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Digital cellular telecommunications system (Phase 2+) (GSM); GSM/EDGE External Network Assisted Cell Change (NACC) (3GPP TR 44.901 version 17.0.0 Release 17)

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Contents

Foreword

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1 Scope

This Technical Report provides background information, motivations, concepts and requirements regarding an extended Network Assisted Cell Change (NACC) feature for external cell change support. Cell change between GERAN and UTRAN cells is outside the scope of this report, although consideration has been taken in order to allow an easier extensibility to that case. The extension is based on the Release 4 version of the NACC feature where the mobile station is only supported by the NACC when performing internal cell re-selection, i.e. within a BSC. The extension of the feature is for GERAN just affecting BSS and for the core network the SGSN and signalling links between these network nodes. To support cell changes between GERAN and UTRAN, also the Um and the Uu interfaces are affected.

The evolved Release 4 NACC proposal as described in this TR provides the basis for the detailed Stage 2 and stage 3 specification work. The feature will be developed in a phased approach and a longer-term vision is presented in the report.

The focus of the TR is to:

- Define the requirements on different nodes
- Specify the requirements for the interfaces
- Propose a plan for the work item project
- Evaluation of what does and does not need to be standardised

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 TD GP-010361, "Network Assisted Cell Change; Concept document"

[2] 3GPP TS 48.018: "General Packet Radio Service (GPRS); BSS GPRS Protocol (BSSGP)".

3 Definitions and abbreviations

3.1 Definitions

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

External cell change: Change of cells where old and new cell do not belong to the same BSC.

External neighbouring cells: Cells listed in the BA-lists within a BSC that belongs to other BSCs.

Extended neighbouring cell list: List of System information received from the external neighbour cells to be used in the Network Assisted Cell Change procedure.

Service outage time: The time between the last received uplink RLC block from the mobile station in the old cell and the mobile station's first uplink RLC block received in the new cell.

3.2 Abbreviations

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

CCN	Cell Change Notification
EDGE	Enhanced Data rates for GSM Evolution
GERAN	GSM/EDGE Radio Access Network
GPRS	General Packet Radio Service
NACC	Network Assisted Cell Change
NC	Network Control mode (can be NC0, NC1 or NC2)
O&M	Operations and Maintenance
PACCH	Packet Associated Common Control Channel
PS	Packet Switched
QoS	Quality of Service
RN	Radio Network
RAN	Radio Access Network
RIM	RAN Information Management
UE	User Equipment
UTRAN	Universal Terrestrial Radio Access Network

4 Introduction and Motivation

4.1 Task Description

The purpose of this new work task is to shorten the service outage time at cell reselection in packet transfer mode when the originating and the target cells belong to different BSCs/RNCs. This will improve the delivered quality of service for most QoS classes.

4.2 GPRS Cell Reselection pre-Release 4

A pre-Release 4 GPRS/EDGE mobile station shall in modes NC0 and NC1 perform cell reselection purely based on neighbour cell measurements and independent of whether a packet transfer is ongoing or not. The cell change is performed without notifying the network. The MS is then not allowed to make random access in order to restart the data transfer in the new cell until a consistent set of system information for that cell has been correctly received. This behaviour is also used in Release 4 for the cases when a GPRS mobile station moves between GSM cells belonging to different BSCs or from a GSM to a UMTS cell.

If the MS is trying to collect the target cell system information before the cell change, the MS may lose downlink data, which then has to be retransmitted in the new cell. If on the other hand the system information is collected after entering the target cell, the MS must first synchronise to the system information broadcast cycle and then collect the required system information before starting to re-establish the data transfer. In both cases the MS will lose a certain amount of time and downlink data when collecting the system information. There is also a risk that one or more RLC SDUs have to be completely retransmitted in the new cell as the cell change can be performed anytime during an ongoing transfer.

For these reasons the Network Assisted Cell Change feature was introduced in Release 4 for MSs performing cell changes between cells belonging to the same BSC. The feature reduced the service outage time for an MS in packet transfer mode from a couple of seconds down to 300-700 ms by giving the network a possibility to assist the MS before and during the cell change. The assistance is given both as sending of neighbouring cell system information and with introduction of new procedures.

4.3 NACC in GERAN Release 4, Short description

NACC, the Network Assisted Cell Change feature introduced in Release 4 is a tool to minimize the service outage time for all QoS classes when a GPRS MS in packet transfer mode moves between GSM cells belonging to the same BSC. An overview of the Release 4 behaviour is described in GP-010361.

NOTE: In the Release 4, NACC is not implemented to support cell reselections between GERAN and UTRAN or between BSCs. In this technical report a possible introduction of these cases is outlined.

The NACC procedures are introduced as a mandatory feature for an Release 4 MS to speed up the cell re-selection. There are two main set of procedures specified for NACC, independent from each other:

- One set which supports the mobile station with neighbouring cell system information and
- One set which prepares the MS and puts the MS into Cell Change Notification mode (CCN mode) during a short period of time before the cell change.

