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*Technical Specification*

**Universal Mobile Telecommunications System (UMTS);  
Mobility procedures for Home Node B (HNB);  
Overall description;  
Stage 2  
(3GPP TS 25.367 version 9.2.0 Release 9)**

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# 1 Scope

This document provides a high level description of the mobility procedures applicable to Home NodeB support in the current Release. Where appropriate, the reasons behind the agreements are provided. Throughout this document, unless otherwise stated, the UE is assumed to be a current Release UE that supports the Closed Subscriber Group (CSG) feature, whether it is actually a member of a CSG or not. A Release 8 UE that does not support the CSG feature is not required to support any of the procedures stated in this document.

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# 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.
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[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 25.304: "UE procedures in idle mode and procedures for cell reselection in connected mode".

[3] 3GPP TS 25.331: "Radio Resource Control (RRC) protocol specification".

[4] 3GPP TS 23.011: "Service accessibility".

[5] 3GPP TS 22.220: "Service Requirements for Home NodeBs and Home eNodeBs".

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# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

**Acceptable Cell:** A cell that satisfies certain conditions as specified [2]. A UE can always attempt emergency calls on an acceptable cell.

**Allowed CSG Cell:** A CSG cell on which a UE may normally camp if its CSG whitelist contains the cell's CSG Identity.

**CSG whitelist:** A list provided by NAS containing all the CSG Identities of the CSGs to which the subscriber belongs.

NOTE: This list is known as Allowed CSG List in Rel-8 Access Stratum specifications.

**Available PLMN:** A PLMN for which the UE has found at least one cell and read its PLMN identity.

**Barred Cell:** A cell a UE is not allowed to camp on.

**Camped on a cell:** UE has completed the cell selection/reselection process and has chosen a cell. The UE monitors system information and (in most cases) paging information.

**Camped on any cell:** UE is in idle mode and has completed the cell selection/reselection process and has chosen a cell irrespective of PLMN identity.

**Closed Subscriber Group (CSG):** A Closed Subscriber Group identifies subscribers of an operator who are permitted to access one or more cells of the PLMN but which have restricted access (CSG cells).

**CSG Cell:** A cell, part of the PLMN, broadcasting a CSG Indicator that is set to TRUE and a specific CSG identity. A CSG cell is accessible by the members of the closed subscriber group for that CSG identity.

**CSG Identity (CSG ID):** An identifier broadcast by a CSG/Hybrid cell or cells and used by the UE to facilitate access for authorised members of the associated Closed Subscriber Group.

**DRX cycle:** Individual time interval between monitoring Paging Occasion for a specific UE.

**Equivalent PLMN list:** List of PLMNs considered as equivalent by the UE for cell selection, cell reselection, MBSFN Cluster selection MBSFN Cluster reselection and handover according to the information provided by the NAS.

**Home NodeB (HNB):** A HNB is a customer-premises equipment that connects a 3GPP UE over UTRAN wireless air interface to a mobile operator's network using broadband IP backhaul.

**HNB Name:** The Home NodeB Name is a broadcast string in free text format that provides a human readable name for the Home NodeB CSG identity.

**Home PLMN:** A PLMN where the Mobile Country Code (MCC) and Mobile Network Code (MNC) of the PLMN identity are the same as the MCC and MNC of the IMSI.

**Hybrid cell:** A cell broadcasting a CSG identity which is accessible as a CSG cell by UEs which are members of the CSG and as a normal cell by all other UEs.

**Non-CSG Cell:** A cell that is not a CSG cell, e.g. a macro cell.

**Process:** A local action in the UE invoked by a RRC procedure or an Idle Mode procedure.

**Radio Access Mode:** Radio access mode of the cell, FDD or TDD.

**Radio Access Technology:** Type of technology used for radio access, for instance UTRA or GSM.

**Registered PLMN:** This is the PLMN on which certain Location Registration outcomes have occurred.

**Registration Area:** (NAS) registration area is an area in which the UE may roam without a need to perform location registration, which is a NAS procedure.

**Reserved Cell:** A cell on which camping is not allowed, except for particular UEs, if so indicated in the system information.

