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Technical Report

**Digital cellular telecommunications system (Phase 2+);
Universal Mobile Telecommunications System (UMTS);
Network Assisted Cell Change (NACC) from UTRAN to GERAN;
Network side aspects
(3GPP TR 25.901 version 7.0.0 Release 7)**

**GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS**

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Foreword

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The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Contents

Foreword

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

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

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1   presented to TSG for information;

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y   the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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1 Scope

This present document is for the 3GPP Release 6 Work Item "Network Assisted Cell Change – Network Side Aspects.".

The purpose of the present document is to aid TSG RAN WG3 to standardise the signalling of relevant GERAN information during cell re-selection across the relevant UTRAN interfaces.

This document is intended to gather all information in order to compare the solutions and to draw a conclusion on the way forward.

This document is a 'living' document, i.e. it is permanently updated and presented to TSG-RAN meetings.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 44.060: "3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol".

[2] 3GPP TS 44.901: "3rd Generation Partnership Project:; Technical Specification Group GSM/EDGE Radio Access Network; External Network Assisted Cell Change".

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

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Local RNC: the local RNC(s) to a given cell or BSS is/are the RNC(s) with cells which are neighbouring to the GERAN cell or BSC.

Remote RNC: an RNC is remote to a given GERAN cell or BSS if none of its cells are neighbours of the GERAN cell or BSS.

3.2 Symbols

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

Gb Interface between the BSS and the 2G SGSN
Gn Interface between two GSNs in the same PLMN

3.3 Abbreviations

Applicable abbreviations can be found in [3]. For the purposes of the present document, the following abbreviations apply:

BSSGP	Base Station Subsystem GPRS Protocol
DRNC	Drift RNC
GERAN	GSM/EDGE Radio Access Network
NACC	Network Assisted Cell Change
PSI	Packet System Information
RAN	Radio Access Network
RIM	RAN Information Management
RNC	Radio Network Controller
SI	System Information
SRNC	Serving RNC

4 Introduction

At the 3GPP TSG RAN #19 meeting, the Work Item Description on "Network Assisted Cell Change from UTRAN to GERAN – Network Aspects" was approved.

In today's GPRS networks (without NACC), cell re-selection can causes a service interruption in the region of 4 – 8 seconds, which obviously has an impact on the user experience. Similar interruption times can be expected in mixed UMTS and GPRS networks, during UE cell re-selection from UTRAN to GERAN.

Consequences of this: e.g. TCP applications may time-out at cell change and suffer from the slow-start mechanism, streaming applications may stop at cell change due to client buffer depletion. All such problems will lead to an unacceptable user experience.

This "Network Assisted Cell Change" feature has already been introduced in the GERAN specifications and the appropriate changes have been to the RLC/MAC protocol [1] within Release 4. Additional enhancements were approved in Release 5 in order to exchange (Packet) System Information between BSSs, so that NACC can work across BSS boundaries.

Currently, there are procedures defined on the Gb and Gn interfaces to enable signalling of GERAN SI/PSI between BSSs. This *RAN Information Management (RIM)* mechanism was defined initially for the use of NACC, although in a manner that could be extended for applications other than NACC. It consists of the following messages:

- RAN INFORMATION REQUEST - from Source BSS to Target BSS – requests GERAN SI/PSI.

- RAN INFORMATION – from target BSS to source BSS – analogous to the Information Exchange over Iur and includes GERAN SI/PSI for one or more GERAN cells.

- RAN INFORMATION ACKNOWLEDGE – from Source BSS to Target BSS.

- RAN INFORMATION ERROR - to inform about e.g. message syntax errors.

In Release 5, TSG RAN approved the provision of the GERAN (P)SI messages in the CELL CHANGE ORDER FROM UTRAN message. In order for this feature to work successfully, a standardised method is required to signal relevant GERAN information across the relevant UTRAN interfaces.

5 Requirements

The standardisation of NACC from UTRAN to GERAN shall meet the following requirements:

1) The impact to the Gb and Gn interfaces shall be minimised.

6 Study Areas

6.1 UTRAN NACC signalling architecture

6.1.1 General

Three possible mechanisms have been identified to gain access to the GERAN SI/PSI at the SRNC, whilst minimising the impacts on the existing Gb/Gn procedures:

1) The (P)SI is stored by the SRNC.

