TSG-RAN Meeting #20
Hämeenlinna, Finland, 03-06 June 2003

RP-030304

Title: CR (Rel-5) to TS 25.922

Source: TSG-RAN WG2

Agenda item: 7.2.5

Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Doc-2nd-Level	Workitem
25.922	023	-	Rel-5	UTRAN-GERAN handovers	F	5.0.0	5.1.0	R2-031396	TEI5

3GPP TSG-RAN WG2 Meeting #36
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CR-Form-v7

CHANGE REQUEST

⌘	25.922	CR	023	⌘ rev	-	⌘	Current version:	5.0.0	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	UTRAN-GERAN handovers		
Source:	⌘	RAN WG2		
Work item code:	⌘	TEI5	***Date:*** ⌘	31/03/2003
Category:	⌘	F	***Release:*** ⌘	Rel-5
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	Rel-5 UTRAN-GERAN handover scenarios are not described.
Summary of change:	⌘	Figures have been updated to refer to Rel-5 specifications, eg. 04.18 –> 44.018. GERAN Iu mode scenarios have been added. Handover Failure scenarios have been updated.
Consequences if not approved:	⌘	Rel-5 UTRAN-GERAN handover scenarios are not described.

Clauses affected:	⌘	5.1.1, 5.1.5.3 (new), 5.1.5.4 (new), 5.1.6.2.3, 5.1.7.2, 5.1.7.3			
		Y	**N**		
Other specs affected:	⌘		**X**	Other core specifications	⌘
			X	Test specifications	
			X	O&M Specifications	
Other comments:	⌘				

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5 RRC Connection Mobility

5.1 Handover

5.1.1 Strategy

The handover strategy employed by the network for radio link control determines the handover decision that will be made based on the measurement results reported by the UE/RNC and various parameters set for each cell. Network directed handover might also occur for reasons other than radio link control, e.g. to control traffic distribution between cells. The network operator will determine the exact handover strategies. Possible types of Handover are as follows:

- Handover 3G -3G;
- FDD soft/softer handover;
- FDD inter-frequency hard handover;
- FDD/TDD Handover;
- TDD/FDD Handover;
- TDD/TDD Handover;
- Inter-RAT Handover 3G - 2G or 3G - 3G (e.g. Handover to GERAN *A/Gb mode* or to GERAN *Iu mode*~~GSM~~);
- Inter-RAT Handover 2G - 3G or 3G - 3G (e.g. Handover from GERAN *A/Gb mode* or from GERAN *Iu mode*~~GSM~~).

5.1.2 Causes

The following is a non-exhaustive list for causes that could be used for the initiation of a handover process.

- Uplink quality;
- Uplink signal measurements;
- Downlink quality;
- Downlink signal measurements;
- Distance;
- Change of service;
- Better cell;
- O&M intervention;
- Directed retry;
- Traffic;
- Pre-emption.

5.1.3 Hard Handover

The hard handover procedure is described in [6].

Two main strategies can be used in order to determine the need for a hard handover:

- received measurements reports;

- load control.

5.1.4 Soft Handover

5.1.4.1 Soft Handover Parameters and Definitions

Soft Handover is a handover in which the mobile station starts communication with a new Node-B on a same carrier frequency, or sector of the same site (softer handover), performing utmost a change of code. For this reason Soft Handover allows easily the provision of macrodiversity transmission; for this intrinsic characteristic terminology tends to identify Soft Handover with macrodiversity even if they are two different concepts; for its nature soft handover is used in CDMA systems where the same frequency is assigned to adjacent cells. As a result of this definition there are areas of the UE operation in which the UE is connected to a number of Node-Bs. With reference to Soft Handover, the "Active Set" is defined as the set of Node-Bs the UE is simultaneously connected to (i.e., the UTRA cells currently assigning a downlink DPCH to the UE constitute the active set).

The Soft Handover procedure is composed of a number of single functions:

- Measurements;
- Filtering of Measurements;
- Reporting of Measurement results;
- The Soft Handover Algorithm;
- Execution of Handover.

The measurements of the monitored cells filtered in a suitable way trigger the reporting events that constitute the basic input of the Soft Handover Algorithm.

The definition of 'Active Set', 'Monitored set', as well as the description of all reporting events is given in [9].

Based on the measurements of the set of cells monitored, the Soft Handover function evaluates if any Node-B should be added to (Radio Link Addition), removed from (Radio Link Removal), or replaced in (Combined Radio Link Addition and Removal) the Active Set; performing than what is known as "Active Set Update" procedure.

5.1.4.2 Example of a Soft Handover Algorithm

A describing example of a Soft Handover Algorithm presented in this subclause which exploits reporting events 1A, 1B, and 1C described in [9] It also exploits the Hysteresis mechanism and the Time to Trigger mechanism described in [9]. Any of the measurements quantities listed in [9] can be considered.

Other algorithms can be envisaged that use other reporting events described in [9]; also load control strategies can be considered for the active set update, since the soft handover algorithm is performed in the RNC.

For the description of the Soft Handover algorithm presented in this subclause the following parameters are needed:

- AS_Th: Threshold for macro diversity (reporting range);
- AS_Th_Hyst: Hysteresis for the above threshold;
- AS_Rep_Hyst: Replacement Hysteresis;
- ΔT: Time to Trigger;
- AS_Max_Size: Maximum size of Active Set.

The following figure describes this Soft Handover Algorithm.

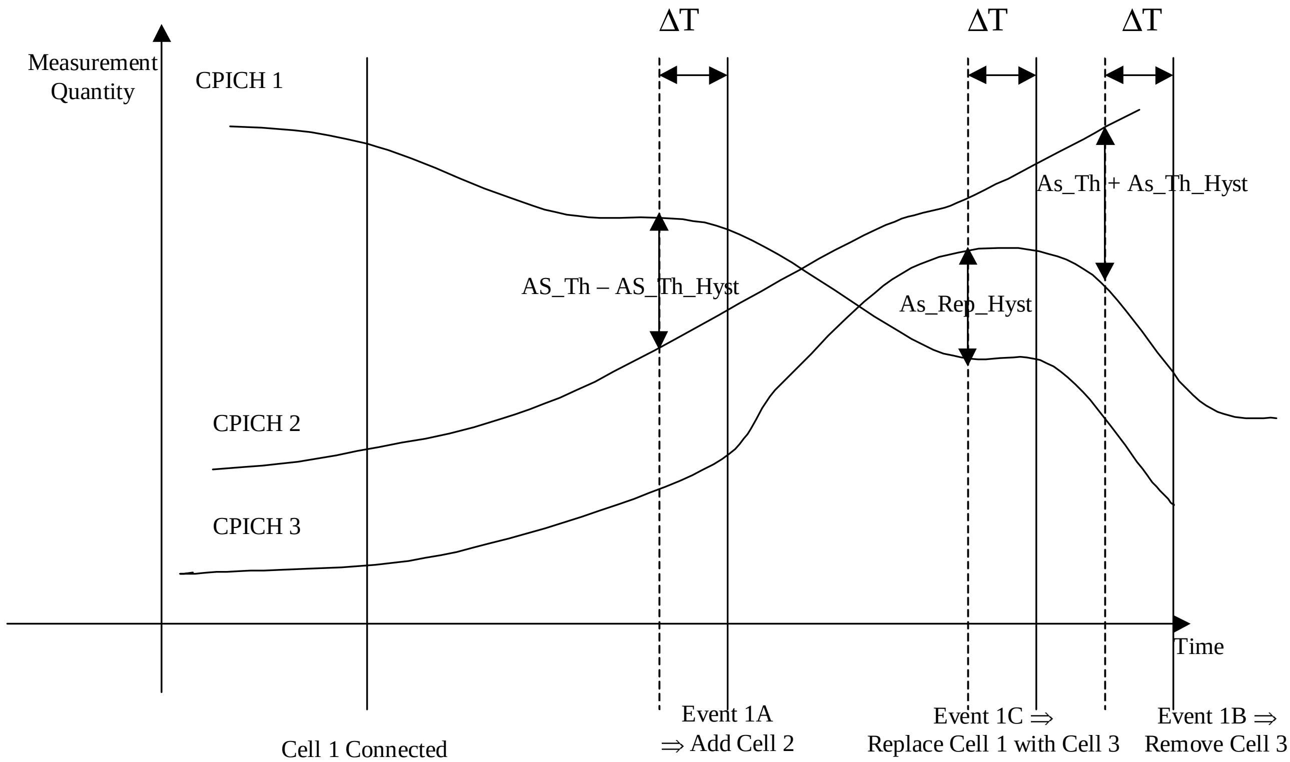


Figure 5-1: Example of Soft Handover Algorithm

As described in the figure above:

- If Meas_Sign is below (Best_Ss - As_Th - As_Th_Hyst) for a period of ΔT remove Worst cell in the Active Set.
- If Meas_Sign is greater than (Best_Ss - As_Th + As_Th_Hyst) for a period of ΔT and the Active Set is not full add Best cell outside the Active Set in the Active Set.
- If Active Set is full and Best_Cand_Ss is greater than (Worst_Old_Ss + As_Rep_Hyst) for a period of ΔT add Best cell outside Active Set and Remove Worst cell in the Active Set.

Where:

- Best_Ss :the best measured cell present in the Active Set;
- Worst_Old_Ss: the worst measured cell present in the Active Set;
- Best_Cand_Set: the best measured cell present in the monitored set.
- Meas_Sign :the measured and filtered quantity.

A flow-chart of the above described Soft Handover algorithm is available in Appendix C.

5.1.4.3 Soft Handover Execution

The Soft Handover is executed by means of the following procedures described in [6]:

- Radio Link Addition (FDD soft-add);
- Radio Link Removal (FDD soft-drop);
- Combined Radio Link Addition and Removal.

The serving cell(s) (the cells in the active set) are expected to have knowledge of the service used by the UE. The new cell decided to be added to the active set shall be informed that a new connection is desired, and it needs to have the following minimum information forwarded from the RNC:

- Connection parameters, such as coding schemes, number of parallel code channels etc. parameters which form the set of parameters describing the different transport channel configurations in use both uplink and downlink.
- The UE ID and uplink scrambling code.
- The relative timing information of the new cell, in respect to the timing UE is experiencing from the existing connections (as measured by the UE at its location). Based on this, the new Node-B can determine what should be the timing of the transmission initiated in respect to the timing of the common channels (CPICH) of the new cell.

