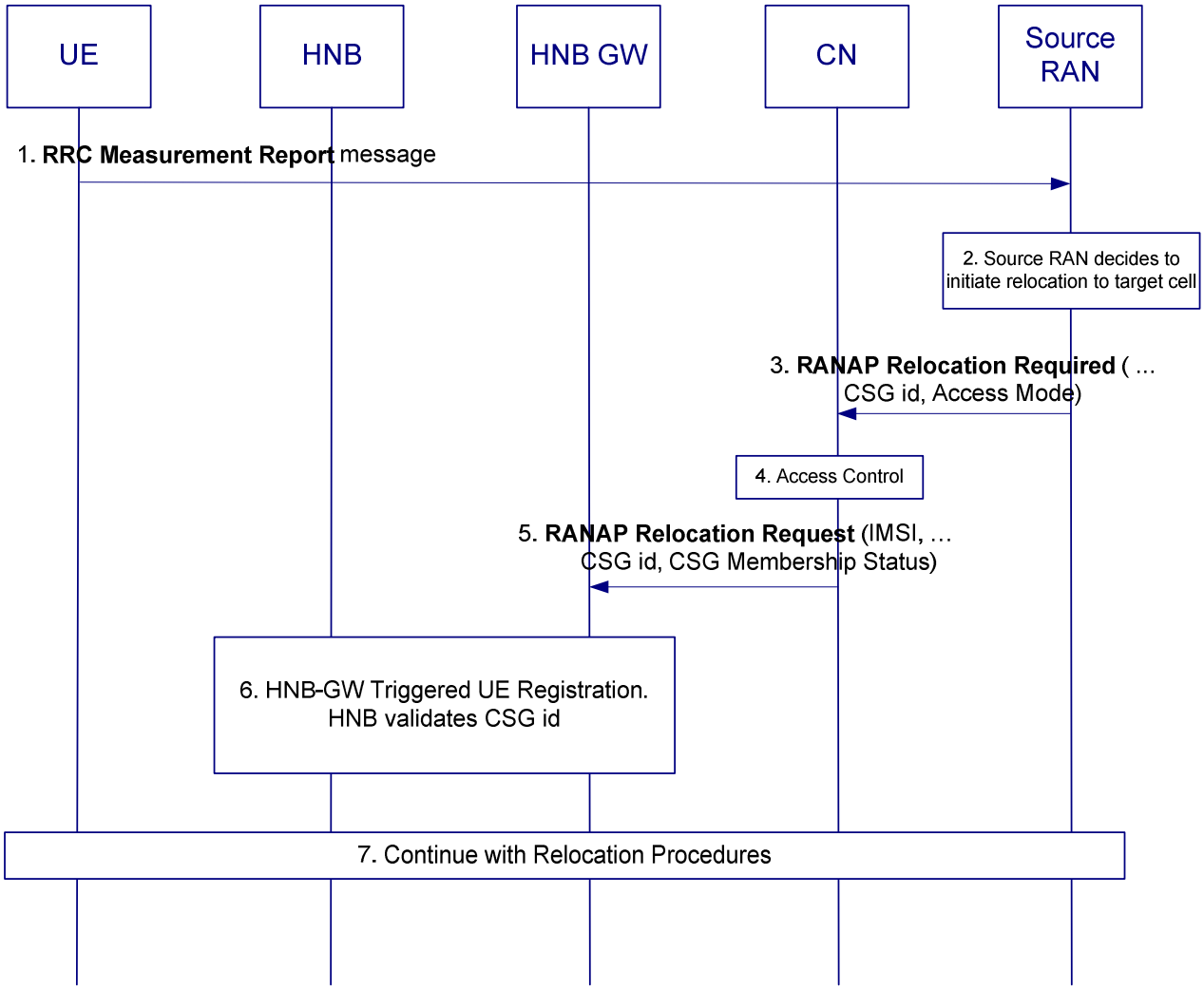


Figure 5.9.2-1: Connected Mode inbound mobility for CSG UEs to CSG HNB or Hybrid Cell

1. The UE is triggered to send an RRC Measurement Report by the rules set by the UTRAN. The Measurement Report includes the Cell Identity, CSG id (if requested) of the target HNB.

