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Digital cellular telecommunications system (Phase 2+) (GSM); GSM/EDGE External Network Assisted Cell Change (NACC) (3GPP TR 44.901 version 18.0.0 Release 18)

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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.
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[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.

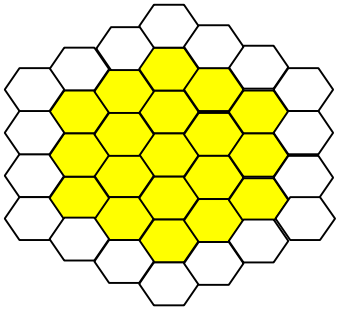
4.4 Extension of NACC in Release 5

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.