As a response the UE needs to know via the existing connections:

- What channelisation code(s) are used for that transmission. The channelisation codes from different cells are not required to be the same as they are under different scrambling codes.
- The relative timing information, which needs to be made available at the new cell is indicated in Figure 5-1 (shows the case where the two involved cells are managed by different Node-Bs).

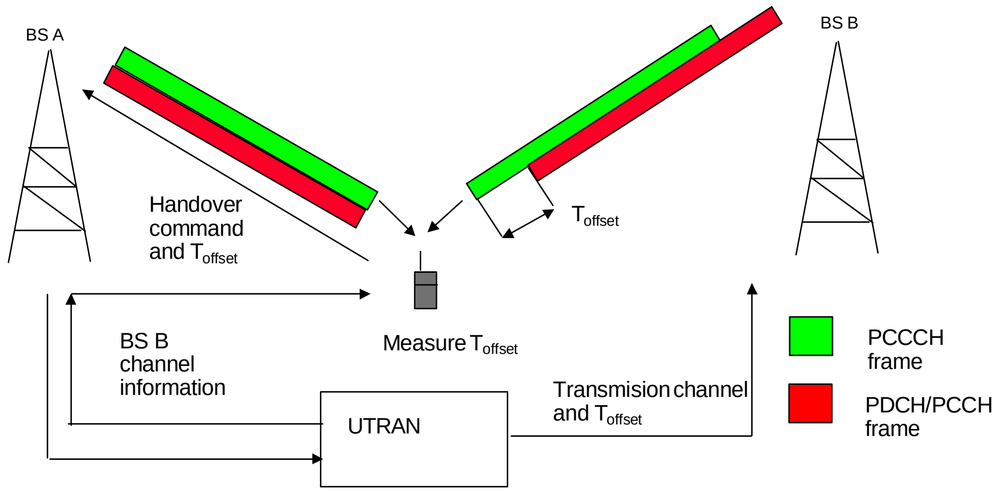


Figure 5-2: Making transmissions capable to be combined in the Rake receiver from timing point of view

At the start of diversity handover, the reverse link dedicated physical channel transmitted by the UE, and the forward link dedicated physical channel transmitted by the diversity handover source Node-B will have their radio frame number and scrambling code phase counted up continuously as usual, and they will not change at all. Naturally, the continuity of the user information mounted on them will also be guaranteed, and will not cause any interruption.

5.1.5 Inter Radio Access Technology Handover

5.1.5.1 Handover 3G to 2G

The handover from UTRA to GSM (offering world-wide coverage already today) has been one of the main design criteria taken into account in the UTRA frame timing definition.

The handover from UTRA FDD mode to GSM can also be implemented without simultaneous use of two receiver chains. Although the frame length is different from GSM frame length, the GSM traffic channel and UTRA FDD channels use similar multi-frame structure.

A UE can do the measurements by using idle periods in the downlink transmission, where such idle periods are created by using the downlink compressed mode as defined in [2]. The compressed mode is under the control of the UTRAN and the UTRAN signals appropriate configurations of compressed mode pattern to the UE. For some measurements also uplink compressed mode is needed, depending on UE capabilities and measurement objects.

Alternatively independent measurements not relying on the compressed mode, but using a dual receiver approach can be performed, where the GSM receiver branch can operate independently of the UTRA FDD receiver branch.

The handover from UTRA TDD mode to GSM can be implemented without simultaneous use of two receiver chains. Although the frame length is different from GSM frame length, the GSM traffic channel and UTRA TDD channels rely on similar multi-frame structure.

A UE can do the measurements either by efficiently using idle slots or by getting assigned free continuous periods in the downlink part obtained by reducing the spreading factor and compressing in time TS occupation in a form similar to the FDD compressed mode.

For smooth inter-operation, inter-system information exchanges are needed in order to allow the UTRAN to notify the UE of the existing GSM frequencies in the area and vice versa. Further more integrated operation is needed for the actual handover where the current service is maintained.

5.1.5.2 Handover 2G to 3G

In the following clauses, first the general concept and requirements are introduced. Next the typical flow of information is described.

5.1.5.2.1 Introduction

The description provided in the following mainly deals with the use of predefined radio configuration during handover from 2G to 3G. However, the description of the handover information flows also includes details of other RRC information transferred during handover e.g. UE radio capability and security information.

5.1.5.2.2 Predefined radio configuration information

In order to reduce the size of certain size critical messages in UMTS, a network may download/ pre- define one or more radio configurations in a mobile. A predefined radio configuration mainly consists of radio bearer- and transport channel parameters. A network knowing that the UE has suitable predefined configurations stored can then refer to the stored configuration requiring only additional parameters to be transferred.

Predefined configurations may be applied when performing handover from another RAT to UTRAN. In the case of handover from GSM to UTRAN, the performance of handover to UTRAN is improved when it is possible to transfer the handover to UTRAN command within a non-segmented GSM air interface message.

Furthermore, it is important to note that it is a network option whether or not to use pre-configuration; the handover to UTRAN procedures also support transfer of a handover to UTRAN command including all parameters and the use of default configurations.

NOTE: In case segmentation is used, subsequent segments can only be transferred after acknowledgement of earlier transmitted segments. In case of handover however, the quality of the UL may be quite poor resulting in a failure to transfer acknowledgements. This implies that it may be impossible to quickly transfer a segmented handover message. Segmentation over more than two GSM air interface messages will have a significantly detrimental, and unacceptable, impact on handover performance.

The UE shall be able to store upto 16 different predefined configurations, each of which is identified with a separate pre-configuration identity. The UE need not defer accessing the network until it has obtained all predefined configurations. The network may use different configurations for different services e.g. speech, circuit switched data. Moreover, different configurations may be needed because different UTRAN implementations may require service configurations to be customised e.g. different for micro and macro cells.

The predefined configurations stored within the UE are valid within the scope of a PLMN; the UE shall consider these configurations to be invalid upon PLMN re-selection. Furthermore, a value tag is associated with each individual pre-defined configuration. This value tag, that can have 16 values, is used by the UE and the network to ensure the stored pre-defined configuration(s) is the latest/required version. The UE erases all pre-defined configurations upon switch off.

The current facilities in 25.331 have focused on the use of predefined configurations during handover from GSM to UTRAN. The same principles may also be applied for the handover procedures used within UTRAN although this would require an extension of the currently defined RRC procedures.

5.1.5.2.2a Default configuration information

A default configuration is a set of radio bearer parameters for which the values are defined in the standard. While the network can configure the parameter values to be used in a predefined configuration in a flexible manner, the set of radio bearer parameter values for a default configuration are specified in the standard and hence fixed. The main advantage of default configurations is that they can be used at any time; they need not be downloaded into the UE.

5.1.5.2.3 Security and UE capability information

The security requirements concerning handover to UTRAN are specified in [14].

The initialisation parameters for ciphering are required to be transferred to the target RNC prior to the actual handover to UTRAN to ensure the immediate start of ciphering. For UEs involved in CS & PS domain services, R'99 specifications support handover for the CS domain services while the PS domain services are re-established later. Consequently, in R'99 only the START for the CS domain service needs to be transferred prior to handover. The START for the PS domain may be transferred at the end of the handover procedure, within the HANDOVER TO UTRAN COMPLETE message.

It should be noted that inter RAT handover normally involves a change of ciphering algorithm, in which case the new algorithm is included within the HANDOVER TO UTRAN COMMAND message.

Activation of integrity protection requires additional information transfer e.g. FRESH. Since the size of the HANDOVER TO UTRAN COMMAND message is critical, the required integrity protection information can not be included in this message. Instead, integrity protection is started immediately after handover by means of the security mode control procedure. Therefore, the HANDOVER TO UTRAN COMMAND and the HANDOVER TO UTRAN COMPLETE messages are not integrity protected.

5.1.5.2.4 UE capability information

When selecting the RRC radio configuration parameters to be included in the HANDOVER TO UTRAN COMMAND message, UTRAN should take into account the capabilities of the UE. Therefore, the UE radio capability information should be transferred to the target RNC prior to handover to UTRAN

5.1.5.2.5 Handover to UTRAN information flows, typical example

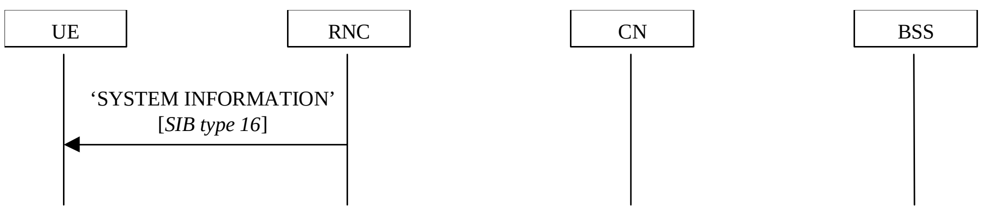
The handover to UTRAN procedure may include several subsequent information flows. The example described in this subclause is representative of a typical sequence of information flows. It should be noted that some procedures may actually be performed in parallel e.g. configuration of UTRA measurements and downloading of pre- defined configurations.

NOTE: Since work is ongoing in this area, the names of the information flows provided in the following diagrams may not reflect the latest status of standards/ CRs.

The description includes the different network nodes and interfaces involved in the handover to UTRAN procedure.

Flow 1: Downloading of predefined configuration information within UTRA

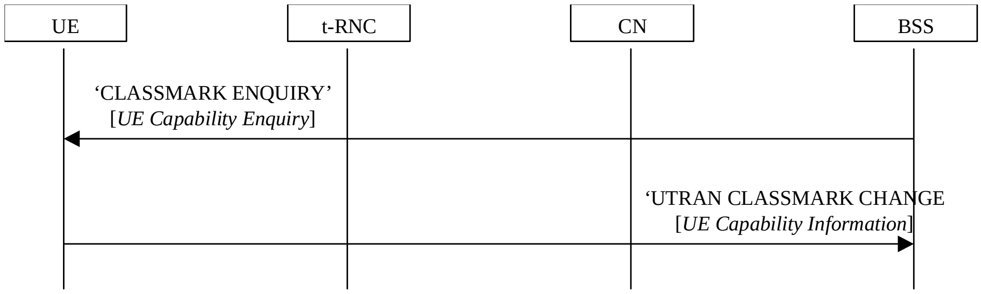
If the mobile uses UTRA prior to entering another RAT, it may download predefined configuration information as shown in the following diagram. UTRAN broadcasts predefined configuration information within the system information. The UE should read and store all the configurations broadcast by UTRAN. The configurations should be used when re- entering UTRAN.