2) The (P)SI is stored by the local RNC

3) O&M-based distribution of (P)SI.
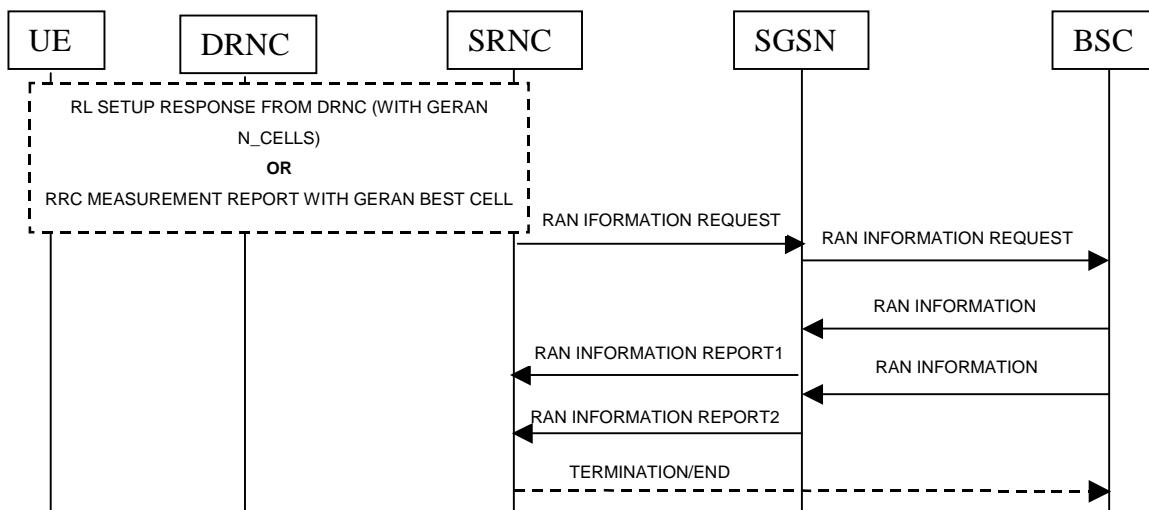
These solutions are explained in the following sub-clauses.

6.1.2 Solution 1: (P)SI stored by the SRNC

6.1.2.1 General description

This solution is based on the serving RNC directly requesting and receiving the SI/PSI from the target BSS and it is depicted in figure 1.

1) The SRNC receives a measurement report from the UE and decides to move the UE to GERAN.

   NOTE: The SRNC could request the info earlier on receiving GERAN n_cell info from DRNC.

2) The SRNC triggers a REQUEST to the SGSN.

3) The SGSN then uses existing RIM procedure to forward the request to the BSS.

4) The BSS uses existing RIM procedure towards SGSN to pass the GERAN SI/PSI back to the SRNC via SGSN either "on-demand" (i.e. single report) or on an "on-modification" basis (i.e. multiple reports).

5) The SGSN then relays this information to the SRNC via the Iu interface.

6) If multiple reports are used, the SRNC could terminate the reporting using a procedure TERMINATION/END message.

NOTE: The measurement report from the UE is a connection oriented procedure, whereas the RAN Information Request procedure is connectionless. It was noted for further study that currently the RNC does not have the functionality to deal with this situation.

Figure 1: Signalling diagram for Solution 1 of GERAN SI/PSI Retrieval

6.1.2.2 Analysis of the solution

Pros:

1) No additional Iur load generated.

2) No additional Iur implementation required.

3) Synchronised update of SI/PSI is possible using "on-modification" measurement reporting.

Cons:

1) Generally more SI/PSI stored in each RNC than in other solutions.

2) Additional load on the SGSN due to signalling path of RIM procedures.

3) Additional load on the BSS due to a potentially high number of measurement contexts being required (for each different SRNC).

6.1.3 Solution 2: (P)SI stored by the local RNC

6.1.3.1 General description

This solution is based on the local RNC requesting SI/PSI from the BSS, and receiving it on an "on-modification" basis. This procedure is depicted in figure 2.

1) After installation and configuration of the GERAN neighbouring cell lists in the local RNC, a REQUEST message is sent to the SGSN requesting GERAN SI/PSI for the GERAN cells that are configured in the local RNC neighbouring cell list.

2) The SGSN then uses existing RIM procedure to forward the request to the BSS.

3) BSS uses existing RIM procedure towards SGSN to pass the GERAN SI/PSI back to the (D)RNC via SGSN "on-modification".