4.3.1 System Information Reception

In the first set of procedures the network may - independent of the NC and the CCN modes - send neighbouring cell system information to an MS. The information is sent on the PACCH and is required for initial access after a cell change. An MS in Packet Transfer mode, which receives this information, shall store the information for 30 seconds. The MS may then use this information in the new cell. In the new cell the MS may then initiate access and receive missing system information from BCCH or PBCCH on PACCH by using the Packet PSI/SI Status procedures.

4.3.2 Cell Change Notification (CCN) Mode Procedures

In the second set of procedures a Release 4 MS in packet transfer mode enters CCN mode when a cell reselection is determined and if the network has ordered the MS to use CCN within the cell and towards the target cell. This order can either be generally given by the network in system information or be individually addressed to a certain mobile.

When in CCN mode the MS informs the network with a Cell Change Notification message that the MS wants to reselect cell. The message contains the identity of the target cell. After sending the message to the network the mobile station continues the ongoing packet transfer for either a maximum time of about 1 second or until the network responds with a Packet Cell Change Continue or Packet Cell Change Order message. The Packet Cell Change Order message may indicate another target cell than the one proposed by the mobile station. After the delay, the MS leaves CCN mode. The MS also leaves CCN mode if it returns to Packet Idle mode, if it enters NC2 mode or if the criteria for camping on the old cell are no longer fulfilled.

In CCN mode the network also has an opportunity to send neighbouring cell system information required for immediate initial access in the new cell when the re-selection has been performed. In CCN mode, the network may also terminate the ongoing packet transfer before sending the Packet Cell Change Continue or the Packet Cell Change Order message to the MS.

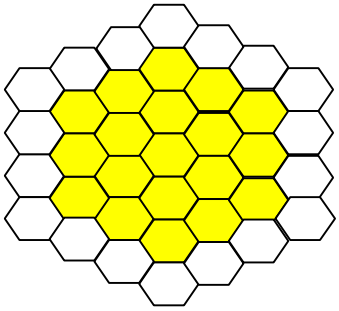
4.4 Extension of NACC in Release 5

4.4.1 General

In Release 4 of the GERAN specifications, the NACC procedures cover only cell re-selection to other GERAN cells within the same BSC where the BSC has system information available for the target cell.

This limits the value of NACC, as external BSC cell changes and also cell changes between GERAN and UTRAN cells in some network configurations are of frequent occurrence. Extensions of the NACC feature to handle also external cell changes will therefore be of a certain value. For cell changes between Gb and Iu mode within GERAN and between GERAN *A/Gb mode* and UTRAN *Iu-mode* it is not obvious that the service for the user is improved by NACC. These cases might require rather heavy signalling to re-establish the RRC, the radio access bearers and the MM connections before the user service can be restarted in the target cell.

A rough estimation of the occurrence of inter BSC cell changes in an assumed scenario where the BSC area consists of a regular hexagonal area surrounded by other BSC areas (Figure 4.1.1.a) and subdivided into smaller, hexagonal clusters is shown in Table 4.1.1.a. The traffic between these areas is then assumed to be equal distributed.



White = External cells belonging to other BSCs
Dark = Internal cells within a BSC Area

Figure 4.1.1.a: Example of internal/external cells for a BSC

Table 4.1.1.a: Relation between External to Total number of cell changes

BSC Area Size (in # of cells)	No of possible external cell changes	Relation External/Total no of cell changes (in %)
1	6	100
7	18	43
19	30	26
37	42	19
61	54	15
91	66	12
127	78	10
169	90	9
271	114	7
397	138	6
547	162	5
721	186	4
1141	234	3

The case with a network composed of a mixture of BTSs and BSCs from different vendors will also give much higher figures (approximately30 - 50% of external cell changes) as the cell clusters for a certain BSC will look like islands among cell clusters from other vendors BSCs. This will also be the case having overlapping GERAN and UTRAN coverage.

This is a simplified network where cell reselection is assumed to be possible only to the 6 closest neighbours. In normal case the neighbouring cell lists can contain cells not directly close to the serving cell. So the figures for external cell changes will probably be higher.

There is also the case when UTRAN and GERAN overlay, which means that the two access technologies have different nodes in the access network.

Based on the reasons described above this study considers an extension of NACC to cover also cell changes to a cell managed by another BSC/RNC where the origin BSC/RNC does not have system information available for the target cell. This requires new signalling between BSCs/RNCs. The signalling may then be performed via the A, Gb, Iu and/or Iur-g interfaces to inform each BSC/RNC of the neighbouring cell system information.

NOTE: the exchange of information between BSCs/RNCs via A and Iu-cs interfaces is out of the scope of this document, although care has been taken in order to allow an easy extension for other features using inter BSC/RNC communication.

The Table 4.1.1.b below indicates scenarios to be considered for cell reselection between different BSCs/RNCs and the possibility to add the NACC feature to each case is then further discussed in this document. GERAN Gb indicates a BSC connected to SGSN only via Gb; GERAN Iu indicates a BSC connected to SGSN only via Iu and GERAN Iu/Gb indicates a BSC connected to SGSN via both Iu and Gb. This paper does not consider cell reselection scenarios involving CDMA 2000 cells.