2. The Source RAN node makes a decision to relocate the UE session.

3. The source RAN triggers relocation of the UE session by sending the RANAP RELOCATION REQUIRED message to the Core Network. The target RNC-Id, CSG id, Target Cell Id and – for relocation to a hybrid cell –Cell Access Mode information along with relocation information are included by the source RAN in the RANAP RELOCATION REQUIRED message.

4. If the target cell is a CSG HNB, the Core Network verifies that the UE is indeed a member of the CSG associated with the target cell, as reported to the Core Network [x1]. Otherwise (if the target is a Hybrid Cell), the Core Network fills the *CSG Membership Status* IE in step 5 to reflect the UE"s membership to the CSG.

5. The HNB-GW receives a RANAP RELOCATION REQUEST message from the Core Network, including the CSG id, Target Cell Id and – for relocation to a hybrid cell – CSG Membership Status.

6. The steps for HNB-GW Triggered UE Registration are executed between the HNB-GW and the HNB. The HNB-GW/HNB validate the CSG id received in the RANAP RELOCATION REQUEST message.

7. The remainder of the relocation procedure continues normally as documented in [9], [10]

Note: Steps 2 to 7, as appropriate, are repeated for the second CN domain when present with the following exceptions. The relocation of the 2nd domain shall not trigger an additional registration. The 2nd RANAP Relocation Request shall

be carried as RUA Direct Transfer. There is only one Context Id assigned to the UE regardless of the number of domains relocated from the source RAN.

5.9.3 Connected Mode Inbound Mobility for non-CSG UEs to CSG HNBs or to Hybrid Cells

The following figure and accomanying steps describe the inbound mobility procedure for non-CSG UEs, when the Source RAN is able to identify the target HNB. The following is assumed:

- UE is non-CSG capable not able to read SIBs for CSG inbound mobility purposes.
- The HNB-GW is able to perform CSG membership verification for the UE.
- The HNB-GW is able to route the incoming relocation to the appropriate target HNB.