4) The SGSN would then relay this information to DRNC via the Iu interface.

5) The GERAN SI/PSI is transferred using existing RNSAP procedures over the Iur interface towards the SRNC when it requires it.
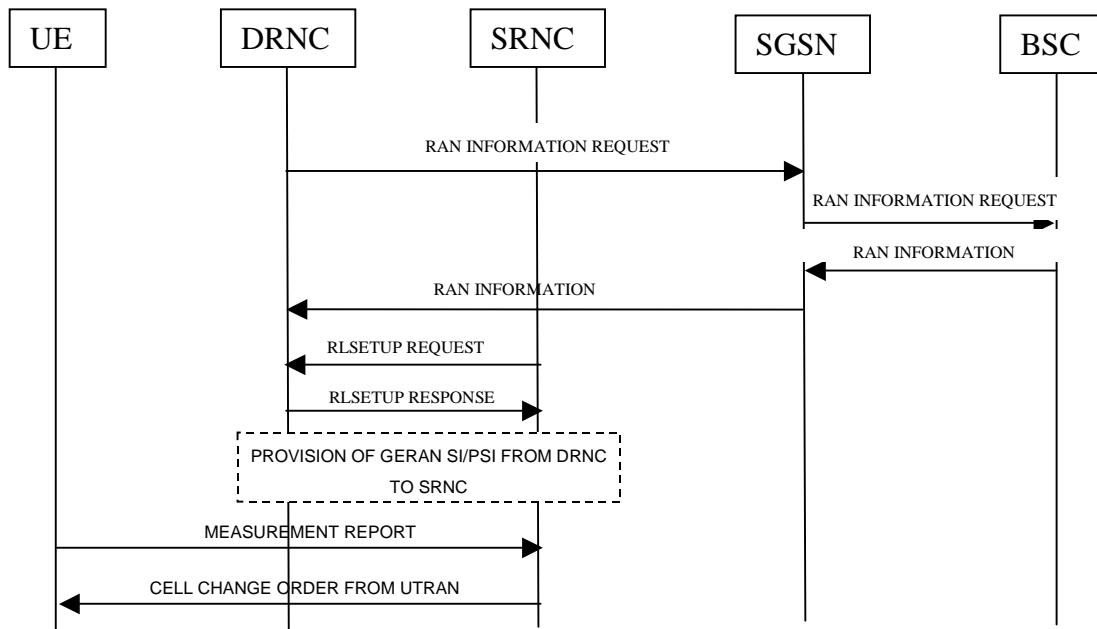
Figure 2: Signalling diagram for Solution 2 of GERAN SI/PSI Retrieval

6.1.3.2 Analysis of the solution

Pros:

1) Generally less SI/PSI stored in each RNC than in other solutions.

2) Synchronised update of SI/PSI is possible using "on-modification" measurement reporting.

3) Impact on SGSN load is minimised.

Cons:

1) More Iur signalling than SRNC terminated solution.

2) Additional load on the DRNC due to potentially high number of measurement contexts being created (for each different SRNC).
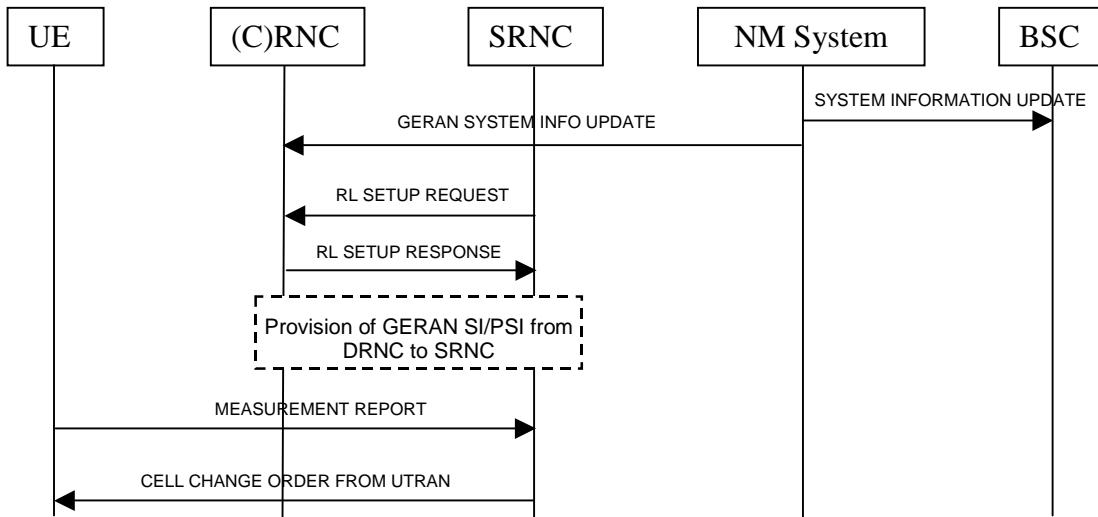
6.1.4 Solution 3: O&M-based distribution of (P)SI