**Restricted Cell:** A cell on which camping is allowed, but access attempts are disallowed for UEs whose access classes are indicated as barred.

**Selected PLMN:** This is the PLMN that has been selected by the NAS, either manually or automatically.

**Serving cell:** The cell on which the UE is camped.

**Strongest cell:** The cell on a particular carrier that is considered strongest according to the layer 1 cell search procedure [14] [15]. As the details of the layer 1 cell search are implementation dependent, the precise definition of 'strongest cell' is also implementation dependent.

**Suitable Cell:** This is a cell on which an UE may camp.

## 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].

AS	Access Stratum
BCCH	Broadcast Control Channel
CM	Connection Management
CN	Core Network

CSG	Closed Subscriber Group
DRX	Discontinuous Reception
E-UTRA	Evolved UMTS Terrestrial Radio Access
FDD	Frequency Division Duplex
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HCS	Hierarchical Cell Structure
HNB	Home NodeB
IMSI	International Mobile Subscriber Identity
MCC	Mobile Country Code
MM	Mobility Management
MNC	Mobile Network Code
NAS	Non-Access Stratum
PCH	Paging Channel
PI	Page Indicator
PICH	Page Indication Channel
PLMN	Public Land Mobile Network
RAT	Radio Access Technology
RRC	Radio Resource Control
SAP	Service Access Point
TDD	Time Division Duplex
TMGI	Temporary Mobile Group Identity
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

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## 4 Overview

In the current Release, a Home NodeB may provide restricted access to only UEs belonging to a Closed Subscriber Group (CSG). One or more of such cells providing restricted access, known as CSG cells, are identified by a unique numeric identifier called CSG Identity. To facilitate access control, a UE with CSG subscription would have an CSG whitelist, which contains one or more CSG Identities associated with the CSG cells on which the UE is allowed access. The UE uses the CSG whitelist along with the CSG Identity broadcast by the CSG Cells in CSG cell selection and reselection.

A HNB can also be operated as a hybrid cell. A hybrid cell is accessed as a CSG cell by a UE whose CSG whitelist contains the cell's CSG ID and as a normal cell by all other UEs. Members of the CSG are expected to receive preferential access according to [5].

**NOTE:** Although pre-Rel9 non-CSG and CSG UEs are able to camp on hybrid cells (which would be regarded as normal cells for access) there is no possibility for these UEs to identify a hybrid cell as a CSG cell even though the cell's CSG identity is in the UE's allowed CSG Identity list.

In addition, manual selection of CSG Identity is introduced, which enables the human user to manually select a CSG Identity for UE to camp on.

This document provides high level descriptions and procedures of the mobility features to support CSG deployment in the current Release. The following areas will be covered in the subsequent chapters:

- Identifiers associated with the CSG framework
- Manual selection of CSG Identity
- Measurement rules for CSG Cells
- Cell reselection to a CSG cell, from a CSG cell, and between CSG cells
- Handover to a CSG cell, from a CSG cell, and between allowed CSG cells, where applicable
- Measurement rules, (re)selection and handover procedures for hybrid cells.

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## 5 CSG Identification

One or more Closed Subscriber Group (CSG) cells are identified by a unique numeric identifier called CSG Identity or CSG ID. A UE belonging to a CSG has the corresponding CSG ID in its CSG whitelist. The CSG whitelist is maintained and provided by NAS. The CSG ID is broadcast in system information by the CSG cell or hybrid cell, and used by the UE for cell (re)selection purposes.

A cell may optionally broadcast the CSG Indicator, whose presence and value of TRUE indicates the cell is a CSG cell. The absence of the CSG indicator in a cell which broadcasts a CSG identity indicates that it is a hybrid cell.

A CSG cell or hybrid cell may broadcast the HNB Name, a textual identifier, in system information. The HNB Name can be used to aid the human user in manual selection of a CSG ID.

At the physical layer, a CSG cell is identified by its carrier frequency (UARFCN) and Primary Scrambling Code (PSC). A set of PSCs could be reserved for CSG deployment and this reserved PSC range may be signalled in system information. The PSC of a CSG cell belongs to the reserved PSC range if broadcast.

