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*Technical Specification*

**3rd Generation Partnership Project;  
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Automatic Neighbour Relation (ANR) for UTRAN;  
Stage 2  
(Release 11)**

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# Foreword

This Technical Specification has been produced by the 3<sup>rd</sup> 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:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

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# 1 Scope

The present document is a technical specification of the overall support of Automatic Neighbour Relation (ANR) Function in UTRA.

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# 2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- 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 TR 21.905: "Vocabulary for 3GPP Specifications".

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# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**Base UTRAN Cell:** A cell in UTRAN for which a missing neighbour cell is detected.

**Neighbour Cell:** A cell in UTRAN, LTE or GSM/GERAN that is a neighbour cell to a Base UTRAN Cell.

**Neighbour Cell Identifier (NCI):** The identifier of a Neighbour Cell

**Neighbour cell Relation (NR):** Information that a Neighbour Cell, identified with NCI, is a neighbour to a Base UTRAN Cell. NR is stored in the RNC controlling the Base UTRAN Cell.

**Conceptual Neighbour Relation Functions:** The ANR is described using a number of conceptual entities and functions in the RNC: Neighbour Relation Table, Neighbour Relation Table Management Function, Neighbour Removal Function and Neighbour Detection Function. These entities and functions are used for descriptive purpose only and shall not be regarded as requirements on the implementation in RNC.

**Receiving RNC:** the RNC receiving the ANR report over Uu

**Base RNC:** the CRNC of the Base UTRAN Cell

**Neighbour RNC:** the CRNC of the Neighbour Cell in UTRAN

**ANR-PLMN List:** A list of PLMNs that is the RPLMN and the list of equivalent PLMNs for the UE at the point of receiving ANR logging configuration.

**ANR measurement:** Physical measurements and reading of System Information towards detected cells outside NCL.

**ANR logging:** Storing of essential information of detected cell into UE internal ANR log, when one or more detected cell satisfies ANR logging criteria.