6.1.4.1 General description

This solution is based on the operator using O&M to update the stored SI/PSI in the neighbouring GERAN cell list of the RNC every time it is modified by O&M in the GERAN cell. This is depicted in figure 3.

1) On installation and initial configuration by O&M of the GERAN neighbouring cell lists in the (C)RNC, the GERAN SI/PSI is included in the information sent to the RNC.

2) The GERAN SI/PSI is transferred using existing RNSAP procedures over the Iur interface towards the SRNC when it requires it.

NOTE: It was discussed that if the NM System is not updated if the BSS changes its system parameters, there can be periods of time where the SI/PSI held in the NM System are out of date. This issue is FFS.

Figure 3: Signalling diagram of Solution 3 of GERAN SI/PSI Retrieval

6.1.4.2 Analysis of the solution

Pros:

1) No direct signalling required between UTRAN and GERAN.

2) No impact on the SGSN.

Cons:

1) Maybe difficult to ensure that SI/PSI stored in UTRAN is always aligned with that in the GERAN cell.2) Extra impact on 3G NMS and R interface.

6.1.5 Comparative analysis of the solutions

The sub-clauses 6.1.2.2, 6.1.3.2 and 6.1.4.2 are summarised in Table 1.

Table 1: Comparative analysis of the proposed solutions.

| Solution	Pros	Cons
1. (P)SI provided to the SRNC	• No additional Iur load generated. • No additional Iur implementation required. • Synchronised update of SI/PSI is possible using "on-modification" measurement reporting.	• Generally more SI/PSI stored in each RNC than in other solutions. • Additional load on the SGSN due to signalling path of RIM procedures. • Additional load on the BSS due to a potentially high number of measurement contexts being required (for each different SRNC).
2. (P)SI provided to the local RNC	• Generally less SI/PSI stored in each RNC than in other solutions. • Synchronised update of SI/PSI is possible using "on-modification" measurement reporting. • Impact on SGSN load is minimised.	• More Iur signalling than SRNC terminated solution. • Additional load on the DRNC due to potentially high number of measurement contexts being created (for each different SRNC).
3. O&M distribution of (P)SI provided to	• No direct signalling required between UTRAN and GERAN. • No impact on the SGSN.	• Maybe difficult to ensure that SI/PSI stored in UTRAN is always aligned with that in the GERAN cell. • Extra impact on 3G NMS and R interface.

6.2   UTRAN signalling procedures for NACC

6.2.1   Iur signalling for GERAN SI/PSI transfer from the DRNC to the SRNC

The transfer of SI/PSI over the Iur is relevant to solution 2, described in sub-clause 6.1.3. Two different solutions have been identified on the Iur interface for the transfer of (P)SI from the local DRNC to the SRNC.

Use the [RNSAP] RADIO LINK SETUP RESPONSE message.

- GERAN SI/PSI could be sent in the "GSM neighbouring cell information" IE for each of the GERAN neighbouring cells.

- It may be inefficient in terms of transmission load and delay increase due to the number of RADIO LINK SETUP RESPONSE messages containing the same information. In addition, there would be no way of knowing (without some kind of "GERAN cell id list" and "value tag" provision in the RADIO LINK SETUP REQUEST) which SI/PSI the SRNC already had and whether it was up-to-date.

- This is perhaps the most time critical of all RNSAP messages and the processing in the DRNC before sending this message should not be unduly complicated.

- This is related to Release 5 work on restricting neighbouring cell information on the Iur.

Use the [RNSAP] Information Exchange procedure.

- An Information Exchange procedure could be initiated from the SRNC towards the DRNC when the SRNC establishes its first radio link in the DRNS. The Report Characteristics would be set to "On-modification" (of GERAN SI/PSI messages).