Table 4.1.1.b: Possible combinations of cell changes

Case No	From	To	Traffic via
1	GERAN Gb	GERAN Gb	SGSN
2	GERAN Gb	GERAN Iu/Gb	SGSN
3	GERAN Gb	GERAN Iu	SGSN
4	GERAN Gb	UTRAN	SGSN
5	GERAN Iu	GERAN Gb	SGSN
6	GERAN Iu	GERAN Iu/Gb	SGSN or Iur-g
7	GERAN Iu	GERAN Iu	SGSN or Iur-g
8	GERAN Iu	UTRAN	SGSN or Iur
9	GERAN Iu/Gb	GERAN Gb	SGSN
10	GERAN Iu/Gb	GERAN Iu/Gb	SGSN or Iur-g
11	GERAN Iu/Gb	GERAN Iu	SGSN or Iur-g
12	GERAN Iu/Gb	UTRAN	SGSN or Iur
13	UTRAN	GERAN Gb	SGSN
14	UTRAN	GERAN Iu/Gb	SGSN or Iur
15	UTRAN	GERAN Iu	SGSN or Iur
16	UTRAN	UTRAN	SGSN or Iur

4.4.2 Short Technical Description

For fast reselection of cells, the MS needs to have knowledge of certain system information of the target cell before performing the cell change. If the cells then belong to different BSCs/RNCs, the required system information has to be transported between BSCs/RNCs when updated to be made available to the MSs when re-selecting cells. The required system information is proposed to be packed into a container within a new RAN-INFORMATION message that may be sent on the Iur-g interface or routed via the Core Network (by one or more SGSNs) from the origin to the target RAN node. The information in the container shall be transparent for the Core Network.

When system information is received, the target BSC/RNC can be ordered to acknowledge the information. If the acknowledgement is requested but not received by the source BSC/RNC, it is an implementation option how to perform retransmission. When system information is received, the information can optionally be associated with a validity timer. After the validity timer expiration the associated system information shall not be used for immediate initial access in the new cell.

A BSC/RNC may request another BSC/RNC to respond with one or multiple RAN-INFORMATION messages or to stop transmission of event driven messages.

5 Requirements

5.1 Architectural Requirements

In order to fulfil all the traffic cases as listed in Table 4.1.1.b, the BSC, the RNC and the SGSN nodes are all affected. The interfaces which requires update are Um, Uu, Gb, Iu, Gn and Iur-g. The Table 5.1.a below lists the required changes for the different cases.

Table 5.1.a: Required changes for the different cell changes.

Case No	From	To	Affected nodes	Affected Network Interface	Affected Radio Interface
1	GERAN Gb	GERAN Gb	BSC, SGSN	Gb, Gn	-
2	GERAN Gb	GERAN Iu/Gb	BSC, SGSN	Gb, Gn and opt Iu	-
3	GERAN Gb	GERAN Iu	BSC, SGSN	Gb, Gn and Iu	-
4	GERAN Gb	UTRAN	BSC, RNC, SGSN	Gb, Gn and Iu	Um and Uu
5	GERAN Iu	GERAN Gb	BSC, SGSN	Gb, Gn and Iu	-
6	GERAN Iu	GERAN Iu/Gb	BSC, SGSN	Iu, Gn and opt (Gb and Iur-g)	-
7	GERAN Iu	GERAN Iu	BSC, SGSN	Iu, Gn and opt Iur-g	-
8	GERAN Iu	UTRAN	BSC, RNC, SGSN	Iu, Gn and opt Iur-g	Um and Uu
9	GERAN Iu/Gb	GERAN Gb	BSC, SGSN	Gb, Gn and opt Iu	-
10	GERAN Iu/Gb	GERAN Iu/Gb	BSC, SGSN	Gb, Gn or alternatively (Iu or Iur-g)	-
11	GERAN Iu/Gb	GERAN Iu	BSC, SGSN	Iu, Gn and opt (Gb or Iur-g)	-
12	GERAN Iu/Gb	UTRAN	BSC, RNC, SGSN	Iu, Gn and opt (Gb and Iur-g)	Um and Uu
13	UTRAN	GERAN Gb	BSC, RNC, SGSN	Iu, Gn and Gb	Uu
14	UTRAN	GERAN Iu/Gb	BSC, RNC, SGSN	Iu, Gn and opt (Gb and Iur-g)	Uu
15	UTRAN	GERAN Iu	BSC, RNC, SGSN	Iu, Gn and opt Iur-g	Uu
16	UTRAN	UTRAN	RNC, SGSN	Iu, Gn and opt Iur	Uu

NOTE: The introduction of NACC for the different cases where UTRAN is a part might be of various importance. If any of these seven cases shall be covered is a decision to be taken together with the RAN subgroups.

5.1.1 Case 16 - Intra-UTRAN case

In Case 16 fast cell re-selection is already available when the neighbouring cells are operating on same frequency which is assumed to be the normal case in UTRAN. A single-RX UE will then be able to read the broadcast information from the new cell while still listening to the PICH/FACH in the old cell. Since this means that the UE can read broadcast information before actually moving to the new cell, the service interruption for the cell re-selection in CELL-PCH or CELL-FACH state is already faster than the NACC supported intra-BCS Cell change specified for Release 4. Conclusion: No improvements are required for the intra frequency cell change within UTRAN.