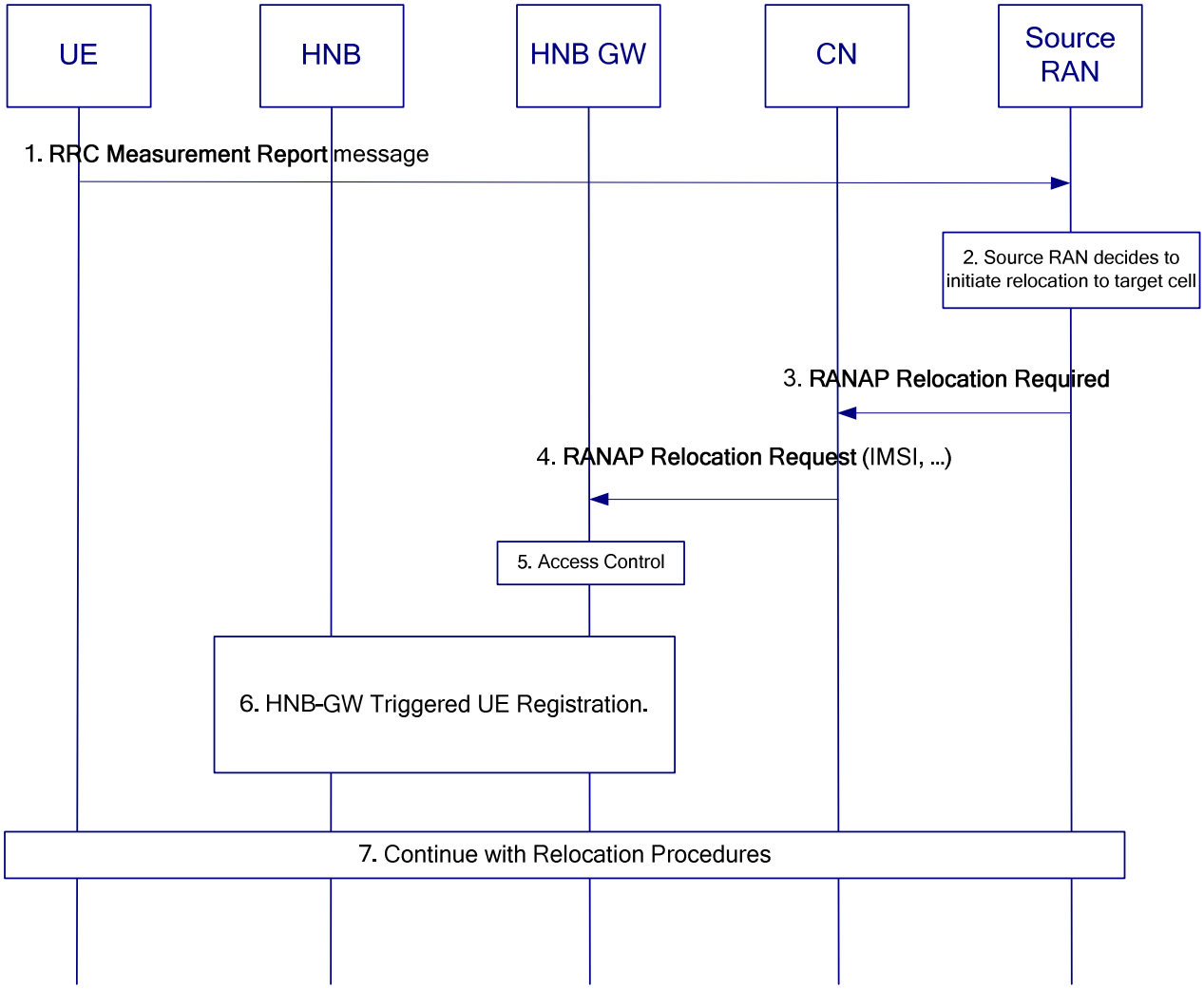


Figure 5.9.3-1: Connected Mode inbound mobility for non-CSG UEs to CSG HNB or Hybrid Cell

1. The UE is triggered to send an RRC Measurement Report by the rules set by the UTRAN.

2. The Source RAN node makes a decision to relocate the UE session.

3. The source RAN triggers relocation of the UE session by sending the RANAP RELOCATION REQUIRED message to the Core Network. The target RNC-Id and Target Cell Id are included by the source RAN in the RANAP RELOCATION REQUIRED message. The source RAN shall not include target CSG ID and the Cell Access Mode in the RELOCATION REQUIRED message.

4. The Core Network shall not perform any access control for the UE and it shall not include target CSG ID and CSG Membership Status in the RELOCATION REQUEST message.

5. The HNB-GW receives a RANAP RELOCATION REQUEST message not including the target CSG ID and the CSG Membership Status. The HNB GW shall perform access control for the UE. If the relocation is towards a closed CSG or hybrid cell the HNB GW shall include the CSG Membership Status in the RUA Connect message.

6. The steps for HNB-GW Triggered UE Registration are executed between the HNB-GW and the HNB.

7. The remainder of the relocation procedure continues normally as documented in [9], [10]

Note: Steps 2 to 7, as appropriate, are repeated for the second CN domain when present with the following exceptions. The relocation of the 2nd domain shall not trigger an additional registration. The 2nd RANAP Relocation Request shall be carried as RUA Direct Transfer. There is only one Context Id assigned to the UE regardless of the number of domains relocated from the source RAN.

6 Requirements for O&M

6.1 O&M for HNB

6.1.1 Provisioning Procedure for HNB

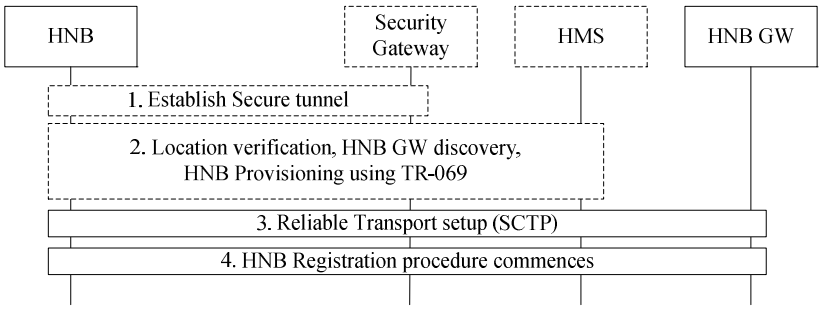


Figure 6.1.1-1. Provisioning procedure for HNB.