In order to reduce the likelihood that a UE starts a call in GSM/ GPRS without having a valid pre-defined configuration stored, UEs that do not have pre-defined configurations stored may temporarily prioritise UMTS cells.

Flow 2: UE capability, security and pre- defined configuration information exchange

In order to prepare for handover to UTRAN, the BSS may retrieve UE capability, security and pre- defined configuration status information by means of the sequence shown below. This procedure may not only be invoked upon initial entry of a mobile supporting UTRA within GSM, but also when the mobile continues roaming within the GSM network. It should be noted that, the mobile could also send the information automatically by means of the early classmark change procedure.



Furthermore, pre- defined configuration status information may be transferred to the BSS during handover from UTRAN.

The BSS has to store the received information until the handover to UTRAN is invoked.

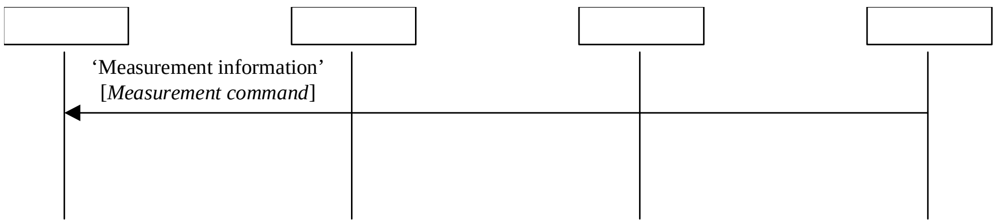
NOTE 1: During the handover procedure, the stored UE capability and security information is sent to the target RNC.

NOTE 2: Depending on the received predefined configuration status information, the BSS may need to invoke the procedure for downloading predefined configurations, as described in flow 4

Flow 3: Configuration of UTRA measurements

The BSS configures the UTRA measurements to be performed by the mobile, including the concerned thresholds and the reporting parameters, by means of the following information flow.

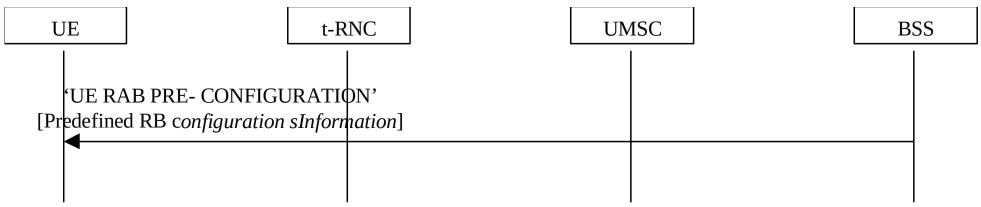
NOTE: The BSS may possibly decide the measurement configuration to be used based upon previously received UE capability information (e.g. supported modes & bands)



NOTE: The network may also provide information about neighbouring UTRAN cells within the CHANNEL RELEASE message.

Flow 4: Downloading of pre- defined radio bearer configurations within GSM

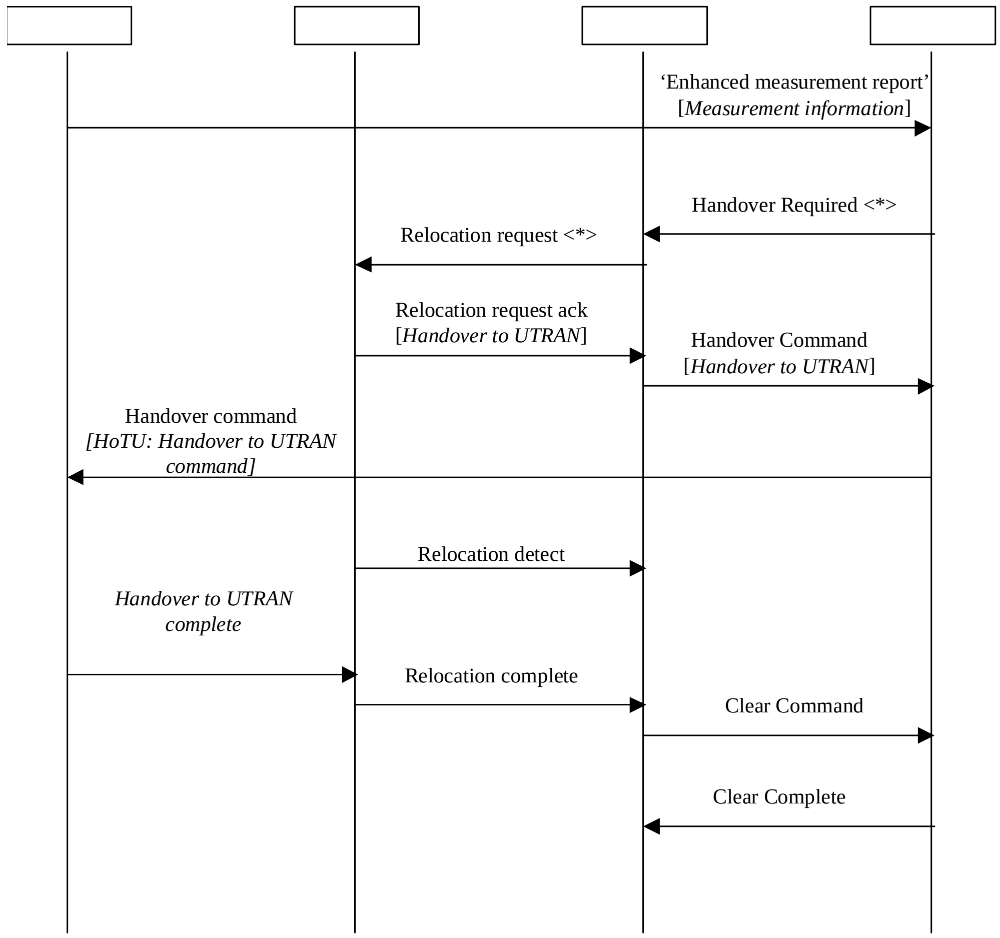
The pre-defined configuration status information (indicating which configurations are stored, as well as their value tags) is included in the UTRAN CLASSMARK CHANGE message This information may indicate that the UE does not have the required predefined configuration stored, in which case the BSS should initiate the transfer of these configurations by means of the information flow shown below.



The handover to UTRAN procedures for this release should not rely on the support of the procedure for the downloading of pre-defined radio bearer configurations within GSM.

Flow 5: Handover

When the BSS decides that handover to UTRAN should be performed, triggered by the reception of a measurement report, it initiates the handover procedure. Next, the CN requests resources by sending a Relocation request to the target RNC. This message should include the UE capability and security information previously obtained by the BSS. The pre- defined configuration status information should be included in the Relocation request also. The main reason for this it that when selecting the predefined configuration to be indicated within the handover to UTRAN command message, the target RNC should know if the UE has downloaded all predefined configurations or only a subset.



The relocation request includes an indication of the service type for which the handover is requested. This information is used by the target RNC to select the predefined configuration to be used by the UE, which is included within the handover to UTRAN command.

In case no (suitable) predefined configuration is stored within the UE, the network may either completely specify all radio bearer, transport channel and physical channel parameters or apply a default configuration (FFS).

5.1.5.3 Handover from UTRAN to GERAN Iu mode

The existing handover mechanisms defined for 3G to 2G handover are reused, see 5.1.5.1 and 5.1.7.

5.1.5.4 Handover from GERAN Iu mode to UTRAN

The existing handover mechanisms defined for 2G to 3G handover are reused, see 5.1.5.2 and 5.1.7.

5.1.6 Measurements for Handover

5.1.6.1 Monitoring of FDD cells on the same frequency

The UE shall be able to perform intra-frequency measurements simultaneously for data reception from the active set cell/s. If one or several compressed mode pattern sequences are activated, intra frequency measurements can be performed between the transmission gaps. During the measurement process of cells on the same frequencies, the UE shall find the necessary synchronisation to the cells to measure using the primary and secondary synchronisation channels and also the knowledge of the possible scrambling codes in use by the neighbouring cells.

The number of intra-frequency cells which the UE is able to measure and report to the UTRAN depends on the amount of time available to perform these measurements i.e. the time left by the activation of all compressed mode pattern sequences the UTRAN may activate is able to support depending on its capability (FDD, TDD, GSM). The rules to derive the number of cells, which can be reported by the UE depending on the characteristics of the activated compressed mode patterns, are given in [16].

5.1.6.2 Monitoring cells on different frequencies

5.1.6.2.1 Monitoring of FDD cells on a different frequency

Upper layers may ask FDD UE to perform preparation of inter-frequency handover to FDD. In such case, the UTRAN signals to the UE the neighbour cell list and if needed, the compressed mode parameters used to make the needed measurements. Setting of the compressed mode parameters defined in [3] for the preparation of handover from UTRA FDD to UTRA FDD is indicated in the following subclause. Measurements to be performed by the physical layer are defined in [3].

5.1.6.2.1.1 Setting of parameters for transmission gap pattern sequence with purpose "FDD" measurements

During the transmission gaps, the UE shall perform measurements so as to be able to report to the UTRAN the frame timing, the scrambling code and the Ec/Io of Primary CCPCH of up FDD cells in the neighbour cell list.

When requiring the UE to monitor inter-frequency FDD cells, the UTRAN may use any transmission gap pattern sequence with transmission gaps of length 5, 7, 10 and 14 slots.

The time needed by the UE to perform the required inter-frequency measurements according to what has been requested by the UTRAN depends on the transmission gap pattern sequence characteristics such as e.g. TGD, TGPL and TGPRC. The rules to derive these measurement times are given in [16].

5.1.6.2.2 Monitoring of TDD cells

Upper layers may ask dual mode FDD/TDD UE to perform preparation of inter-frequency handover to TDD. In such case, the UTRAN signals to the UE the handover monitoring set, and if needed, the compressed mode parameters used to make the needed measurements. Setting of the compressed mode parameters defined in [3] for the preparation of handover from UTRA FDD to UTRA TDD is indicated in the following subclause. Measurements to be performed by the physical layer are defined in clause 5.

5.1.6.2.2.1 Setting of the compressed mode parameters

When compressed mode is used for cell acquisition at each target TDD frequency, the parameters of compressed mode pattern are fixed to be:

TGL	TGD	TGP	PD

NOTE: settings for cell acquisition are FFS.