- In Release 5, reporting is only allowed for a single cell.

- The transfer of GERAN SI/PSI information from the DRNC to the SRNC can be time critical i.e. the SRNC may wish to push the UE to GERAN almost immediately after RL establishment. Delays may occur in the SRNC acquiring the SI/PSI if multiple information reporting initiations, and multiple reports, are required.

NOTE: It needs to be analysed if the *Information Exchange Object Type* IE could contain a list of cells to enable a faster initial report and subsequent reports to the SRNC.

New RNSAP procedure.

- A new procedure could be initiated from the DRNC towards the SRNC after the SRNC establishes its first radio link in the DRNC.

- The DRNC already keeps a list of the GERAN neighbouring cells for each local UTRAN cell. In addition, the DRNC, as local RNC, also keeps the (P)SI of those GERAN cells.

- The local RNC would also be required to keep a list of other RNCs acting as SRNCs for UEs with radio links in local DRNC (i.e. DRNC) and whether they have an update copy of the (P)SI messages of the GERAN cells.

- This procedure would be initiated by the DRNC:

  a) towards the SRNC of a UE when a new radio link is added/created to another UTRAN cells with new GERAN neighbouring cells for which the corresponding SRNC does not have the (P)SI;

  b) towards one or more (S)RNCs when the local RNC receives an update from a GERAN BSS of the (P)SI for one or more GERAN cells.

6.2.2   Use of RANAP or O&M for provision of GERAN SI/PSI to RNC

The issue of whether to use O&M or whether to use RANAP signalling to inform the RNC of the GERAN SI/PSI is dependant on how often the GERAN SI/PSI would be changed, i.e. how often the operator optimises GERAN SI/PSI. If the O&M solution were chosen and if it is required to update the SI/PSI very frequently, there may be problems in synchronising the BSS/RNC provision of the GERAN SI/PSI between 2G and 3G O&M systems. This would be due to the fact that the operator would probably have to manually synchronise the carrying out of the respective procedures from their respective 2G/3G O&M systems.

GERAN SI/PSI information may evolve, which means that there may be a more dynamic change of this information. So in this case, O&M alignments would be more complex to organise.

6.2.3   Adaptation of GERAN RIM procedures for use across the Iu interface

6.2.3.1.   General

In UMTS the information as to which BSC the target neighbouring GERAN cell belongs is not known at the RNC.

Whilst the present NACC RIM GERAN messages [2] can be used as a basis for inclusion into the relevant 3GPP/RAN3 specifications, the following areas for study are identified:

6.2.3.2.   Message definition

A RANAP message similar to the GERAN "RAN INFORMATION REQUEST" message sent from the RNC should contain a source RNC-ID (instead of the source CGI as happens in GERAN), the destination (GERAN) CGI, plus a list of other (GERAN) neighbouring cells if whose (P)SI is requested.

The subsequent RAN INFORMATION message sent from the BSCBSS to SGSN would contain the source RNC-ID, in addition to the list of GERAN SI/PSI mapped to each target CGI.

Devising a RANAP message corresponding to the [GERAN] RAN INFORMATION message cannot be a direct correlation i.e. existing connectionless downlink RANAP messages do not include the RNC-ID, as the destination SCCP address is used to route the message on the Iu.

6.2.3.3.   Format of RIM messages

6.2.3.3.1   General

What form should the BSS <=> 3G SGSN response RIM messages take?

Three options are analysed in this sub-clause:

1. As per existing agreements for inter-RAT signalling, the **host source system - when inter-RAT signalling - adapts to the target system** and thus constructs an appropriate RANAP message.

2. The GERAN system continues using with its **existing RIM procedures** in both directions, – i.e. no adaptation of messages to target system and this means the GERAN RIM message is **translated at the CN**. (The procedures would not be fully transparent, since the 3G SGSN must "look into" the message and translate the GERAN RIM message into the appropriate RANAP RIM message).

3. The GERAN continues using its **existing RIM procedures** in both directions, i.e. no adaptation of messages to target system. The GERAN RIM message is routed through the CN and **terminated at the UTRAN**. The 3G SGSN would need to place the contents of the GTP message on the Gn interface into a RANAP message on the Iu interface, without interpreting its contents.