There will also be inter-frequency cell-reselection case. Then the UE will not have read the system information broadcast yet (comparable to pre-release 4 GERAN situation) and the service interruption time is not so predictable since the scheduling of system broadcast information is not standardized. 3GPP TS 34.108 does specify a system - broadcast schedule for testing purposes. The more important information is only transmitted every 2.5 seconds, which would mean that the service interruption could take to at most something like 2.6 seconds (including reading Master Information Block which is scheduled every 80ms). In an implementation, the system information broadcast schedule can be assumed to be something around 2 seconds.

2 seconds service outage time in this case is probably not severe since:

1) Most of the time the UE will perform the intra-frequency case;

2) When the UE is in CELL-PCH state, the probability of requesting service should be quite low.

So the service interruption is mainly a problem for CELL-FACH state. Then the question is how often the UE is in CELL-FACH state when having PS services. If the UTRAN keeps the UE in Cell-DCH quite long (where handover is performed instead of cell reselections), the UE might not be in CELL-FACH state that often.

Conclusion: The inter-frequency cell change is not a relevant issue in UTRAN.

5.1.2 Case 4, 8, 12: GERAN → UTRAN

Cases 4, 8 and 12 where the UTRAN is the target cell might be of limited value as the service interrupt for the user will be significant due to complex and time consuming procedures to read system information and to and re-establish the layer 2 and layer 3 in the target cell.

Conclusion: It is questionable if it is important that the inter-RAT cell re-selection has the same or better performance than the intra-RAT inter frequency cell reselection.

5.1.3 Case 13 - 15: UTRAN → GERAN

The cases 13-15 will imply introduction of the same NACC procedures in UTRAN as specified for GERAN Release 4.

5.2 Node Requirements

5.2.1 BSC

The BSC is involved in all cases of Table 5.1.a except case 16. The following functionality has to be added in the BSC:

- An origin BSC shall immediately when changed or, in case of periodic refresh (implementation option), at certain time intervals put in a container and distribute over the Gb, Iu or Iur-g interfaces part of the system information for a certain cell to all BSCs and RNCs parenting neighbouring cells..
- At start up, restart or deletion of a cell the system information shall also be sent to all external neighbouring BSCs/RNCs affected.
- There may be one or more RAN information messages for each target BSC/RNC. A container message may contain multiple container units each carrying updated system information for one source cell and addressed to one destination BSC/RNC.
- The origin BSC can choose any of the available interfaces and CN domain for the transport of the RAN information messages. It is up to the BSC to analyze if the used interface and the first receiving node allows the transport. If not, the RAN information message shall not be sent over that interface. When using the Gb interface the origin BSC will via the Feature bitmap mechanism in the BSSGP protocol be informed whether the RIM procedures are supported.
- A BSC/RNC shall be able to request information from any BSC/RNC with neighbouring cells.
- A target BSC/RNC shall be able order another BSC/RNC to stop event driven transmission of information to the target BSC/RNC.
- The originating RAN node is required to keep information regarding the addressing method to use for each external neighboring cell.
- When using a 2G address only one CI of any valid cell is required by the core network for routing purposes in order to find the route to a certain BSC/RNC.
- The External NACC procedure requires consistent software in several nodes to operate properly. There will be occasions when the complete set of network nodes is not all updated with the required software. As an implementation option an algorithm can be used to detect whether the destination BSC node support external NACC. Such an algorithm can e.g. draw conclusions when not receiving external NACC procedure response messages and after loss of several response messages in a row during a specified time period it could be concluded that the External NACC procedure is not supported in a remote node.

5.2.2 RNC

The RNC is involved in cases 4, 8 and 12-16 of Table 5.1.a. In addition to the requirements listed above for the BSC, the following requirements has to be added if all cases shall be covered:

- If required for optimised cell reselection from GERAN to UTRAN or within UTRAN, procedures for optimised access have to be introduced.

- For support of optimised cell re-selection from UTRAN to GERAN (cases 13-15) and internally within UTRAN (case 16) for inter-frequency cell change, the RNC has to include the functionality of NACC specified for BSC in Release 4 which mainly affects the Uu interface. That includes support for the Cell Change Notification mode procedures and distribution of neighbouring cell system information to mobile stations in packet transfer mode.

- All changes affecting the RNC is outside the responsibility of TSG GERAN.

5.2.3 SGSN

The SGSN is involved in all cases where the Gb, Iu and the Gn interface is used. The following main requirements concern the SGSN node:

- The RAN information messages shall be routed to target BSC/RNC either over Iu or Gb or for the inter SGSN case tunnelled over the Gn interface to another SGSN

- The SGSN shall be able to identify from the addresses in the RAN specific information messages whether it is connected directly to the RAN node for which the message is intended. From the Routeing Area Identity (MCC+MNC+LAC+RAC) of the destination cell address, the SGSN shall decide whether or not it is connected to the destination BSS. If the SGSN is not connected to the destination BSS, then it shall use the RAI to route the message to the correct SGSN via the Gn interface. The SGSN connected to the destination BSS decides which BSS to send it to based on the CI of the destination address.