5.1.6.2.2.2 Setting of compressed mode parameters with prior timing information between FDD serving cell and TDD target cells

When UTRAN or UE have this prior timing information, the compressed mode shall be scheduled by upper layers with the intention that SCH on the specific TDD base station can be decoded at the UE during the transmission gap.

TGL	SFN	SN
4	(calculated by UTRAN)	(calculated by UTRAN)

5.1.6.2.3 Monitoring of GSM cells

In the context of the measurements, the term GSM refers to both GERAN A/Gb mode and GERAN Iu mode.

Upper layers may ask a dual RAT FDD/GSM UE to perform preparation of inter-frequency handover to GSM. In such case, the UTRAN signals to the UE the neighbour cell list and, if needed, the compressed mode parameters used to make the needed measurements.

The involved measurements are covered by 3 measurement purposes "GSM RSSI" (Subclause 5.1.6.2.3.1), "GSM BSIC identification" (Subclause 5.1.6.2.3.2) and "GSM BSIC reconfirmation" (Subclause 5.1.6.2.3.3). A different transmission gap pattern sequence is supplied for each measurement purpose. This implies that when the UE is monitoring GSM, up to 3 transmission gap pattern sequences can be activated by the UTRAN.

5.1.6.2.3.1 Setting of parameters for transmission gap pattern sequence with purpose "GSM RSSI"

When compressed mode is used for GSM RSSI measurements, any transmission gap pattern sequence can be used which contains transmission gap of lengths 3, 4, 7, 10 or 14 slots.

In order to fulfil the expected GSM power measurements requirement, the UE can get effective measurement samples during a time window of length equal to the transmission gap length reduced by an implementation margin that includes the maximum allowed delay for a UE's synthesiser to switch from one FDD frequency to one GSM frequency and switch back to FDD frequency, plus some additional implementation margin.

The number of samples that can be taken by the UE during the allowed transmission gap lengths and their distribution over the possible GSM frequencies is given in [16].

5.1.6.2.3.2 Setting of parameters for transmission gap pattern sequence with purpose "GSM initial BSIC identification"

The setting of the compressed mode parameters is described in this subclause when used for first SCH decoding of one cell when there is no knowledge about the relative timing between the current FDD cells and the neighbouring GSM cell.

The table below gives a set of reference transmission pattern gap sequences that might be used to perform BSIC identification i.e. initial FCCH/SCH acquisition.

The time available to the UE to perform BSIC identification is equal to the transmission gap length minus an implementation margin that includes the maximum allowed delay for a UE's synthesiser to switch from one FDD frequency to one GSM frequency and switch back to FDD frequency, the UL/DL timing offset, and the inclusion of the pilot field in the last slot of the transmission gap for the case of downlink compressed mode.

	TGL1 [slots]	TGL2 [slots]	TGD [slots]	TGPL1 [frames]	TGPL2 [frames]	$T_{identify\ abort}$ [s]	$N_{identify\_abort}$ [patterns]
Pattern 1	7	0	0	3	0	1.53	51
Pattern 2	7	0	0	8	0	5.20	65
Pattern 3	7	7	47	8	0	2.00	25
Pattern 4	7	7	38	12	0	2.88	24
Pattern 5	14	0	0	8	0	1.76	22
Pattern 6	14	0	0	24	0	5.04	21
Pattern 7	14	14	45	12	0	1.44	12
Pattern 8	10	0	0	12	0	2.76	23
Pattern 9	10	10	75	12	0	1.56	13
Pattern 10	8	0	0	8	0	2.80	35
Pattern 11	8	0	0	4	0	1.52	38

For the above listed compressed mode patterns sequences, $N_{identify\ abort}$ indicates the maximum number of patterns from the transmission gap pattern sequence which may be devoted by the UE to the identification of the BSIC of a given cell. $T_{identify\ abort}$ times have been derived assuming the serial search and two SCH decoding attempts since the parallel search is not a requirement for the UE.

Each pattern corresponds to a different compromise between speed of GSM SCH search and rate of use of compressed frames. Requirements are set in [16] to ensure a proper behaviour of the UE depending on the signalled parameters.

5.1.6.2.3.3 Setting of parameters for transmission gap pattern sequence with purpose "GSM BSIC reconfirmation".

BSIC reconfirmation is performed by the UE using a separate compressed mode pattern sequence (either the same as for BSIC identification or a different one). When the UE starts BSIC reconfirmation for one cell using the compressed mode pattern sequence signalled by the UTRAN, it has already performed at least one decoding of the BSIC (during the initial BSIC identification).

UTRAN may have some available information on the relative timing between GSM and UTRAN cells. Two alternatives are considered for the scheduling of the compressed mode pattern sequence by the UTRAN for BSIC reconfirmation depending on whether or not UTRAN uses the timing information provided by the UE.

The requirements on BSIC reconfirmation are set in [16] independently of how the transmission gap pattern sequence are scheduled by the UTRAN. These requirements apply when the GSM SCH falls within the transmission gap of the transmission gap pattern sequence with a certain accuracy. The UTRAN may request the UE to re-confirm several BSICs within a given transmission gap.

The UTRAN may use any transmission gap pattern sequence with transmission gap length 5, 7, 8, 10 or 14 slots for BSIC reconfirmation. For the following reference transmission gap pattern sequences, $T_{re\text{-}confirm\_abort}$ indicates the maximum time allowed for the re-confirmation of the BSIC of one GSM cell in the BSIC re-confirmation procedure, assuming a worst-case GSM timing. This parameter is signalled by the UTRAN to the UE with the compressed mode parameters.

	TGL1 [slots]	TGL2 [slots]	TGD [slots]	TGPL1 [frames]	TGPL2 [frames]	$T_{re\text{-}confirm\_abort}$ [s]	$N_{re\text{-}confirm\_abort}$ [patterns]
Pattern 1	7	0	0	3	0	1.29	43
Pattern 2	7	0	0	8	0	4.96	62
Pattern 3	7	0	0	15	0	7.95	53
Pattern 4	7	7	69	23	0	9.89	43
Pattern 5	7	7	69	8	0	2.64	33
Pattern 6	14	0	0	8	0	1.52	19
Pattern 7	14	14	60	8	0	0.80	10
Pattern 8	10	0	0	8	0	1.76	22
Pattern 9	10	0	0	24	0	4.80	20
Pattern 10	8	0	0	8	0	2.56	32
Pattern 11	8	0	0	23	0	7.82	34
Pattern 12	7	7	47	8	0	1.76	22
Pattern 13	7	7	38	12	0	2.64	22
Pattern 14	14	0	0	24	0	4.80	20
Pattern 15	14	14	45	12	0	1.20	10
Pattern 16	10	0	0	12	0	2.52	21
Pattern 17	10	10	75	12	0	1.32	11
Pattern 18	8	0	0	4	0	1.28	32

NOTE: it is to be decided within RAN WG4 whether 18 patterns should be kept for BSIC reconfirmation.

5.1.6.2.3.3.1 Asynchronous BSIC reconfirmation

In this case, the UTRAN provides a transmission gap pattern sequence without using information on the relative timing between UTRAN and GSM cells.

The way the UE should use the compressed mode pattern for each cell in case the BSIC reconfirmation is required for several cells is configured by the UTRAN using the $N_{re\text{-}confirm\_abort}$ parameter, which is signalled with the transmission gap pattern sequence parameters. Requirements are set in [16] to ensure a proper behaviour of the UE depending on the signalled parameters.

5.1.6.2.3.3.2 Synchronous BSIC reconfirmation

When UTRAN has prior timing information, the compressed mode can be scheduled by upper layers with the intention that SCH(s) (or FCCH(s) if needed) of one or several specific GSM cells can be decoded at the UE during the transmission gap(s) i.e. the transmission gap(s) are positioned so that the SCH(s) of the target GSM cell(s) are in the middle of the effective measurement gap period(s). Which BSIC is to be reconfirmed within each gap is not explicitly signalled, but determined by the UE based on prior GSM timing measurements.

5.1.7 Transfer of RRC information across interfaces other than Uu

5.1.7.1 Introduction and general principles

During several procedures, e.g. handover to UTRAN, handover from UTRAN, SRNC relocation RRC information may need to be transferred across interfaces other than the UTRA air interface (Uu), e.g. Iu, A, Um interface. In order to maintain independence between the different protocols, to facilitate transparent handling by intermediate network nodes and to ease future extension, the preference is to use RRC information containers across such interfaces. In some cases however RRC messages may be used, e.g. for historical reasons.

An RRC information container is an extensible self-contained information unit that can be decoded without requiring information about the context, e.g. in which interface message it was included. In general an RRC information container is defined for each node that terminates/receives RRC information, e.g. the source RAT, target RNC. By definition, an RRC information container includes a choice facilitating the transfer of different types of RRC information.

In the following a typical example of an RRC information container is provided:

```
-- ***************************************************
--
-- RRC information, to target RNC
--
-- ***************************************************
-- RRC Information to target RNC sent either from source RNC or from another RAT
```

```
ToTargetRNC-Container ::= CHOICE {
 InterRAThandover                    InterRATHandoverInfoWithInterRATCapabilities,
 srncRelocation                      SRNC-RelocationInfo,
 extension                           NULL
}
```

The term RRC message is used for the RRC information identified by a choice value, e.g. HANDOVER TO UTRAN COMMAND, INTER RAT HANDOVER INFO. The characteristics and handling defined for these RRC messages to a large extent resemble the RRC messages transferred across the Uu interface. The specification focuses on UE requirements. Hence, RRC messages that originate from/terminate in the UE/ MS are treated in the main clauses (clauses 8, 9, 10) while the other RRC messages are specified in clause 14 of TS 25.331.

As stated before, RRC information containers have been defined to limit the impact of transferring RRC information across other interfaces. Intermediate nodes transparently pass the information carried in such containers; only the originating and terminating entities process the information. This transparency makes the protocols independent. In case there is RRC information on which intermediate nodes need to act, the information elements should be introduced in the corresponding interface protocols. If the information is to be passed on to another target node also, this may result in duplication of information. For RRC information containers the same extension mechanism as defined for RRC messages applies; both critical and non-critical extensions may be added. If the extension would not be defined at RRC information container level, other interface specification would be affected whenever the RRC information would be extended.