On the mixed carrier frequency shared by both non-CSG cells (UMTS macro cells) and CSG cells, CSG cells broadcast in system information the PSC range reserved by the network for CSG cells. The non-CSG cells may also broadcast the reserved PSC range. The reserved PSC range is only applicable to the UARFCN within the PLMN where the UE received this information. The UE considers the last received reserved PSC range to be valid within the entire PLMN for the duration of 24 hours. The UE may use the reserved PSC information for CSG cell search and (re)selection purposes, according to UE's implementation.

NOTE: It is FFS whether the network should also reserve a PSC list for hybrid cells.

Macro cells and CSG cells may broadcast indications of one or more carrier frequencies used for dedicated CSG deployment. This information may be used by a UE to avoid unnecessary measurements on that frequency even when cell measurement rules would require measurements of this carrier frequency. Indications of which carrier frequencies are dedicated to CSG-only deployment may be signalled in system information and are applicable only in the cell where this information is broadcast.

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## 6 CSG Selection

### 6.1 Manual CSG ID Selection

Manual CSG ID selection enables a human user to select a CSG ID. In manual CSG ID selection the UE may scan all frequencies in the supported frequency bands and display a list of found CSG IDs or the corresponding HNB Names if broadcast by the CSG cells or hybrid cells, and indications as to whether the found CSG IDs are contained in the UE's CSG whitelist. When the user selects an entry in the list, the UE selects any CSG cell or hybrid cell among the ones with same CSG ID. The UE may normally camp on the chosen cell if it is an allowed CSG cell or a hybrid cell.

During manual CSG ID selection a UE is allowed to perform Location Registration procedure on a CSG cell whose CSG ID is not in the CSG whitelist.

Based on the outcome of a Location Registration procedure initiated on a CSG cell, the UE's CSG whitelist is updated.

The UE is allowed to *not* support manual CSG ID selection in connected mode.

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## 7 CSG Cell Reselection

### 7.1 Measurement Rules for CSG Cells

To measure allowed CSG cell(s), a UE applies an autonomous search function, per UE implementation, regardless of which RAT the UE is camping on. The autonomous search function determines when and where to search for the allowed CSG cells.

Autonomous search procedure is disabled by the search function if UE's CSG whitelist does not exist or is empty.

On a mixed carrier, a UE may avoid measurements of any CSG cells that are known by the UE to be not allowed.

A UE may avoid measurements of any CSG cells that are known by the UE to be not allowed on the carrier frequency dedicated to CSG deployment.

## 7.2 Reselection to CSG Cell

The cell reselection criteria described in this section is applicable when the UE is in the following call states: Idle Mode, Cell\_PCH and URA\_PCH states, but not Cell\_FACH, unless otherwise stated.

### 7.2.1 Criteria for Intra-frequency Cell Reselection

For intra-frequency reselection from a non-CSG cell to an allowed CSG cell, the UE follows the same cell ranking rules as those defined for the UTRA case in [2]. The UE may ignore not allowed CSG cells in the ranking. The UE applies reselection parameters broadcast by the serving cell. A UE may normally camp on an allowed CSG cell.

### 7.2.2 Criteria for Inter-frequency Cell Reselection

For inter-frequency cell reselection, the UE considers the frequency where its allowed CSG cell is on to have the highest priority value, irrespective of network configured frequency priorities, as long as the CSG cell remains allowed and best ranked on that frequency.

### 7.2.3 Criteria for Inter-RAT Cell Reselection

Inter-RAT reselection to an allowed CSG cell is supported when the UE is camped on another RAT. The UE requirements are defined in the specifications of the concerned RAT.

## 7.3 Reselection from CSG Cell

### 7.3.1 Criteria for Intra-frequency Cell Reselection

For intra-frequency reselection from an allowed CSG cell to a non-CSG cell, the UE follows the same cell ranking rules as those defined for the UTRA case defined in [2].

### 7.3.2 Criteria for Inter-frequency Cell Reselection

For inter-frequency reselection from an allowed CSG cell to a non-CSG cell, the UE follows the same cell ranking rules as those defined for the UTRA case defined in [2].