- The SGSN shall perform relaying between BSSGP messages and GTP messages to support the end-to-end transport between BSCs.

- The SGSN shall not interpret the information contained in the payload of the RAN information messages.

5.2.4 MSC

NOTE: The use of the MSC is for further study.

5.3 Interface Requirements

5.3.1 Gb interface

The Gb interface may be used for transmission of the RAN information messages between the BSC and the SGSN when it exists. The following main requirements concerns the Gb interface:

- The RAN Information Management (RIM) procedure shall transport information between BSCs/RNCs via one or more SGSNs. The SGSNs shall perform a simple relay of the messages from the Gb interface to the Gn interface and vice versa.

- The RAN Information Management procedure may provide end-to-end acknowledgements between BSCs.

- The RAN Information Management procedure shall provide end-to-end error handling between BSCs.

- The origin BSC will at the Gb interface from the Feature bitmap mechanism in the BSSGP protocol check whether the RIM procedures aresupported.

5.3.2 A interface

NOTE: The use of the A-interface is for further study.

5.3.3 Iu interface

The Iu interface can be used for transmission of the RAN information messages between the BSC/RNC and the SGSN when it exists. The requirements concerning the Iu interface are the same as for the Gb interface above.

NOTE: The use of the Iu-interface is for further study.

5.3.4 Iur-g (Iur) interface

The Iur-g interface is an optional interface which, if available, may be used instead of routing the information via the CN. The requirements concerning the Iur-g interface are the same as for the Gb interface above.

NOTE: The use of the Iur-g (Iur)-interface is for further study.

5.3.5 Gn interface

The Gn interface (GTP protocol) shall be used by the SGSN for transfer of RAN information messages between two SGSNs. The requirements concerning the Gn interface are the following:

- The SGSNs shall perform a simple relay of the messages from the Gb interface to the Gn interface and vice versa.
- The required service from GTP for the transfer between SGSN nodes is the unconfirmed type (i.e. no request/response message pair should be required on GTP). Ran Information Management will include the option for confirmed service operating end-to-end between the BSCs.
- Requirement for error handling in SGSN are as follows. When the SGSN receives a GTP message related to some RIM functionality and this message contains a protocol error, it is an implementation choice to log the error in the SGSN node. It would be possible to include mapping in the Relay function in the SGSN of GTP cause codes to BSSGP cause codes, and vice versa. This mapping of cause codes will however complicate both standardization and implementation. Very limited improvements on the overall functionality will be achieved via cause code mapping. Therefore no mapping function of cause codes is required.
- The SGSN node needs to be able to cope with communication between inconsistent releases of GTP without system failure. The requirement on the GTP entity which receives an unsupported PDU is to discard the PDU. No notification is required back to the sending node.

5.3.6 Uu interface

If cases 4, 8 and 12-16 shall be supported the Uu interface has to be updated with the NACC feature as specified for Release 4 of the GERAN specifications.

For the cases 4, 8 and 12 where the mobile station reselects from a GERAN to a UTRAN cell, changes has to be done to support fast access (distribution of UTRAN system information to the MS after the transfer has been re-established in the UTRAN cell). For the cases 13-15 where the mobile station reselects from a UTRAN to a GERAN cell, the CCN mode procedures as specified in Release 4 for GERAN has to be added. That includes distribution of GSM system information on UTRAN associated channels.

All changes affecting the Uu interface are outside the responsibility of TSG GERAN.

5.3.7 Um interface

If cases 4, 8 and 12 shall be supported, the Um interface (GPRS RLC/MAC protocol) has to be updated to distribute also the UTRAN system information to the MS before the MS reselects from a GERAN to a UTRAN cell. These are the only cases which requires update of the NACC feature in the GPRS mobile stations.

6 Generic mechanism for exchange of RAN information

6.1 General

These clauses describe generic RAN Information Management (RIM) procedures for the exchange of RAN information between RAN nodes. In order to make it transparent for the Core Network, the message(s) conveying the RAN information include a container that shall not be interpreted by the Core Network nodes. For future extensibility of this

generic mechanism to features other than external NACC, the container includes independent Container Units which can be customised for different applications.

6.2 Generic RIM procedures for exchange of RAN information

6.2.1 General

The following RIM procedures are defined in order to allow the exchange of information between RAN nodes:

- **RAN Information Request procedure**: This procedure is initiated by a BSC/RNC when it requires information from another BSC/RNC or when it requires stop of event driven reports from another BSC/RNC.

- **RAN Information Send procedure**: This procedure is initiated by a BSC/RNC when it has information to be sent to another BSC/RNC. The procedure may be event triggered (e.g. change of System Information) or scheduled (e.g. by a request procedure). Event driven reports may be stopped by the RAN Information Request procedure.

These procedures are defined in detail in the following clauses. The description of the procedures assumes a means of communication between the two RAN nodes involved. The messages may go directly if there is an Iur-g interface between the two RAN nodes. Alternatively, they shall be routed via the Core Network.

NOTE: Which CN domain the BSC/RNC shall choose to send the information to the other BSC/RAN is implementation dependent.