In some cases information in containers is exchanged by peer entities that do not speak the same (protocol) language, e.g. a GSM BSC may have to exchange information with a UTRA RNC. For such cases, it has been agreed that the source/sender of the information adapts to the target/receiver, e.g. upon handover to UTRAN the BSS provides RANAP information within a Source to Target RNC transparent container.

NOTE: The handover to UTRAN info is not only transferred from UE, via BSS to target RNC but may also be returned to another BSS, to be forwarded later on to another RNC. To simplify the handling of RRC information in network nodes, it is therefore desirable to align the format of the RRC information used in both directions. The alignment of formats used in the different directions is not considered to violate these general principles, since for this information that is moved forwards and backwards it is difficult to speak of source and target anyhow.

The error handling for RRC information containers that are terminated in network nodes applies the same principles as defined for RRC messages. A network node receiving an invalid RRC information container (unknown, unforeseen or erroneous container) from another network node should return an RRC INFORMATION FAILURE message and include an appropriate cause value within IE "Protocol error cause". Although the return of a failure container is considered desirable, no compelling need has been identified to introduce support for transferring this failure container in R'99 for all concerned interface protocols. In case the interface protocols do not support the failure procedure, the failure may instead be indicated by means of a cause value that is already defined within the interface protocol.

5.1.7.2 Message sequence diagrams

As stated before, most RRC information is carried by means of containers across interfaces other than Uu. The following sequence diagrams illustrate which RRC messages should be included within these RRC information containers used across the different network interfaces. Concerning the contents of RRC messages, i.e. when optional IEs should be included, requirements are specified in TS 25.331 only for the RRC messages originated/terminated in the UE, since the RRC specification focuses on UE requirements.

NOTE: In order to maintain independence between protocols, no requirements are included in the interface protocols that are used to transfer the RRC information.

For each of the different message sequences not only the details on the RRC information transferred are provided, but also deviations from the general principles described in the previous are highlighted. One common deviation from the general principles is that containers are not used for any RRC information transferred across the GSM air interface; in all these cases RRC messages are used instead (mainly for historical reasons).

The following two figures illustrate~~s~~ the message sequence for the handover to UTRAN procedure:

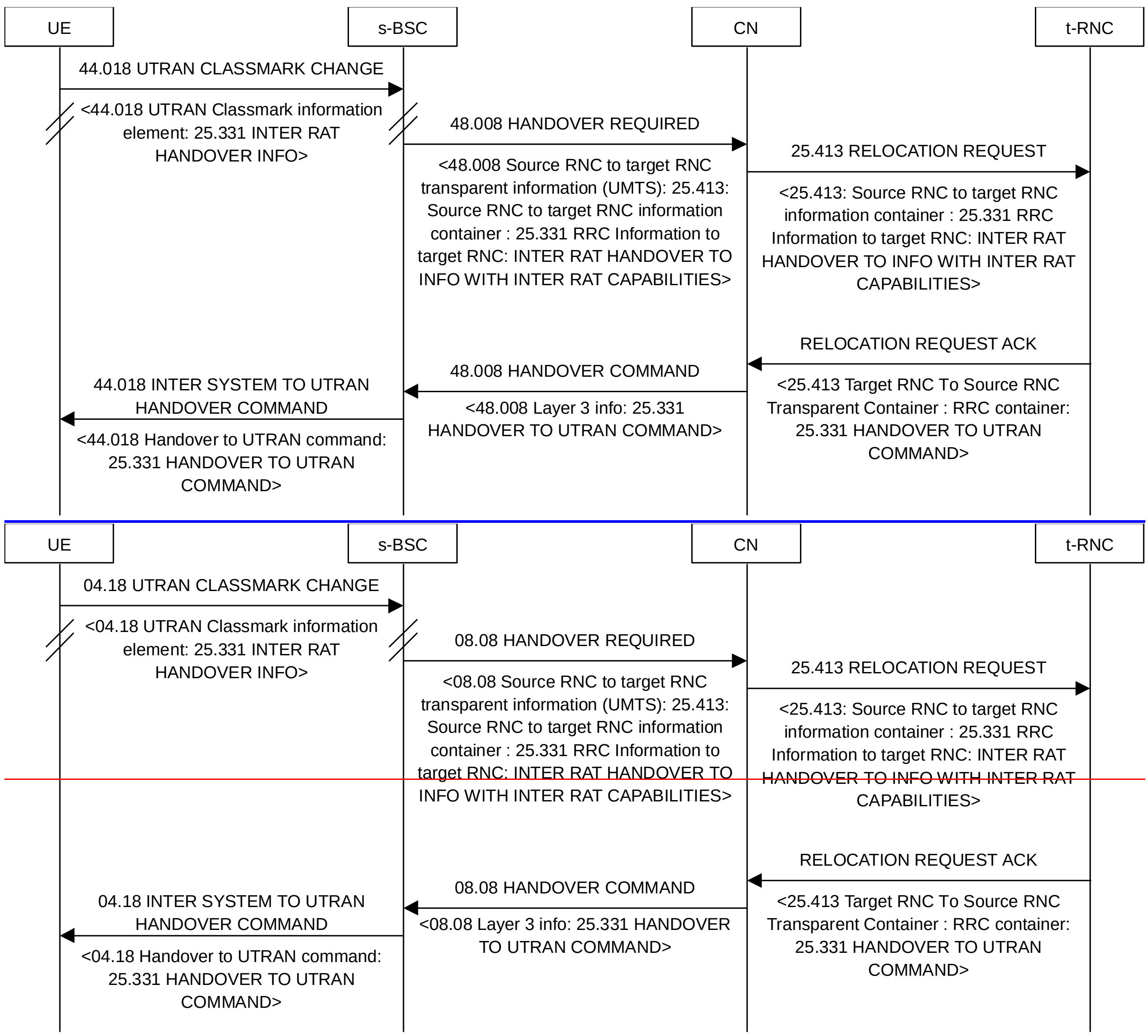


Figure 5.1.7.2-1: Handover from GERAN A/Gb mode to UTRAN, normal flow

As can be seen in the previous figure, the RRC information transfer within the handover from GERAN A/Gb mode to UTRAN procedure deviates from the common principles in the following areas:

- Containers are not used to transfer the HANDOVER TO UTRAN COMMAND message across the Iu and the A-interface.

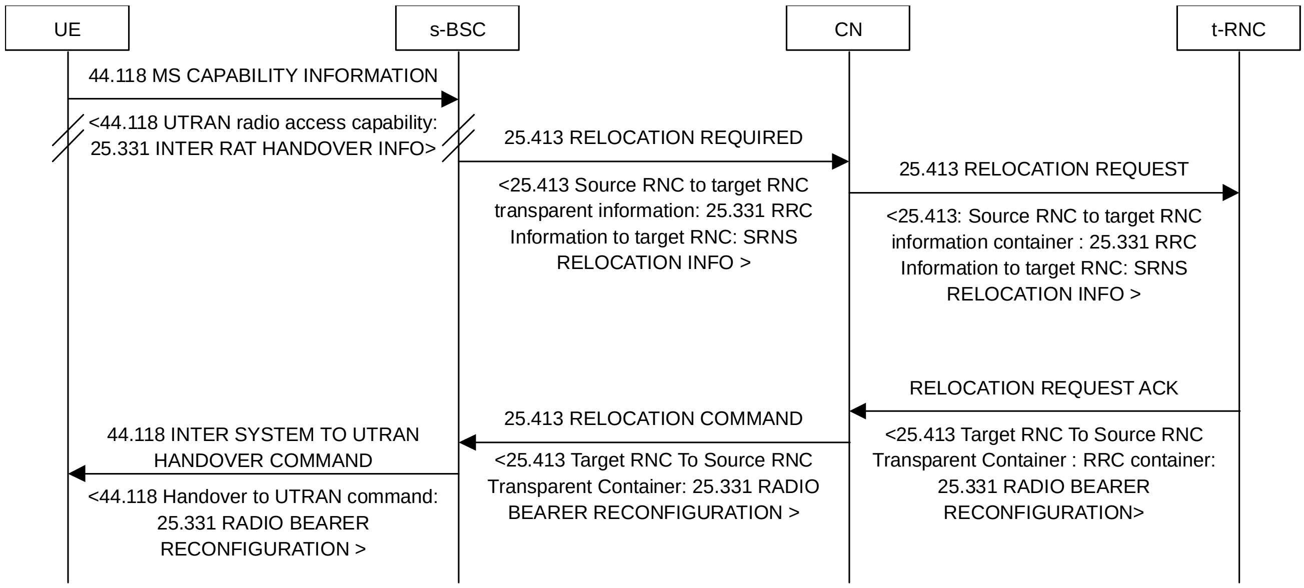


Figure 5.1.7.2-1a: Handover from GERAN Iu mode to UTRAN, normal flow

NOTE: The UTRAN RRC message to be encapsulated in 44.118:INTER SYSTEM TO UTRAN HANDOVER COMMAND is FFS.

~~As can be seen in the previous figure, the RRC information transfer within the handover to UTRAN procedure deviates from the common principles in the following areas:~~

- ~~Containers are not used to transfer the HANDOVER TO UTRAN COMMAND message across the Iu and the A-interface.~~

The following two figures illustrate~~s~~ the message sequence for the handover from UTRAN procedure:

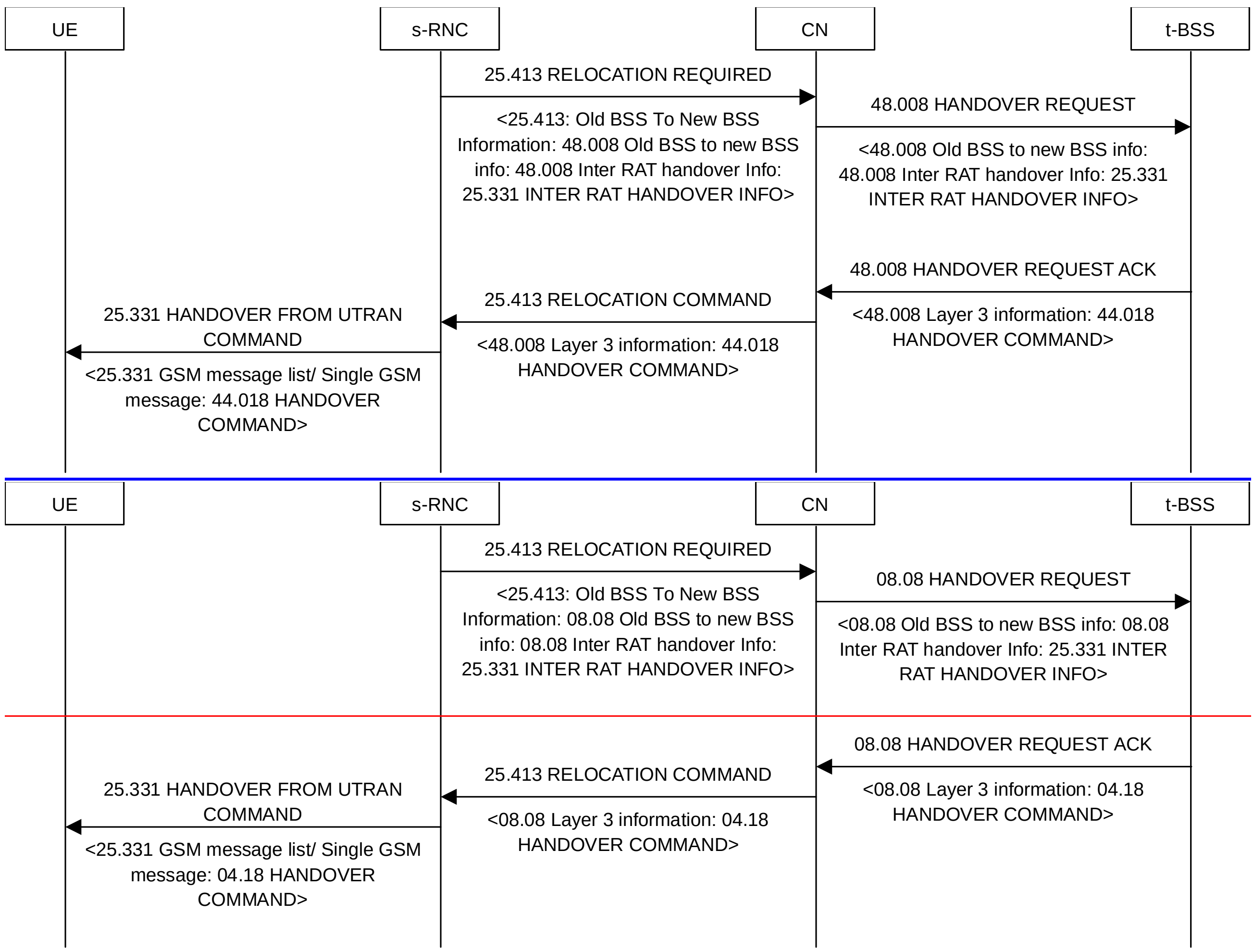


Figure 5.1.7.2-2: Handover from UTRAN to GERAN A/Gb mode, normal flow

As can be seen in the previous figure, the RRC information transfer within the handover from UTRAN to GERAN A/Gb mode procedure deviates from the common principles in the following areas:

- Containers are not used to transfer the INTER RAT HANDOVER INFO message across the Iu and the A- interface.

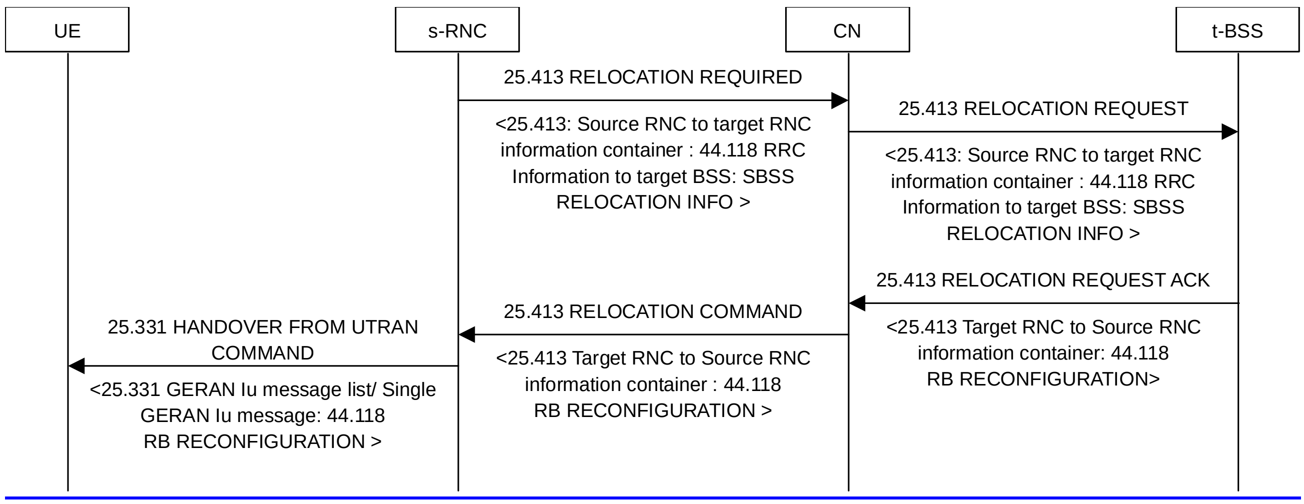


Figure 5.1.7.2-2a: Handover from UTRAN to GERAN Iu mode, normal flow

~~As can be seen in the previous figure, the RRC information transfer within the handover from UTRAN procedure deviates from the common principles in the following areas:~~

- ~~Containers are not used to transfer the INTER RAT HANDOVER INFO message across the Iu and the A-interface.~~

The following figure illustrates the message sequence for the SRNS relocation procedure:

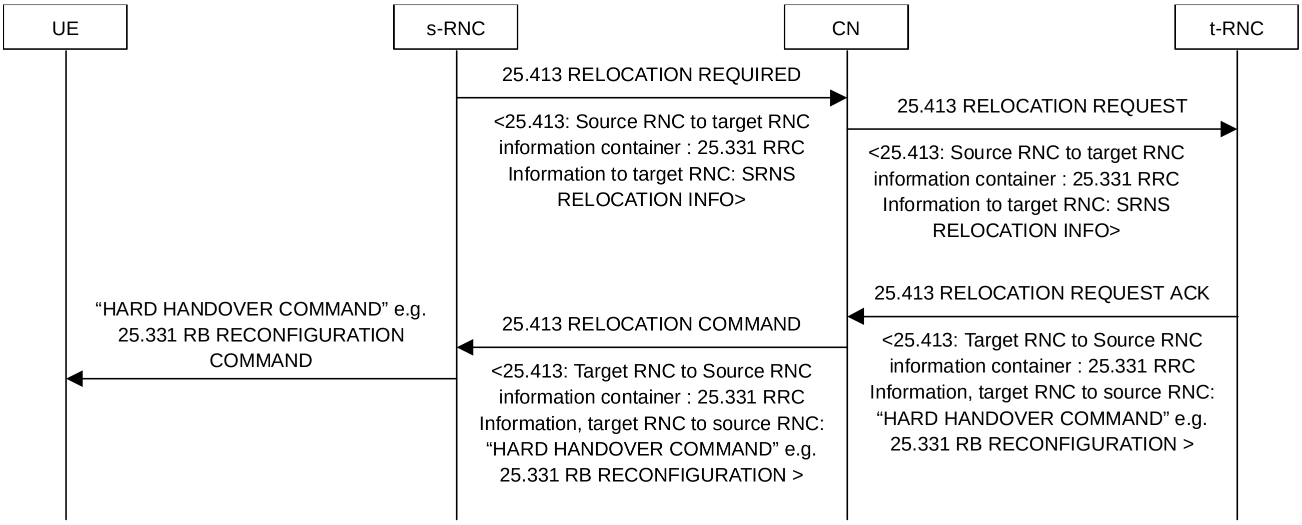


Figure 5.1.7.2-3: SRNS relocation, normal flow

As can be seen in the previous figure, the RRC information transfer within the SRNS relocation procedure does not deviate from the common principles.

The following two figures, showing the message sequence for the inter BSC handover (GERAN A/Gb mode) and SBSS relocation (GERAN Iu mode), are~~is~~ provided for completeness.

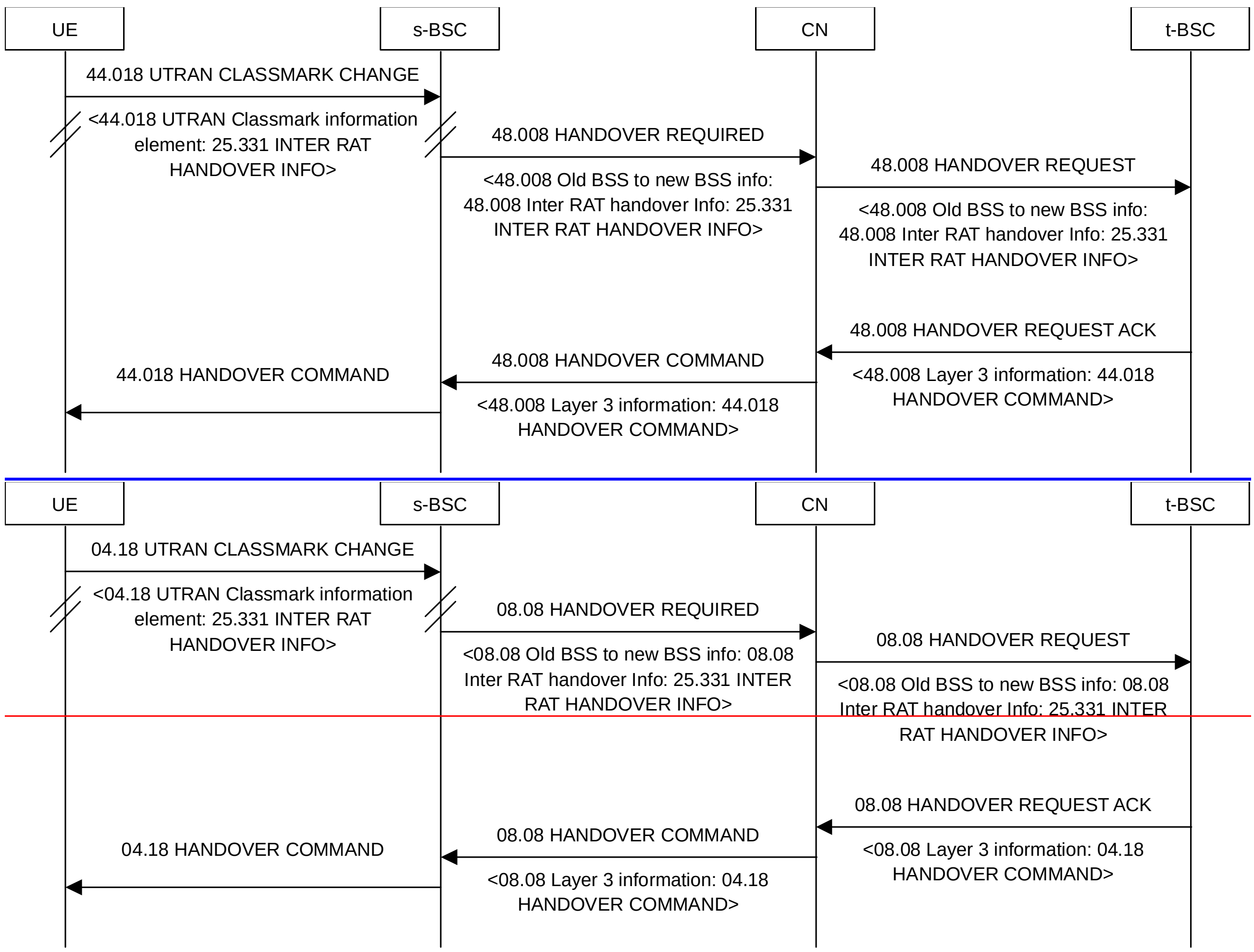


Figure 5.1.7.2-4: Inter BSC handover, GERAN A/Gb mode, normal flow

As can be seen in the previous figure, the RRC information transfer within the inter BSC handover procedure deviates from the common principles in the following areas:

- Containers are not used to transfer the INTER RAT HANDOVER INFO message across the A-interface.

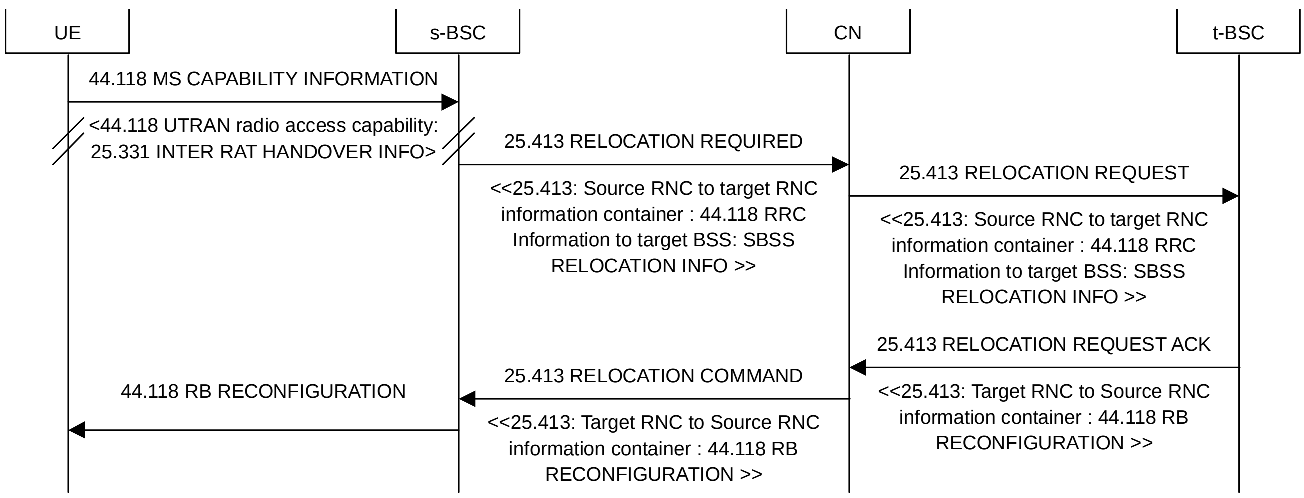


Figure 5.1.7.2-4a: SBSS relocation, GERAN Iu mode, normal flow

~~As can be seen in the previous figure, the RRC information transfer within the inter BSC handover procedure deviates from the common principles in the following areas:~~

- ~~Containers are not used to transfer the INTER RAT HANDOVER INFO message across the A-interface.~~

5.1.7.3 General error handling for RRC containers

As indicated in the previous sections, the characteristics and the handling of RRC messages transferred across other interfaces than Uu is the same as that of regular RRC messages. This equally applies for the extension of such messages as well as for the related general error handling. In this section three generic error handling cases are distinguished that have distinct characteristics that are specific to RRC containers.

<u>RRC message sent by UE via another RAT</u>

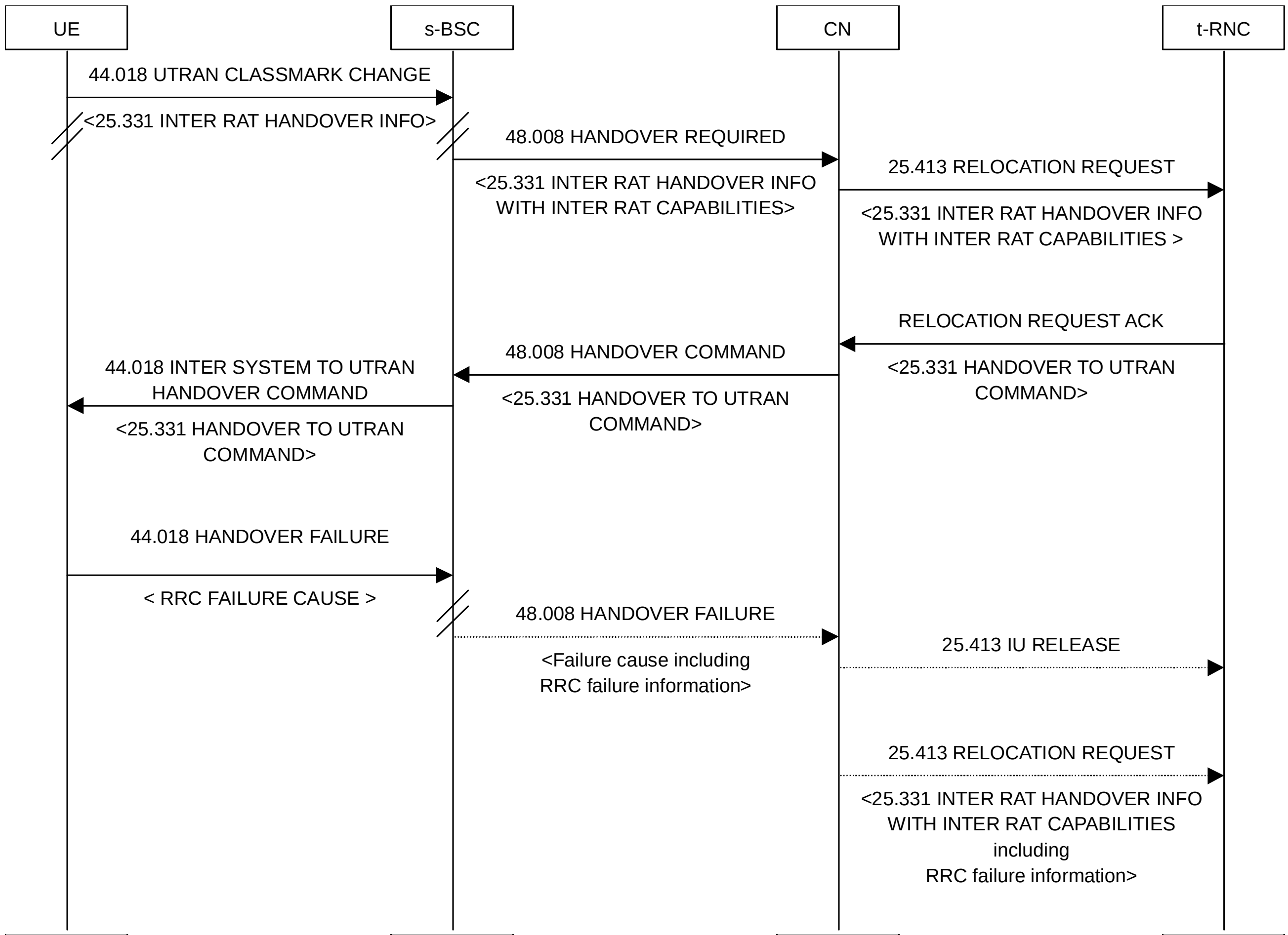
As for regular messages, only non-critical extensions apply in uplink. Upon not comprehending a non-critical extension, the receiver just ignores this information and processes the other parts as if the not comprehended extension was absent. Hence, it is not applicable to use a RRC FAILURE INFO message in the reverse direction.

For the HANDOVER TO UTRAN INFO message, the BSS not only transparently passes the information received from the UE, but also adds information and includes it in an RRC container to be forwarded to the target RNC. For information originated and terminated in a network nodes both critical and non-critical extensions apply. Since critical extensions applies for the information inserted by the BSS, they also apply for the HANDOVER TO UTRAN INFO WITH INTER RAT CAPABILITIES message that includes them. The corresponding RRC FAILURE INFO message would be terminated in the BSS.

<u>RRC container information terminated in UE (HANDOVER TO UTRAN COMMAND)</u>

In case of a not comprehended critical extension, the UE shall reject the handover and return a failure message towards the BSC. The RRC procedure also states that a RRC FAILURE INFO message should be included, depending on system specific procedures. The (network) interface signalling procedures do not support the transfer of this RRC message which is not a problem since the extension mechanism does not require it. Instead a cause value may be returned.