These alternatives are depicted in Figure 4.
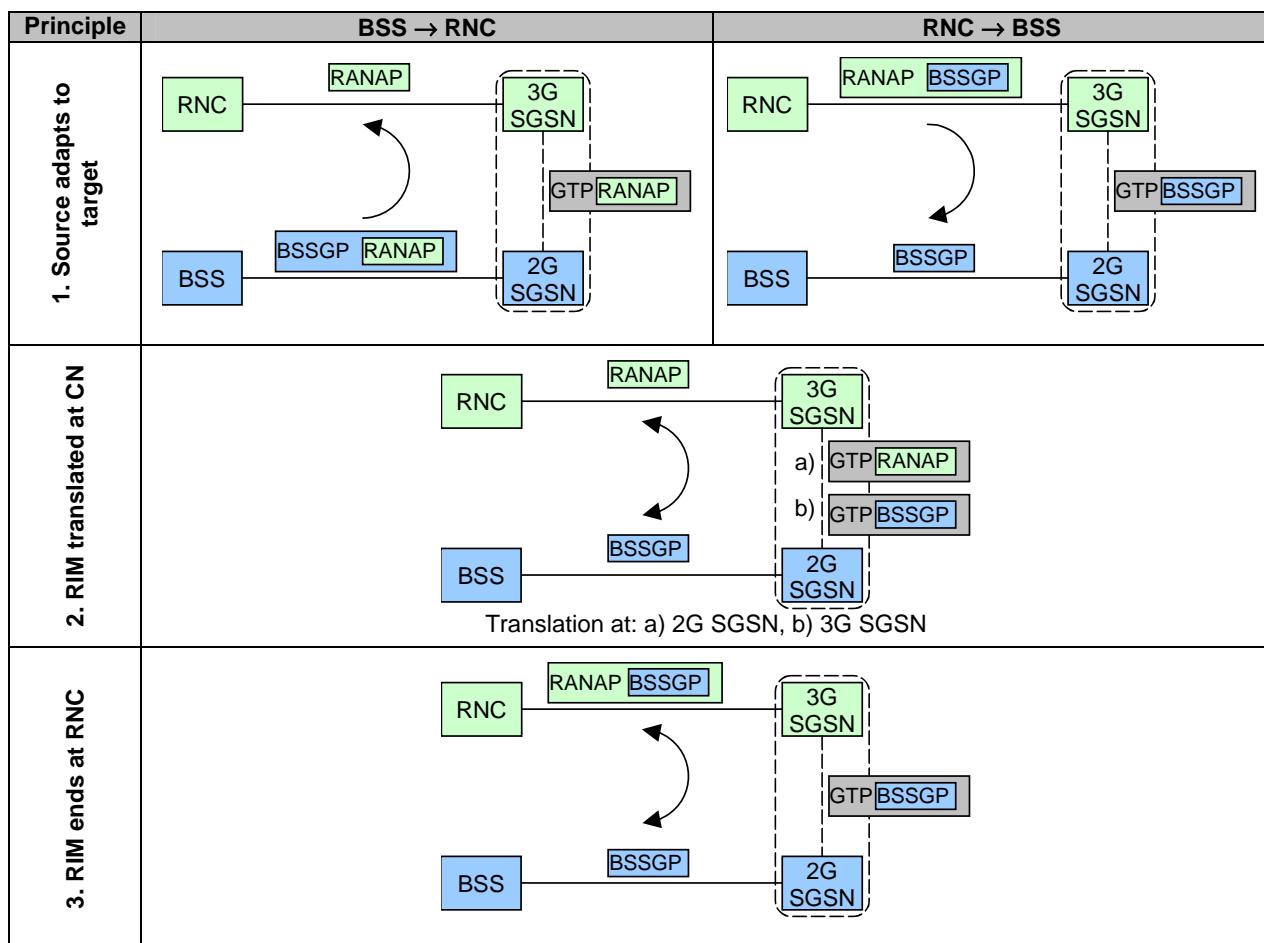
Figure 4: Alternatives for coding of RIM messages.

6.2.3.3.2. Format of RIM messages on the Iu interface

There are two possible options for the format of the messages sent on the Iu interface:

1. What form should the 3G SGSN <=> RNC RIM messages take?

   a) A new RIM procedure is created in RANAP to transfer this NACC information/messages across the Iu interface to the source RNC;

   b) OR, (corresponding to 2b) the RIM procedure messages are sent in a container inside messages of the existing Information Transfer procedure messages over the Iu interface. In this case, an INFORMATION TRANSFER REQUEST message would need to be created to contain the [GERAN] RAN INFORMATION REQUEST message.