### 7.3.3 Criteria for Inter-RAT Cell Reselection

For reselection from a CSG cell to a GSM or E-UTRA cell, the UE follows the respective procedures defined in [2].

## 7.4 Reselection from CSG Cell to CSG Cell

For reselection between allowed CSG cells, the UE follows the same cell ranking rules as those defined for the UTRA case in [2].

## 7.5 Parameters for CSG Cell Reselection

No new parameters are defined for CSG cell ranking. The same cell reselection parameters defined for the UTRA case in [2] are used for CSG cell ranking purposes, if configured. The operator may configure the cell reselection parameters, such as Qoffset and Qhyst, to bias the reselection of CSG cells.

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## 8 CSG Cell Handover

### 8.1 Handover to CSG Cell

In Cell\_DCH state, handover from a non-CSG cell to an allowed CSG cell is not within the scope of Release 8.

### 8.2 Handover from CSG Cell

In Cell\_DCH state, the handover procedure from an allowed CSG cell to a non-CSG cell is expected to be the same as the procedure specified in [3].

### 8.3 Handover from CSG Cell to CSG Cell

In Cell\_DCH state, handover between allowed CSG cells with the same CSG ID is expected to be the same as the procedure specified in [3].

In Cell\_DCH state, handover between allowed CSG cells with different CSG IDs is expected to be the same as the procedure specified in [3].

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## 9 Support of Hybrid Cells

### 9.1 Measurement Rules

To measure for hybrid cells with a CSG Identity belonging to an entry in the UE's CSG whitelist, measurement rules of Chapter 7.1 apply. Otherwise, normal measurement rules apply.

NOTE: The autonomous search for hybrid cells does not imply that UE need to constantly check the CSG ID of all cells it sees.

### 9.2 Reselection

In case the UE has CSG ID of the hybrid cell in its CSG whitelist, cell reselection procedures will be the same as for a CSG cell as described in Chapter 7.2.

For all other UEs, cell reselection procedures will utilise normal cell reselection rules.

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## Annex B (informative): Mobility and Access Control Requirements associated with Closed Subscriber Group (CSG) Cells and Hybrid Cells

### B.1 Inbound Mobility Considerations for handover to CSG cells and hybrid cells

#### B.1.1 PSC Confusion

Due to the typical cell size of HNBs being much smaller than macro cells, there can be multiple HNBs within the coverage of a macro cell with the same PSC. This leads to a condition referred to as PSC confusion, wherein the network is unable to determine the correct target cell for handover from measurement reports received from the UE.

- 1: Hybrid cells can suffer from PSC confusion

#### B.1.2 Preliminary access check

In order to avoid handover attempts to CSG cells which are not in the UE's CSG whitelist, a preliminary access check of the measured CSG cell needs to be performed by the UE. The network typically only initiates the handover preparation towards a reported CSG cell if UE indicates that the reported cell is an allowed CSG cell for the UE. Preliminary access check is not required for hybrid cells.

- 2: Preliminary access check shall be performed by the UE. The network typically initiates handover preparation only to cells for which UE has verified the CSG ID

#### B.1.3 UE Measurement Reports of CSG and Hybrid cells

Given that to initiate handover preparation to a CSG cell or hybrid cell (a) measurement information has to be reported to the serving cell and (b) correct target HNB has to be identified, a measurement report serves as the trigger for handover preparation. Furthermore, the measurement report that triggers the handover preparation includes the result of the preliminary access check for CSG cells and the Cell Identity to enable correct identification of the target cell.

- 3: The UE shall use the measurement reporting procedure to help the serving cell trigger handover preparation. UE shall send a measurement report that includes the result of the preliminary access check for CSG cells and the Cell Identity. The trigger for sending this measurement report and initiation of autonomous gaps required to read the relevant system information from the target cell for the inter-frequency case shall be controlled by the network. The inclusion of other information in this report is FFS.

In the intra-frequency case, the network can configure the UE with the set of PSCs of the cells for which the UE needs to acquire System Information as explained above. This configuration is performed in the course of measurement configuration.