1. A secure tunnel is established from the HNB to the Security gateway.

2. Location verification shall be performed by the HMS based on information sent by the HNB (e.g. macro neighbour cell scans, global navigational satellite system type of information etc.). HMS determines the serving elements and provides the HNB GW, HMS and Security Gateway to the HNB. The HMS also provisions configuration parameters to the HNB only after successful location verification in the HMS.

NOTE: Steps 3 & 4 are shown only for completeness. Security Gateway and HMS are shown to highlight the general architecture.

NOTE: In the event information required for verifying location are not available (for example, no macro neighbour cells, no GNSS, no DSL line ID etc. available), HNB GW discovery may be based on specific operator and/or regulatory policies.

6.1.2 Location Verification

6.1.2.1 General

During location verification, the HNB reports its location information to the HMS. The HMS in turn examines the provided information and verifies the HNB"s location. There are 3 possible types of information for this purpose:

1. Macrocell Information

2. GNSS location information

3. Broadband connection information, provided that the resulting location information is at least as accurate as location determination based on macro-cell coverage information, whether or not there is macro-cell coverage available at the location of the HNB (e.g. as determined by point 1. above).

NOTE: Not all of this information is mandatory. In fact, the type of reported information is based on factors such as the physical environment in which the HNB is installed and/or possible variations in the HNB"s HW and SW implementation.

6.1.2.2 Macro-cell Information

6.1.2.2.1 General

The HNB is expected to have a radio environment measurement capability. This includes capturing the following type of information from the surrounding environment.

a) UTRAN cell information

- RF level information
- Broadcast information

b) GSM cell information

- RF level information
- Broadcast information

6.1.2.2.2 UTRAN Cell Information

The information in the following table is reported by the HNB to the HMS for each UTRAN cell detected.

Table 6.1.2.2.2.-1. UTRAN Cell Information.

Information		Description / Note	Presence	3GPP Reference
RF information	UARFCNDL	UARFCN (DL)	M	25.104, sec.5.4 32.642 sec. 6.3.11
	CPICHRSCP	RSCP of CPICH	M	
	PSC	Primary Scrambling Code	M	32.642 sec. 6.3.11
Broadcast information	PLMN Type	« GSM-MAP » or « ANSI-41 »	M	25.331, sec.10.3.1.12
	MCC	Mobile Country Code	M	24.008 32.642 sec. 6.3.10
	MNC	Mobile Network Code	M	24.008 32.642 sec. 6.3.10
	LAC	Location Area Code	M	24.008, sec.10.5.1.3 32.642 sec. 6.3.10
	RAC	Routing Area Code	M	24.008, sec.10.5.1.12.3 25.413, sec.9.2.3.7 32.642 sec. 6.3.10
	CellID	Cell ID	M	25.331, sec.10.3.2.2
	CSG Cell Info	<detail TBD per Rel.8 RRC spec>	O	Applicable to Rel.8 compliant cell only.

6.1.2.2.3 GSM Cell Information

The information in the following table is reported by the HNB to the HMS for each GSM cell detected.

Table 6.1.2.2.3. GSM Cell Information.

Information		Description / Note	Presence	3GPP Reference
RF information	ARFCN	Channel number	M	32.652 sec. 6.3.5
	BCCHRSSI	RSSI of the BCCH carrier.	M	32.652 sec. 6.3.5
	BSIC	Base Station ID Code	M	32.652 sec. 6.3.5
Broadcast Information	MCC	Mobile Country Code	M	32.652 sec. 6.3.5
	MNC	Mobile Network Code	M	32.652 sec. 6.3.5
	LAC	Location Area Code	M	32.652 sec. 6.3.5
	RAC	Routing Area Code	M	32.652 sec. 6.3.5
	CellID	Cell ID	M	32.652 sec. 6.3.5

6.1.2.3 GNSS Location Information

This information consists of, at minimum, latitude and longitude detected by the GNSS receiver (e.g. GPS receiver), if the HNB implementation includes this functionality.

6.1.2.4 Broadband Connection Information

This information consists of the information associated with the broadband connection (e.g. DSL) the HNB is connected with: 1) public IP address assigned to the RGW (e.g. DSL-GW/router), and 2) line identifier to which the RGW is connected with (e.g. DSL line ID) as seen on the broadband service provider. These are applicable only when this information is available to the HNB, and only when the resulting location information is at least as accurate as location determination based on macro-cell coverage information, whether or not there is macro-cell coverage available at the location of the HNB (e.g. as determined by clause 6.1.2.2 above).