When considering this question it should be noted that it is not seen as feasible to deconstruct the BSSMAP/RANAP message fully in the SGSN and construct a corresponding RANAP/BSSMAP message. This would have a higher impact on the SGSN implementation, with no extra gain, apart from the fact that the RNC-ID would not be transferred in the RANAP message.

7 Agreements and associated Contributions

The main text of the document should start here, after the above clauses have been added.

7.1 UTRAN NACC signalling architecture

The mechanism used to gain access to the GERAN SI/PSI at the SRNC is such that the (P)SI will be stored by the local RNC.

7.2 Format of RIM messages

GERAN does not adapt RIM messages to the target system and are routed via the CN without interpretation. The RNC alone needs to send and receive BSSGP messages within a container within the RANAP message.

7.3 Exchange of Information over Iu

The transfer of RIM information over the Iu from UTRAN, will be performed using a new RANAP procedure – *Direct Information Transfer*. This generic Class 2 RANAP procedure has been designed such that it will transfer information from the RNC to the CN or vice versa, in unacknowledged mode – maintaining the previously agreed RIM principles.

7.4 Exchange of Information over Iur

The transfer of RIM information over the Iur between the SRNC and the DRNC will be performed using an existing RANAP R5 procedure – [RNSAP] Information Exchange – following an appropriate modification/addition to the procedure.

8 Specification Impact & associated Change Requests

This section is intended to list the affected specifications and the related agreed Change Requests. It also lists the possible new specifications that may be needed for the completion of the Work Task.

8.1 TS 25.401 UTRAN Overall Description

8.1.1 Impacts

GERAN System Information Retrieval is introduced as an additional UTRAN function, as is *RAN Information Management* as an additional function related to radio resource management and control.

8.1.2 List of Change Requests

Refer to http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_24/Docs/ZIP/RP-040182.ZIP.

8.2 TS 25.410 UTRAN Iu Interface: General Aspects and Principles

8.2.1 Impacts

GERAN System Information Retrieval is introduced as an Iu Mobility Management function.

8.2.2 List of Change Requests

Refer to http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_24/Docs/ZIP/RP-040182.ZIP.

8.3 TS 25.413 UTRAN Iu interface RANAP signalling

8.3.1 Impacts

A generic Class 2 RANAP procedure (bi-directional i.e. UL and DL) – Direct Information Transfer - has been introduced in RANAP to enable the transfer of RIM-PDU for the NACC feature initially, and thereafter for future uses if/when they present themselves.

8.3.2 List of Change Requests

Refer to http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_24/Docs/ZIP/RP-040182.ZIP.

8.4 TS 25.420 UTRAN I$_{ur}$ interface general aspects and principles

8.4.1 Impacts

The exchange of information over the Iu of UTRAN and GERAN information has been included as a function of the Iur.

8.4.2 List of Change Requests

Refer to http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_24/Docs/ZIP/RP-040182.ZIP.

8.5 TS 25.423 UTRAN Iur interface RNSAP signalling

8.5.1 Impacts

In the case that the CRNC is not the SRNC, and the SRNC would like to request NACC information, the Information Exchange Procedure has been modified such that the SRNC can request NACC related data for one or several GSM cells.

8.5.2 List of Change Requests

Refer to http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_24/Docs/ZIP/RP-040182.ZIP.

9 Project Plan

9.1 Schedule

Date	Meeting	Scope	[expected] Input	[expected]Output
Sept 2003	RAN#21	RAN Approval		TR Approved
Mar 2004	RAN#23	RAN Approval		TR Approved
June 2004	RAN#24	RAN Approval		TR Approved

9.2 Work Task Status

	Planned Date	Milestone	Status

Annex A:
Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
June 2004	TSG-RAN#24	RP-040186			Presentation of TR for information	-	1.0.0
June 2004	TSG-RAN#24				Approved at TSG RAN #24 and placed under Change Control	1.0.0	6.0.0
September 2004	TSG-RAN#25	RP-040307	001	-	Tidy Up CR for TR 25.901 (NACC)	6.0.0	6.1.0
June 2007	TSG-RAN#36				Upgrade to Release 7	6.1.0	7.0.0

History

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