The RAN Information Send procedure shall be completed using the same CN domain and set of interfaces used by the RAN Information Request procedure that triggered it.

Multiple procedures can exist in parallel.

6.2.2 RAN Information Request procedure

This procedure is initiated by a BSC/RNC when it requires to start or stop the RAN information flow from another BSC/RNC.
The BSC/RNC starts the procedure by sending the RAN INFORMATION REQUEST message to the BSC/RNC from which information is required. In the message is indicated if single or multiple reports are requested, or if the transmission of multiple reports shall be stopped. If single or multiple reports are requested, the receiving BSC/RNC shall immediately initiate a RAN Information Send procedure containing the requested information. If the transmission of multiple reports shall be stopped, the application in the receiving BSC shall initiate a RAN Information Send Procedure to send one single RAN INFORMATION message and thereafter immediately stop sending of further reports. If the RAN INFORMATION message is not received, it is an implementation option if and how to perform periodic retransmission of the RAN INFORMATON REQUEST message to the target BSC/RNC.

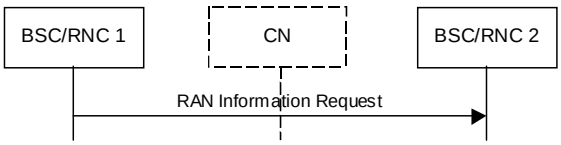


Figure 6.2.2.a: RAN Information Request procedure.

6.2.3 RAN Information Send procedure

The RAN Information Send procedure is initiated by a BSC/RNC when it has information to be sent to another BSC/RNC. This procedure may be event triggered (e.g. change of System Information) or scheduled (e.g. by a RAN Information Request procedure). The procedure is initiated by sending a RAN INFORMATION message to another BSC/RNC. The RAN INFORMATION message also contains an indication of whether or not acknowledgement is needed. If such indication is not present, the procedure concludes.

If the RAN INFORMATION message contains a request for acknowledgement, the receiving BSC/RNC shall send a RAN INFORMATION ACK. If the acknowledgement is not received, it is an implementation option if and how to perform periodic retransmissions of the RAN INFORMATON message to the target BSC/RNC.

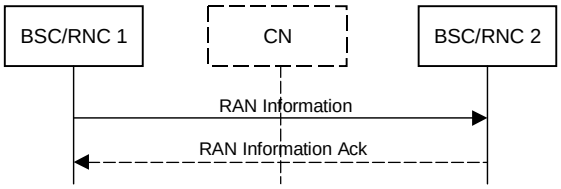


Figure 6.2.3.a: RAN Information Send procedure.

6.2.4 RIM support in CN/RAN nodes.

The end-to-end support of the RIM procedures require Core Network nodes, source and destination BSC's to provide support for RIM. The following functions may discover if nodes support or not the RIM procedures:

- The BSSGP protocol will via the Feature bitmap indicate if RIM procedures are supported between 2 specific BSC/SGSN nodes.
- The reception of a RAN INFORMATION or a RAN INFORMATION REQUEST PDU indicates that the BSC identified by the source cell address is supporting the RIM procedures.
- As an implementation option an algorithm can be used to detect whether the destination BSC node parenting the addressed cell supports the RIM procedures. Such an algorithm can draw conclusions from not receiving RIM response messages. After loss of several response messages in a row during a specified time period it could be concluded that the RIM procedures are not supported by the BSC parenting the addressed cell.
- Operation and Maintenance procedures can be used to configure whether or not the BSC parenting the external neighbouring cells support the RIM procedures.

NOTE: The functions in the first two bullets are based on standardised mechanism and functions in bullets 3 and 4 are examples of implementation options.

6.3 Messages for RAN information

6.3.1 Message format

All the messages for the exchange of information between RAN nodes have the format which is shown in figure 4. The message type identifies the message and how the payload is coded. All messages contain a source address and a destination address that are used for the routeing between the RAN nodes. The Container Units are optional and not included for all message types.

Message Header	Message Type	
	Destination Address	
	Source Address	
Message Payload	RIM Application Identity	**Container Prefix**
	PDU specific IEs	
	Container Unit 1	**Container Units**
	Container Unit 2	
	⋮	
	Container Unit N	

Figure 6.3.1.a: Generic format of a RIM message.

6.3.2 Message Type

The following messages are defined:

- RAN INFORMATION REQUEST message,
- RAN INFORMATION message,
- RAN INFORMATION ACK message and
- RAN INFORMATION ERROR message

6.3.3 Addressing and routeing

The RAN information shall be transferred to and from GERAN and UTRAN. This information may be routed directly within GERAN or between GERAN and UTRAN if the Iur-g interface is present. Alternatively, it may be routed via the Core Network using different interfaces: potentially A, Gb, Iu, Gn and E interfaces.

For the direct routeing case via the Iur-g interface, no addressing mechanism at Layer 3 is necessary. When the information is sent via the Core Network, addressing information is needed in order to route the information to the correct destination RAN node. In this case the routeing is performed in three stages:

1. **Routeing to a source CN node**: the source RAN node sends the message to a parenting CN node (MSC or SGSN). No address evaluation is needed for this routeing.
2. **Routeing to a destination CN node**: the CN node parenting the source RAN node shall route the information towards the CN node parenting the destination RAN node. There are two cases:

   If the *Circuit Switched* domain of the Core Network is used, the LAI (i.e. MCC, MNC and LAC) shall be used to identify the source and destination MSC.