6.1.3 HNB-GW Discovery

During the HNB-GW Discovery procedure, the HMS provides the HNB with 3 identities as shown in the following table. The information may be either IP address or FQDN to be resolved by DNS.

Table 6.1.3. HNB-GW Discovery Information.

Parameter	Description / Note	Presence	3GPP Reference
Serving HMS ID	One or more IDs may be provided	M	
Serving SeGW ID	One or more IDs may be provided	M	
Serving HNB-GW ID	One or more IDs may be provided	M	

6.1.4 HNB Provisioning

6.1.4.1 General

During the HNB Provisioning procedure, the HMS transfers the HNB configuration information to the HNB. This includes 3 types of parameters:

1. CN level parameters
2. RAN level parameters
3. RF level parameters

NOTE: The HNB may have auto-configuration capabilities, such that the HMS sends a list/range of values to the HNB, which selects (and returns to HMS) a single value, also based on the information collected measuring the radio environment. The HMS may also provide control parameters of the auto-configuration process.

6.1.4.2 CN Level Parameters

Table 6.1.4.2. CN Level Parameters.

Parameter	Description / Note	Presence	3GPP Reference
PLMN Type	'GSM-MAP' or 'ANSI-41'	M	25.331, sec.10.3.1.12
MCC	Mobile Country Code	M	24.008 32.642 sec. 6.3.8
MNC	Mobile Network Code	M	24.008 32.642 sec. 6.3.8
LAC	Location Area Code (one or more LACs may be provided)	M (Note 1)	24.008, sec.10.5.1.3 32.642 sec. 6.3.9
SAC	Service Area Code	M	25.413, sec.9.2.3.9 32.642 sec. 6.3.9
T3212	Periodic LAU timer (CS domain)	M	24.008, sec.10.5.1.12.2
ATT	Attach-detach allowed (CS domain)	M	24.008, sec.10.5.1.12.2
RAC	Routing area code (PS domain) (one or more RACs may be provided)	M (Note 1)	24.008, sec.10.5.1.12.3 25.413, sec.9.2.3.7 32.642 sec. 6.3.9
NMO	Network Mode of Operation (Gs i/f)	M	24.008, sec.10.5.1.12.3
Equivalent PLMN ID	List of one or more equivalent PLMN ID (MCC + MNC)	O (Note 2)	24.008, sec.10.5.1.13
Allowed IMSI list	For access control purpose.	O (Note 3)	24.008, sec.10.5.1.4
CSG Cell Info	CSG Capability Indication, CSG Id, in case the Cell is CSG capable <any further detail FFS per Rel.8 RRC spec>	M	Applicable to Rel.8 compliant cell only.
HNB Location Information	Location information (Geographical coordinates, Uncertainty code)	O (FFS Note 4)	25.413, sec.9.2.3.11
SAI for broadcast	Service Area for broadcast	M	25.419, sec. 9.2.11

NOTE 1: May be a list/range of values in case the HNB has auto-configuration capabilities.
NOTE 2: This information is operator-dependent based on its circumstance.
NOTE 3: ACL is an optional function at HNB. This information is provided if this function is enabled in the HNB.
NOTE 4: Due to possible regulatory requirements (future or current), this parameter may become mandatory.

6.1.4.3 RAN Level Parameters

Table 6.1.4.3-1. RAN Level Parameters.