If the INTER SYSTEM TO UTRAN HANDOVER FAILURE message used across the GSM air interface would support the transfer of the RRC FAILURE INFO message, the RRC message would not be passed beyond the source BSC since there are no further signalling procedures. However, when needed, this failure information may be transferred to the t-RNC in a subsequent attempt to perform handover for the same UE and to the same RNC. To accommodate this, the HANDOVER TO UTRAN INFO message may include the failure information. This is illustrated in the following figure:


UE
s-BSC
CN
t-RNC
44.018 UTRAN CLASSMARK CHANGE
<25.331 INTER RAT HANDOVER INFO>
48.008 HANDOVER REQUIRED
<25.331 INTER RAT HANDOVER INFO WITH INTER RAT CAPABILITIES>
25.413 RELOCATION REQUEST
<25.331 INTER RAT HANDOVER INFO WITH INTER RAT CAPABILITIES >
RELOCATION REQUEST ACK
<25.331 HANDOVER TO UTRAN COMMAND>
48.008 HANDOVER COMMAND
<25.331 HANDOVER TO UTRAN COMMAND>
44.018 INTER SYSTEM TO UTRAN HANDOVER COMMAND
<25.331 HANDOVER TO UTRAN COMMAND>
44.018 HANDOVER FAILURE
< RRC FAILURE CAUSE >
48.008 HANDOVER FAILURE
<Failure cause including RRC failure information>
25.413 IU RELEASE
25.413 RELOCATION REQUEST
<25.331 INTER RAT HANDOVER INFO WITH INTER RAT CAPABILITIES including RRC failure information>

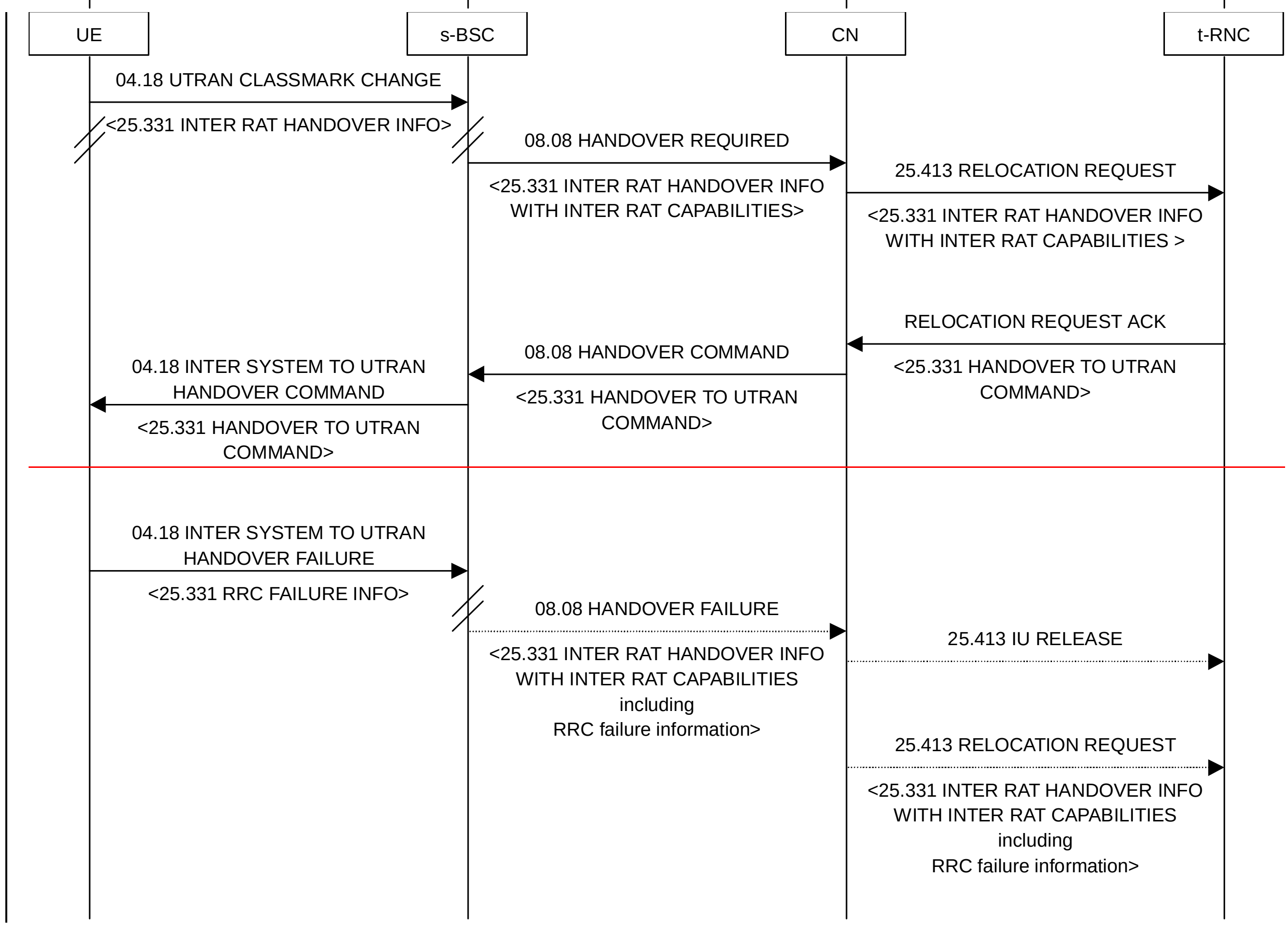

UE
s-BSC
CN
t-RNC
04.18 UTRAN CLASSMARK CHANGE
<25.331 INTER RAT HANDOVER INFO>
08.08 HANDOVER REQUIRED
<25.331 INTER RAT HANDOVER INFO WITH INTER RAT CAPABILITIES>
25.413 RELOCATION REQUEST
<25.331 INTER RAT HANDOVER INFO WITH INTER RAT CAPABILITIES >
RELOCATION REQUEST ACK
<25.331 HANDOVER TO UTRAN COMMAND>
08.08 HANDOVER COMMAND
<25.331 HANDOVER TO UTRAN COMMAND>
04.18 INTER SYSTEM TO UTRAN HANDOVER COMMAND
<25.331 HANDOVER TO UTRAN COMMAND>
04.18 INTER SYSTEM TO UTRAN HANDOVER FAILURE
<25.331 RRC FAILURE INFO>
08.08 HANDOVER FAILURE
<25.331 INTER RAT HANDOVER INFO WITH INTER RAT CAPABILITIES including RRC failure information>
25.413 IU RELEASE
25.413 RELOCATION REQUEST
<25.331 INTER RAT HANDOVER INFO WITH INTER RAT CAPABILITIES including RRC failure information>

Figure 5.1.7.3-1: Handover from GERAN A/Gb mode to UTRAN, failure due to critical extension not supported by UE

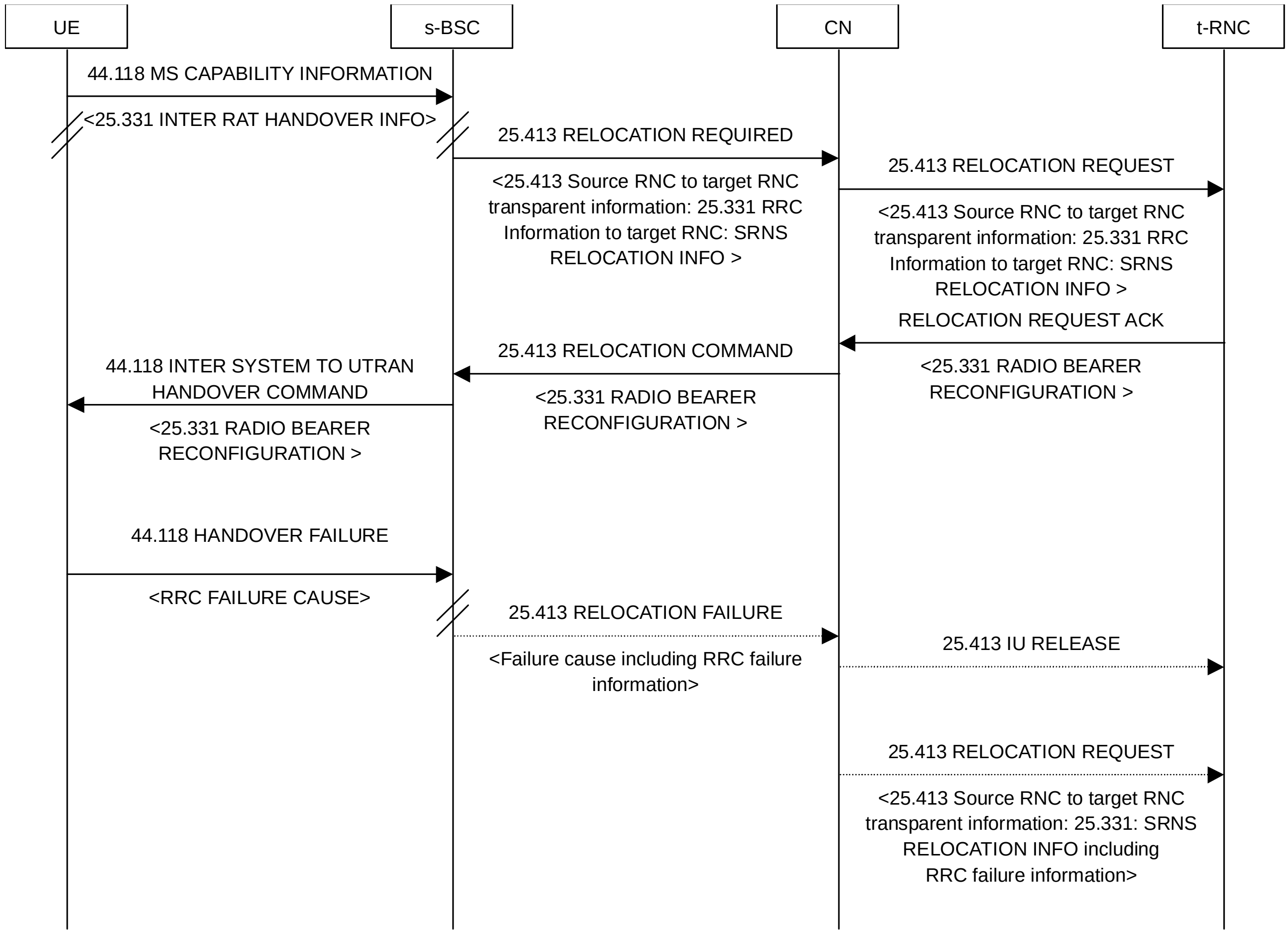


Figure 5.1.7.3-1a: Handover from GERAN Iu mode to UTRAN, failure due to critical extension not supported by UE

NOTE: The UTRAN RRC message to be encapsulated in 44.118:INTER SYSTEM TO UTRAN HANDOVER COMMAND is FFS.

RRC container information terminated in network (SRNS relocation info & commands)

This case is basically the same as for the handover to UTRAN command, although in this case the container is really terminated by the s-RNC. Nevertheless, in case the hard handover command includes a critical extension that the UE does not comprehend, it will notify the s-RNC by means of the applicable failure message including IE "Protocol error cause" set to "Message extension not comprehended". If a failure notification is desired towards the t-RNC upon a subsequent attempt to perform the handover, the s-RNC has to generate this based on the received protocol error information.