- 4: As part of the intra-frequency measurement configuration, the network can configure a range of PSCs (corresponding to CSG cells or cells suffering from PSC confusion) for which the UE should report other relevant handover preparation information (acquired by reading SIB3/4 of the target cell) in addition to the result of the preliminary access check.

In the inter-frequency case, the network can configure the UE with the set of PSCs of the cells to measure on a frequency. This configuration is performed in the course of measurement configuration.

- 5: As part of the inter-frequency measurement configuration, the network can configure a range of PSCs (corresponding to CSG cells or cells suffering from PSC confusion) for which the UE needs to perform measurements.

In the inter-frequency case, a UE may have already acquired that cell's SIB3/SIB4 (see section B.1.4) even before a measurement configuration is sent requesting the UE to do so for a certain PSC. In such a case, the UE shall not provide

the acquired handover preparation information in the measurement report that includes that cell's PSC, following such opportunistic SIB3/SIB4 acquisition. However, the UE can send the already acquired handover preparation information for that cell's PSC in the measurement report when the network requests it via measurement configuration, if the acquired information is still valid.

- 6: For the inter-frequency case, following opportunistic SIB3/SIB4 acquisition, the UE shall not include the relevant handover preparation information in a measurement report, if such information was not explicitly requested in the measurement configuration. However, when requested by the network, the UE can send already acquired handover preparation information, if valid, in a measurement report. The mechanism whereby the network configures the cells for which such reporting is possible is FFS.

In the intra-frequency case, a UE may have already acquired a cell's SIB3/SIB4 (see section B.1.4) even before a measurement configuration including that cell's PSC in the range of PSCs (for which the UE should report relevant handover preparation information) is sent to the UE. In such a case, the UE shall not provide the acquired handover preparation information in the measurement report that includes that cell's PSC, following such opportunistic SIB3/SIB4 acquisition. However, the UE can send the already acquired handover preparation information for that cell's PSC (if the acquired information is still valid) in the measurement report when the network includes this cell's PSC in the range of PSCs for which the UE should report the relevant handover preparation information.

- 7: For the intra-frequency case, following opportunistic SIB3/SIB4 acquisition, the UE shall not include the relevant handover preparation information for a cell in a measurement report, if that cell's PSC was not included (in the measurement configuration) in the range of PSCs for which the UE should report the relevant handover preparation information. However, when included in the range of PSCs for which the UE should report the relevant handover preparation information, the UE can send already acquired handover preparation information, if valid, in a measurement report.

## B.1.4 Acquiring System Information of CSG and Hybrid cells

In order to include the Cell Identity of the HNB in a measurement report, and to perform the preliminary access check, the UE has to acquire MIB and SIB3/SIB4 of the HNB.

For intra-frequency inbound mobility to HNBs (shared carrier HNB deployment), the system information (MIB and SIB3/SIB4) shall be acquired without interrupting ongoing reception of serving cell transmissions in CELL\_DCH. One way to reduce the time it takes for the UE to acquire the target cell system information, would be for the HNBs to use a small repetition period for SIB3/SIB4. However this has been left to HNB implementation.

- 8: Acquiring MIB and SIB3/SIB4 of intra-frequency HNB cells shall be performed in parallel with reception of the serving cell transmissions in CELL\_DCH. No measurement gaps shall be required for reading MIB and SIB3/SIB4 in this case.

For inter-frequency inbound mobility to HNB cells, the UE may be unable to acquire target cell system information without interrupting reception of serving cell transmission in CELL\_DCH. In such a case, the UE may be instructed by the network to use autonomous gaps to acquire relevant system information of the target cell.

- 9: The UE, when instructed by the network, performs MIB and SIB3/SIB4 acquisition with autonomous gaps for the inter-frequency HNB inbound mobility case.

This section describes techniques that the UE can support to assist in providing an inbound mobility solution. Support for inbound mobility towards CSG cells and hybrid cells that are subject to PSC confusion may be contingent on the UE's support for detection and acquisition of System Information of such cells.