Parameter		Description	Presence	3GPP Reference
RNCID for HNB		RNC ID used by HNB	M	32.642 sec. 6.3.8
Cell ID		28-bit 'Cell ID' in SIB3	M	25.331, sec.10.3.2.2
HSPA related	HSflag	Whether HSDPA/HSUPA is used or not	O	32.642-820 32.642 sec. 6.3.9
HCS related	UseOfHCS HCSPrio QHCS		M	25.331, sec.10.3.7.47, 10.3.7.12 32.642 sec. 6.3.9
Cell selection / reselection related	Quality measure QqualMin QqualMin-offset QrxlevMin QrxlevMin-offset Sintrasearch Sintersearch SsearchRAT SsearchHCS Treselections UETxPwrMaxRACH QHyst1	CPICH Ec/N0 or RSCP if Ec/N0 is used if RSCP is used	O (Note*1)	25.331, sec.10.3.2.3, 10.3.2.4 32.642 sec. 6.3.9 25.304
Intra Freq Measurement Related	Filter coefficient Measurement quantity for freq quality estimate Hysteresis for event 1x Threshold for event 1x TimetoTrigger for event 1x Weighting factor for event 1x Reporting Range Triggering Condition	Filter coefficient CPICH Ec/No, CPICH RSCP, or pathloss 'x' in 1x includes applicable events from 1A to 1J	O (Note*1)	25.331 sec.10.3.7.38, 10.3.7.39
Inter-Freq Measurement Related	Filter coefficient Measurement quantity for freq quality estimate Hysteresis for event 2x Threshold for event 2x TimetoTrigger for event 2x Weighting factor for event 2x	Filter coefficient CPICH Ec/No, CPICH RSCP 'x' in 2x includes applicable events from 2A to 2F	O (Note*1)	25.331 sec.10.3.7.18, 10.3.7.19
Inter-RAT Measurement Related	Filter coefficient BSIC verification required Hysteresis for event 3x Threshold for event 3x TimetoTrigger for event 3x Weighting factor for event 3x	Filter coefficient 'required' / 'not required' 'x' in 3x includes applicable events from 3A to 3D	O (Note*1)	25.331 sec.10.3.7.29, 10.3.7.30
RRC related	N30x, N31x T30x, T31x, T320	RRC constants RRC timers	O (Note*1)	25.331, sec.10.3.3.43, 10.3.3.44
Neighbour list (UTRA Intra-Freq cell info list)	RNCID C-Id LAC RAC PSC	Defined for each intra-freq cells C-Id is either 12 or 16 bits depending on RNCID length.	O (Note*2)	32.642 sec. 6.3.10 25.401 sec. 6.1 25.413 sec. 9.2.1.28
Neighbour list (UTRA Inter-Freq cell info list)	RNCID C-Id LAC RAC UARFCN (DL) PSC	Defined for each inter-freq cells C-Id is either 12 or 16 bits depending on RNCID length	O (Note*2)	32.642 sec. 6.3.10 25.401 sec. 6.1 25.413 sec. 9.2.1.28
Neighbour list (GERAN cell info list)	CellID BSIC BandIndicator BCCHARFCN	Defined for each inter-RAT cells (assume GSM cell only).	O (Note*2)	32.652 sec. 6.3.5

Note (*1): Marked as optional based on the operator preference on the extent of provisioning that the HMS performs to the HNB vs. the level of autonomy that HNB has for auto-configuration. In case this IE is absent, default value is assumed (additional implication is that HNB has a set of default parameter values).
Note (*2): Marked as optional due to several implications: 1) there may be no suitable neighbour cell available based on the RF scanning procedure described earlier, 2) based on operator deployment policy (e.g. dedicated RF channel for HNB layer vs. macro layer), and 3) operator preference on the extent of provisioning that the HMS performs to the HNB vs. the level of autonomy that HNB has for auto-configuration. Regarding 3) above, this may include capabilities such as the HMS to add or remove neighbour cells initially detected by the HNB during the radio environment scanning process, and the HNB to extend the received Neighbour list based on auto-configuration capabilities.

6.1.4.4 RF Level Parameters

Table 6.1.4.4. RF Level Parameters.