## 3.2 Symbols

Void

### 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] apply.

## 4 Automatic Neighbour Relation Function, Main Concepts

### 4.1 General

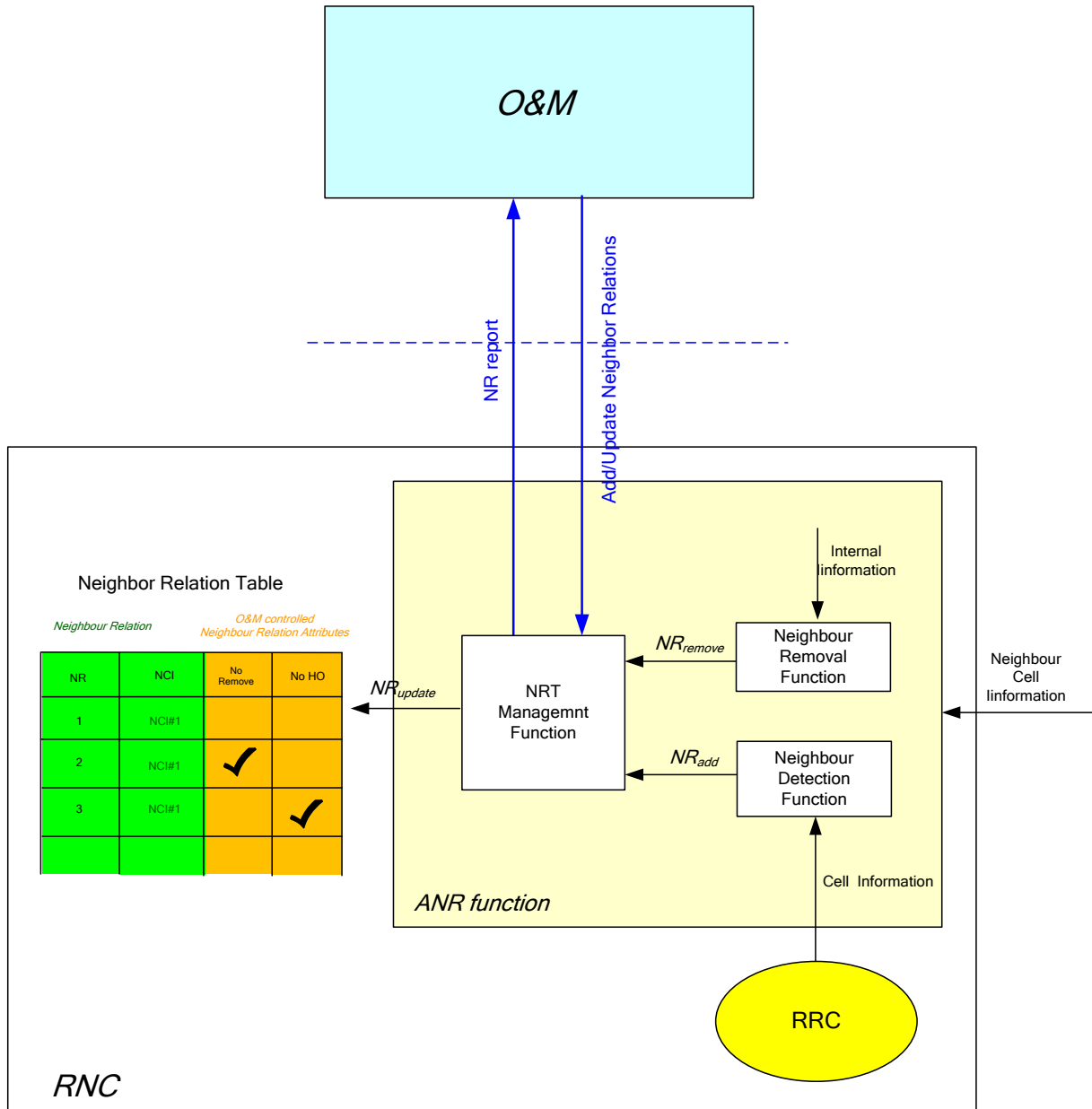


Figure 4.1-1: Interaction between RNC and O&M due to ANR

The ANR function resides in the RNC and is composed of the Neighbour Relation Table (NRT) Management Function, Neighbour Detection Function and Neighbour Removal Function.

The Neighbour Detection Function detects new neighbours and adds them to the NRT. The Neighbour Removal Function removes outdated NRs.

A Neighbour cell Relation (NR) between a Base UTRAN Cell and a Neighbour Cell exists if the RNC controlling the Base UTRAN Cell:

- a) Knows the following Neighbour Cell information:
  - Neighbour cell is in UTRAN: PLMN-Id, Cell Identifier(C-ID), RNC-ID/Extended RNC-ID,
  - Neighbour cell is in LTE: ECGI (PLMN Id + Cell Identity)
  - Neighbour cell is in GSM/GERAN: PLMN Id, LAC, CI, BSIC
- b) Has an entry in the Neighbour Relation Table for the Base UTRAN Cell identifying the neighbour cell.
- c) Has all required attributes defined in the Neighbour Relation Table entry or set to default values. Among these attributes are the frequency information (UARFCN, BCCH ARFCN, EARFCN) and handover routing parameters not already considered in (a):
  - Neighbour cell is in UTRAN: LAC and RAC
  - Neighbour cell is in LTE: TAI

For each NR, the NRT contains the Neighbour Cell Identifier (NCI), which identifies the neighbour cells. A neighbour cell may be a UTRAN, LTE or GSM cell. Furthermore, each NR has two attributes, the No Remove and the No HO attributes. These attributes have the following definitions:

- No Remove: If checked, the RNC shall not remove the Neighbour cell Relation from the NRT.
- No HO: If checked, the Neighbour cell Relation shall not be used as a neighbour cell by Intra RNS, Inter RNS or Inter RAT mobility functions in UTRAN.

The ANR function also allows O&M to manage the NRT. O&M can add and delete NRs. It can also change the attributes of the NR. The O&M system is informed about changes in the NRT.

## 4.2 ANR Handling in the UTRAN Infrastructure - Overall Description

If UTRAN ANR functionality is supported in UTRAN, RNC shall be able to configure the UE to perform the ANR measurement. ANR capable UE performs the ANR measurement and records in its logbook newly detected cells which meet the criteria given in the configuration. The Receiving RNC uses RRC signalling to retrieve the ANR report over the Uu interface after the UE has indicated that it has a logged ANR report. The Receiving RNC handles the ANR report and may forward the ANR report to different RNCs.

This chapter illustrates the handling and message sequences to be used to configure a new neighbour relation for a UTRAN cell.

### 4.2.1 Iur Connectivity exists between the involved RNCs

The ANR function supports forwarding of ANR reports from the Receiving RNC to RNCs indicated as Base RNCs in the ANR report. Furthermore the ANR function supports suspension (and resuming) ANR logs reporting over Iur from other RNCs as described in 5.1.2. This chapter describes the handling in the Receiving, Base and Neighbour RNCs when Iur connectivity exists between the involved RNCs.

#### 4.2.1.1 ANR Report over Uu for UTRAN cells

When receiving an ANR report over Uu, the Receiving RNC uses the globally unique cell identities in the report to determine the network addresses of the RNCs that are controlling the Base UTRAN cells. The network address of this Base RNC is retrieved using configuration in the Receiving RNC and/or O&M.