   If the *Packet Switched* domain of the Core Network is used, the RAI (i.e. MCC, MNC, LAC and RAC) shall be used to identify the source and destination SGSN.

   This step is not present when source and destination RAN nodes are parented by the same CN node.
3. **Routeing to a destination RAN node**: the address shall contain information to help the destination CN node route the information to its correct RAN node. This information is different depending on whether the destination RAN node supports *A/Gb mode* and/or *Iu mode*:

   - In A/Gb mode, the Cell Identity (CI) is known by both domains of the core network and shall be used to address the target RAN node. In A/Gb mode, there is no specific RAN node identity available.
   - In Iu mode the cell identity is not known by the core network. Instead, the address contains a BSC-Id/RNC-Id that shall be used for routeing of RAN information from the CN node to a 3G BSC/RNC.

NOTE: If the destination RAN node supports both *A/Gb mode* and *Iu mode*, it is an implementation issue which interface shall be used.

Consequently RAN information messages have to be addressed differently by the originating RAN node depending on:

- the CN domain used.
- whether the destination RAN node supports *A/Gb mode*, *Iu mode* or both.

The addresses used shall contain the Information Fields listed in table 6.3.3.a.

Table 6.3.3.a: Generic format of a RAN node address.

Information Field	Presence	Length	Comments
MCC+MNC	Mandatory	3 octets	=PLMN-code; see 3GPP TS 24.008
LAC	Mandatory	2 octets	
RAC	Optional	1 octet	See note 1
BSC-Id/RNC-Id	Conditional	12 bits	See note 2

NOTE 1: This Information Field is required if the message or the response to the message has to be sent via the Packet Switched domain of the Core Network.

NOTE 2: This Information Field may be used to address a 3G RAN node (i.e. that supports *Iu mode*).

NOTE 3: This Information Field may be used to address a 2G RAN node (i.e. that supports *A/Gb mode*).

6.3.4 Container Prefix and Container Units

6.3.4.1 General

Only the message type and destination address information elements of the RAN INFORMATION messages are to be interpreted by CN nodes. The rest of the information is routed by the CN without interpretation. The payload is collected in the form of containers. For an easier reuse of this transport mechanism for different features, the information is defined in a C*ontainer Prefix* and in one or more *Container Unit IEs*.

6.3.4.2 Container Prefix

The *Container Prefix* consists of:

- RIM Application Identity (e.g. NACC),
- Message specific information (e.g. optional Sequence Number, Acknowledgement required in the RAN INFORMATION message, Multiple Report Indication in the RAN INFORMATION REQUEST message).

Table 6.3.4.2.a: Generic format of the Container prefix.

Information Field	Presence	Length	Comments
RIM Application Identity	Mandatory	1 octet	0=NACC; All other values reserved
Message specific Information Optional sequence number ….	Optional		For sequence number see NOTE 1,

NOTE 1: End-to-end transport can be supervised by the ACK mechanism. Anyhow the need for having an acknowledged service shall be based on the probability of losing messages. The sequence number is valuable to avoid duplicates and to reorder messages in the destination node. The sequence number is also required for the ACK handling and reports the correct reception of the RAN INFORMATION message sent with the same sequence number. The sequence number is not included in the error message.

6.3.4.3 Container Unit

One message may carry zero, one or more Container Units all related to the same application (e.g. NACC). Each Container Unit carries information related to one entity (e.g. cell). The coding of a Container Unit is specific to the application using it.

7 Exchange of RAN information for external NACC

7.1 Principles for use of the generic mechanism for exchange of RAN information for NACC application

7.1.1 General

The rules specified below apply when the Container Unit Type is NACC:

- The RAN INFORMATION message is used to send system information for one or more cells (one container unit is used per source cell) from a source BSC to a destination BSC/RNC.

- The RAN INFORMATION REQUEST message is used to let a source BSC/RNC request or stop transmission of system information from a destination BSC.
- The RAN INFORMATION ACK message is used to send acknowledgement for a correctly received RAN INFORMATION message back from the destination BSC/RNC to the source BSC.
- The RAN INFORMATION ERROR message is used to indicate that a PDU could not be successfully decoded.

7.1.2 Container Unit Disposition for NACC

Each Container Unit includes a 'Container Unit Length'. The coding of the rest of the Container Unit depends on the Message Type and the *Container Unit Type IEs* as defined in the 3GPP TS 48.018.

7.1.3 Error Handling

The BSSGP entity in the destination BSC will send the following type of error message to the source BSC under the following circumstances:

- The RAN INFORMATION ERROR message, including a relevant cause code, will be sent when the destination BSC is unable to comply with part of or all information elements in any of the RAN INFORMATION message types.