Parameter	Description / Note	Presence	3GPP Reference
UARFCN (DL)	Frequency channel number (one or more UARFCNs may be provided)	O (note 1)	25.101, sec.5.4, 25.104, sec.5.4, 32.642, sec.6.3.11
PSC	Primary scrambling code (one or more PSCs may be provided)	O (note 1)	32.642, sec.6.3.11
MaxHNBTxPower	Maximum allowed Tx power of the HNB.	O (note 1)	25.104, sec.6.2, 32.642, sec.6.3.9
MaxULTxPower	The parameter defines the maximum transmission power level a UE can use on PRACH.	O (note 1)	25.101, sec.6.2, 32.642, sec.6.3.9
P-CPICHPower	Transmission power of Primary CPICH (DL config). This may be either a specific value or a range (min / max) of values.	O (note 1)	32.642, sec.6.3.11
P-SCHPower	Primary SCH power offset (DL config)	O (note 1)	32.642, sec.6.3.11
S-SCHPower	Secondary SCH power offset (DL config)	O (note 1)	32.642, sec.6.3.11
BCHPower	BCH power offset (DL config)	O (note 1)	32.642, sec.6.3.11
AICHPower	AICH power offset (DL config, BCCH info)	O (note 1)	25.331, sec.10.3.6.3, 32.642, sec.6.3.11
PICHPower	PICH power offset (DL config, BCCH info)	O (note 1)	25.331, sec.10.3.6.50, 32.642, sec.6.3.9
PCHPower	PCH power offset (DL config, BCCH info)	O (note 1)	32.642, sec.6.3.9
FACHPower	FACH power offset (DL config, BCCH info)	O (note 1)	32.642, sec.6.3.9
NOTE 1: Marked as optional based on the operator preference on the extent of provisioning that the HMS performs to the HNB vs. the level of autonomy that HNB has for auto-configuration. In case this IE is absent, it is assumed that the HNB will derive the suitable value based on its auto-configuration capability. In case this IE is a list/range of values, the HNB will choose a single value based on its auto-configuration capability. UARFCN UL may be automatically determined by the HNB upon UARFCN DL (basing on standard duplex configuration and country-specific spectrum allocation).			

6.2 O&M for HNB GW

Editors Note: FFS

7 Iuh interface protocol structure

7.1 General

Figure 7.2-1 shows the Control Plane and the User Plane protocol structures over the Iuh interface. For the control plane, the HNBAP protocol provides the signalling service between the HNB and the HNB-GW required to fulfil the functions described in 25.469 [3].

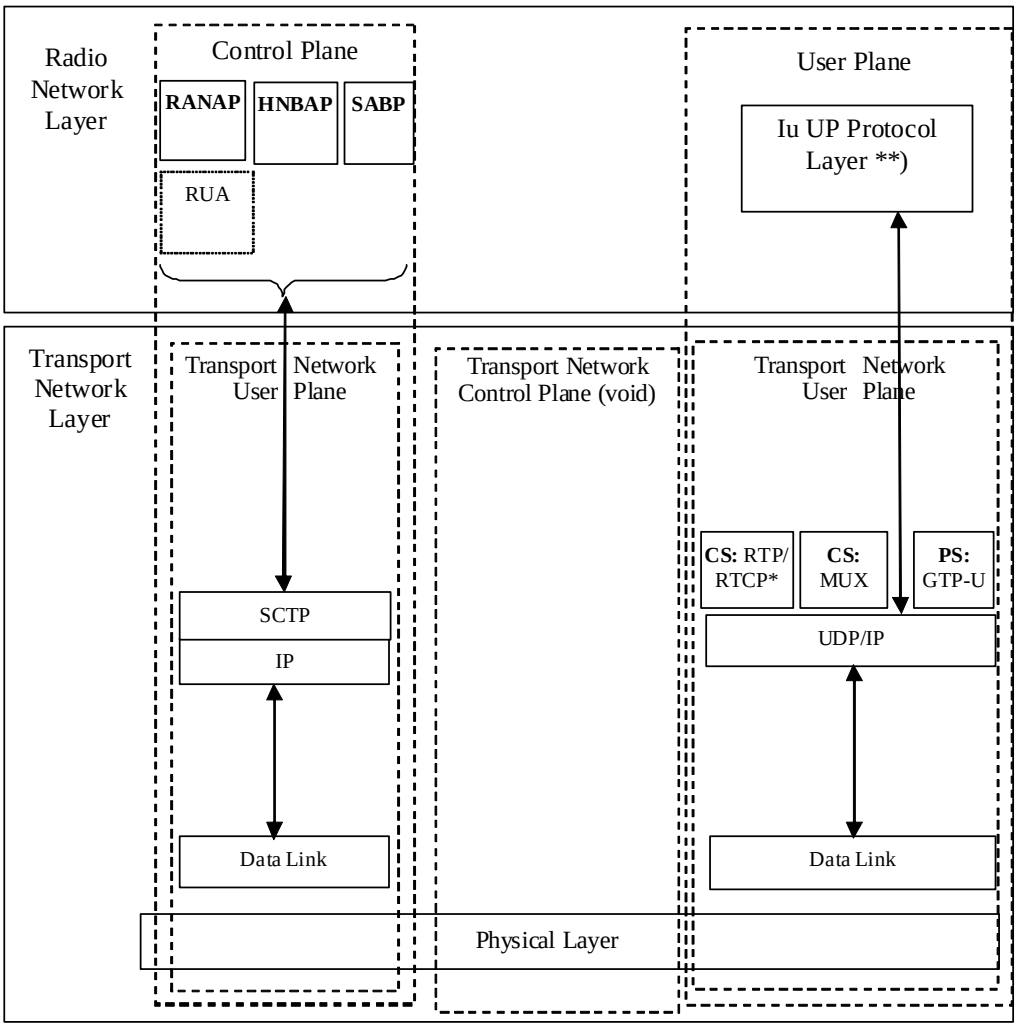
RUA provides the signalling service between the HNB and the HNB-GW that is required to fulfil the functions described in 25.468 [2].