- 10: Support of inbound mobility towards CSG cells and hybrid cells that are subject to PSC confusion shall depend on the UE's support for PSC detection of such cells and for SIB 3/SIB 4 acquisition from such cells.

## B.1.5 Use of Proximity Information

Proximity information can be used to trigger handover preparation if needed. For example, if UE is able to determine that it is near its CSG cell, it could take necessary actions to trigger handover preparation. However, if the UE has not visited a hybrid cell previously, it may not have stored proximity information for the hybrid cell.

- 11: Inbound mobility to hybrid cells whose CSG IDs are not in the UE's CSG whitelist shall not depend on proximity information.

## B.1.6 PSC detection of CSG and Hybrid cells

### B.1.6.1 Non-member UEs

Existing PSC search triggers are used to support hand-in of non-member UEs towards a hybrid cell.

12: For non-member UEs of a hybrid cell, existing triggers are used for detecting the presence of that cell's PSC.

### B.1.6.2 Member UEs

For supporting inter-frequency inbound mobility towards CSG or hybrid cells, the member UE shall notify the network of the need for compressed mode gaps to acquire such cells' PSCs. The UE may rely on autonomous search (e.g. based on fingerprint) for notifying the network. The network can then configure compressed mode gaps to provide the UE with PSC measurement opportunities.

13: For inter-frequency inbound mobility of a UE towards cells whose CSG ID is in the UE's CSG whitelist, compressed mode gaps can be configured following UE's proximity indication that it needs such gaps to assist the UE in acquiring the handover preparation information. The proximity indication includes the frequency and (if applicable) RAT for which the UE requests inter-frequency or inter-RAT measurements to be configured. The need of proximity indication for the intra-frequency inbound mobility is FFS.

## B.1.7 Disabling of Inbound Mobility to CSG cells and Hybrid cells

The network may indicate to the UE that sending of proximity indications is disabled. Furthermore, the indication to disable proximity indication shall be possible on a per RAT basis. If the UE receives such an indication, it shall not send a proximity indication.

14: If the network indicates to the UE that sending of proximity indication is disabled for a particular RAT, the UE shall not send proximity indication for inbound mobility to cells of that particular RAT. It shall be possible to indicate to each UE individually whether sending of proximity indication is disabled.

## Annex B (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Re v	Subject/Comment	Old	New
2008-11-17	RAN2#64				Proposal for 25.367 TS structure and Text Proposals	-	0.0.0
2008-11-20	RAN2#64				Revision based on discussion for email agreement.	-	0.0.1
2008-11-21	RAN2#64				Final text proposals for email agreement.	-	0.0.2
2008-11-25	RAN2#64				Revision based on email agreement.	-	1.0.0
2008-12	RP-42	RP-080873	-	-	v1.0.0 was approved at RAN #42 as v8.0.0 and put under CR control	1.0.0	8.0.0
2009-03	RP-43	RP-090135	0001	1	Corrections to manual CSG search	8.0.0	8.1.0
	RP-43	RP-090135	0002	1	Allignement to latest stage 3 agreements	8.0.0	8.1.0
2009-06	RP-44	RP-090524	0003	-	Idle mode requirements to support hybrid cells for HNB	8.1.0	9.0.0
2009-09	RP-45	RP-090930	0005	4	CR capturing HNB inbound mobility agreements	9.0.0	9.1.0
	RP-45	RP-090911	0008	-	Correction to manual CSG ID selection_25.367CR(R9)	9.0.0	9.1.0
2009-12	RP-46	RP-091343	0010	1	CR on Add Hybrid cell into the manual CSG ID selection in 25.367	9.1.0	9.2.0
	RP-46	RP-091343	0011	2	Draft CR capturing HNB inbound mobility agreements	9.1.0	9.2.0
	RP-46	RP-091343	0012	-	Removal of description related to small repetition of SIB3/4	9.1.0	9.2.0
	RP-46	RP-091343	0014	1	Renaming Allowed CSG List (25.367 Rel-9)	9.1.0	9.2.0
	RP-46	RP-091330	0015	-	Correction to definition of CSG cell.	9.1.0	9.2.0

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## History

<b>Document history</b>		
V9.2.0	February 2010	Publication