7.1.4 External NACC software support in RAN nodes

The end-to-end support of the external NACC procedure requires Core Network nodes to support the RIM procedures and source and destination BSC's to provide support for external NACC. The following functions may discover if nodes support or not the external NACC procedure:

- The reception of a RAN INFORMATION or a RAN INFORMATION REQUEST PDU with RIM Application Identity equal to NACC indicates that the BSC identified by the source cell address is supporting the external NACC procedure.
- As an implementation option an algorithm can be used to detect whether the destination BSC node support or not external NACC. Such an algorithm can draw conclusions from not receiving external NACC procedure response messages. After loss of several response messages in a row during a specified time period it could be concluded that the External NACC procedure is not supported for all nodes.
- Operation and Maintenance procedures can be used to configure whether or not the BSCs parenting the external neighbouring cells supports external NACC.

NOTE: The functions in the first bullet are based on standardised mechanisms and functions in bullets 2 and 3 are examples of implementation options.

8 Interface load

The signalling load on interfaces between the BSCs is depending on the frequency of the system information updates in each cell with external neighbours.

If the same assumptions as in clause 4.4.1 are used and the following assumptions are added

- there is 3 external cells which has to be informed if system information is changed in a cell,
- the system information for a cell is updated N times per hour and each update generates 3 container messages,
- each container message sent to an external cell consists of 250 octets (based on an estimated need to send 11 system information messages (instances),
- there is only one SGSN serving the 2 BSCs.

the resulting load on the Iu/Gb interface between the BSC and SGSN will be as shown in table 4. As seen from the table the reduction of a 2Mbit Gb (Iu) capacity for the container transport will for the largest BSC be $N^* 5^*10^{-5}$. Note that it

is assumed here that there is one message sent to each external neighbouring cell and not only one to each external BSC.

Table 8.a: Iu/Gb load for external NACC.

BSC Area Size (in # of cells)	No of cells with external neighbours	No of octets transmitted over Gb(Iu)/hour (one direction)
1	1	N*750
7	6	N*4500
19	12	N*9000
37	18	N*13500
61	24	N*18000
91	30	N*22500
127	36	N*27000
169	42	N*31500
271	48	N*36000
397	60	N*45000= N*100 bits/sec

9 Phased approach for the implementation

The distribution of neighbouring cell system information between BSC/RNC nodes to support the mobile stations at inter BSC/RNC cell change can be developed in a phased approach:

Phase 1: distribution of neighbouring cell system information between BSCs over the Gb interface.

Phase 2: distribution of neighbouring cell system information between BSCs over the Iu and the Iur-g interfaces. The phase 2 is required first when 'Iu-only' cells not supporting pre-REL5 mobile stations will be introduced.

Phase 3: distribution of neighbouring cell system information for cell changes from UTRAN to GERAN.

10 Open Issues

NOTE: This section will list issues where agreement and/or solutions have not been reached. It may be removed before a final decision(s) is made.

- Behaviour of the BSC/RNC after a re-start is proposed to be an implementation option.
- Is inter-RAN NACC needed? RAN2 and GERAN2 agree that there are no clear benefits for the GERAN→UTRAN direction; the UTRAN→GERANdirection is for further study.

11 Specification Impact and Associated Change Requests

11.1 General

This section will discuss the impact of the external NACC Work Item on current GERAN/UTRAN specifications as identified at present. It may be the case that this WI impacts other specifications not identified as yet, or after study the specifications listed below are not impacted upon. There may be a sub-section for each specification impacted.

11.2 3GPP TS 23.060 GPRS; Stage 2 description

A new clause – 'External Network Assisted Cell Change' shall be added describing the procedures in chapter 7.

11.3 3GPP TS 44.018 Mobile radio interface layer 3 specification

It shall be updated if the cell reselection cases from GERAN to UTRAN in table 4.1.1.b shall be included in the work Item.. It might be affected if new system information essential for access in the new cell has to be added for GERAN Release 5.

11.4 3GPP TS 44.060 GPRS RLC/MAC Protocol

It shall be updated if the cell reselection cases from GERAN to UTRAN in table 2 shall be included in the work Item.. It might be affected if new system information essential for access in the new cell has to be added for GERAN Release 5.

11.5 3GPP TS 48.018 BSS GPRS Protocol (BSSGP)

It shall be updated for all traffic cases in table 4.1.1.b where the Gb interface is involved.

11.6 3GPP TS 29.060 GPRS Tunneling Protocol (GTP)

It shall be updated for all traffic cases in table 4.1.1.b where the Gn interface is involved.

11.7 3GPP TS 25.41x UTRAN Iu interface

It shall be updated for all traffic cases in table 4.1.1.b where the Iu interface is involved.

Annex A:
Change History

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2016-01		-	-	-	-	Release 13 version created based on v12.0.0	13.0.0
2017-03	RP-75	-	-	-	-	Release 14 version (frozen at TSG-75)	14.0.0
2018-06	RP-80	-	-	-	-	Release 15 version (frozen at TSG-80)	15.0.0
2020-07	RP-88e	-	-	-	-	Upgrade to Rel-16 version without technical change	16.0.0
2022-03	RP-95e	-	-	-	-	Upgrade to Rel-17 version without technical change	17.0.0

History

Document history		
V17.0.0	May 2022	Publication