The payload protocol identifier (PPI) field in SCTP [6] is set to the value 19 assigned by IANA for use with the RUA protocol. In addition, the value 20 is assigned for the PPI for HNBAP. The value [xx] is assigned for the PPI for SABP.The multiplexing protocol as specified in [8] provides the means to multiplex CS user plane on the uplink.

The destination port number field in SCTP [6] is set to the value 29169 assigned by IANA for setup of the common SCTP association in HNBAP, RUA and SABP.

7.2 Iuh

Figure 7.2-1 shows the protocol structure for Iuh, following the structure described in [5].



*) RTCP is optional.
**) Iu UP is terminated in CN and HNB only (i.e. not in the HNB GW)

Figure 7.2-1. I_{uh}–Interface Protocol Stack.

8 Enhanced Interference Management

8.1 General

There is a type of interference which may be considered: 1) Interference from HNB to Macro.

Scenarios are listed in Table 8.1.

Table 8.1. Interference scenarios.

Scenario	Aggressor	Victim	Type of interference
1	HNBUE (UL)	Macro NB	Interference from HNB to Macro *applicable to co-channel deployment scenario
2	HNB (DL)	Macro UE	

8.2 Mitigation of interference from HNB to Macro

8.2.1 Interference from HNB UE(UL) to Macro NB

The scenario involves:-

1. Adaptively limiting the HNB UE"s maximum UL Tx Power in connected mode possibly using HNB UE measurement and calculating the path loss between HNB UE and Macro NB.

8.2.2 Interference from HNB(DL) to Macro UE

The scenario involves:-

1. Redirecting unauthorized UE to another carrier possibly based on uplink access attempts by unauthorised UE.

2. Adjusting HNB"s DL CPICH Tx Power adaptively either temporarily or over long term possibly based on uplink access attempts by unauthorised UE.

Annex A (informative): Change History

TSG #	TSG Doc.	CR	Rev	Subject/Comment	New
09/2009				Rel-9 version is created based on v.8.3.0	9.0.0
45	RP-090999	0044	3	Support for paging optimization with CSG membership changes	9.0.0
45	RP-090999	0048	1	Enhancements to handle HNB to HNB mobility	9.0.0
45	RP-090999	0049	1	Access Mode and Membership notification for UEs accessing CSG-Hybrid cells	9.0.0
10/2009				Editorial changes: 5.x.2 -> 5.7.2 and adding numbering to Figure 5.7.2-1	9.0.1
46	RP-091191	0039	4	CS Mux on Uplink	9.1.0
46	RP-091195	0053	2	Enhanced Interference Management Mechanisms for HNB	9.1.0
46	RP-091191	0057		Introducing changes for supporting ETWS in Home Node B (Rel9)	9.1.0
46	RP-091184	0059	1	Add assigned SCTP Port Number for RUA and HNBAP	
46	RP-091191	0061		Addition of use of COMMON ID message to convey Hybrid cell membership information.	9.1.0
46	RP-091184	0067		Clean up of 25.467	9.1.0
46	RP-091191	0070	1	Mitigating IMSI spoofing in non-CSG UE registration	9.1.0
46	RP-091191	0071	1	UE registration in case of HNB-GW access control	9.1.0
46	RP-091191	0072	1	Inbound Mobility to CSG and Hybrid Cells	9.1.0

History

Document history		
V9.1.0	January 2010	Publication