The Receiving RNC decides the necessity to forward the ANR report. If the Base UTRAN Cell is under control of the Receiving RNC, the Receiving RNC terminates the relevant ANR report entry, and may update the Neighbouring Relation accordingly. Otherwise, the ANR report is forwarded to the Base RNCs over Iur with the RNSAP Direct Information Transfer procedure.



If newly detected neighbour cells are controlled by another RNC the RNSAP Information Exchange Initiation procedure is used to request cell information from the neighbour RNC. In addition the Base RNC may interact with O&M before a neighbour relation is stored in the NRT.

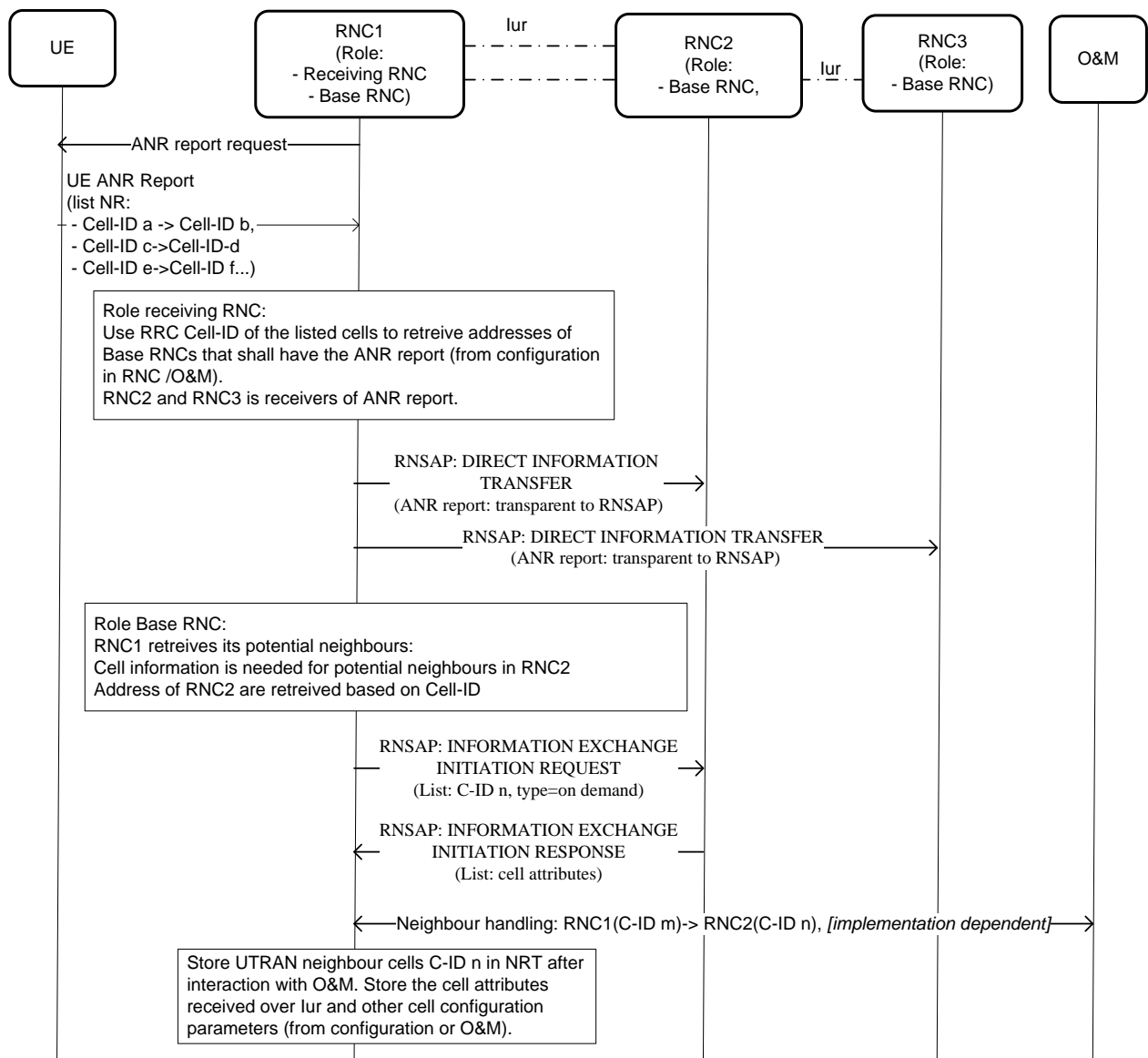
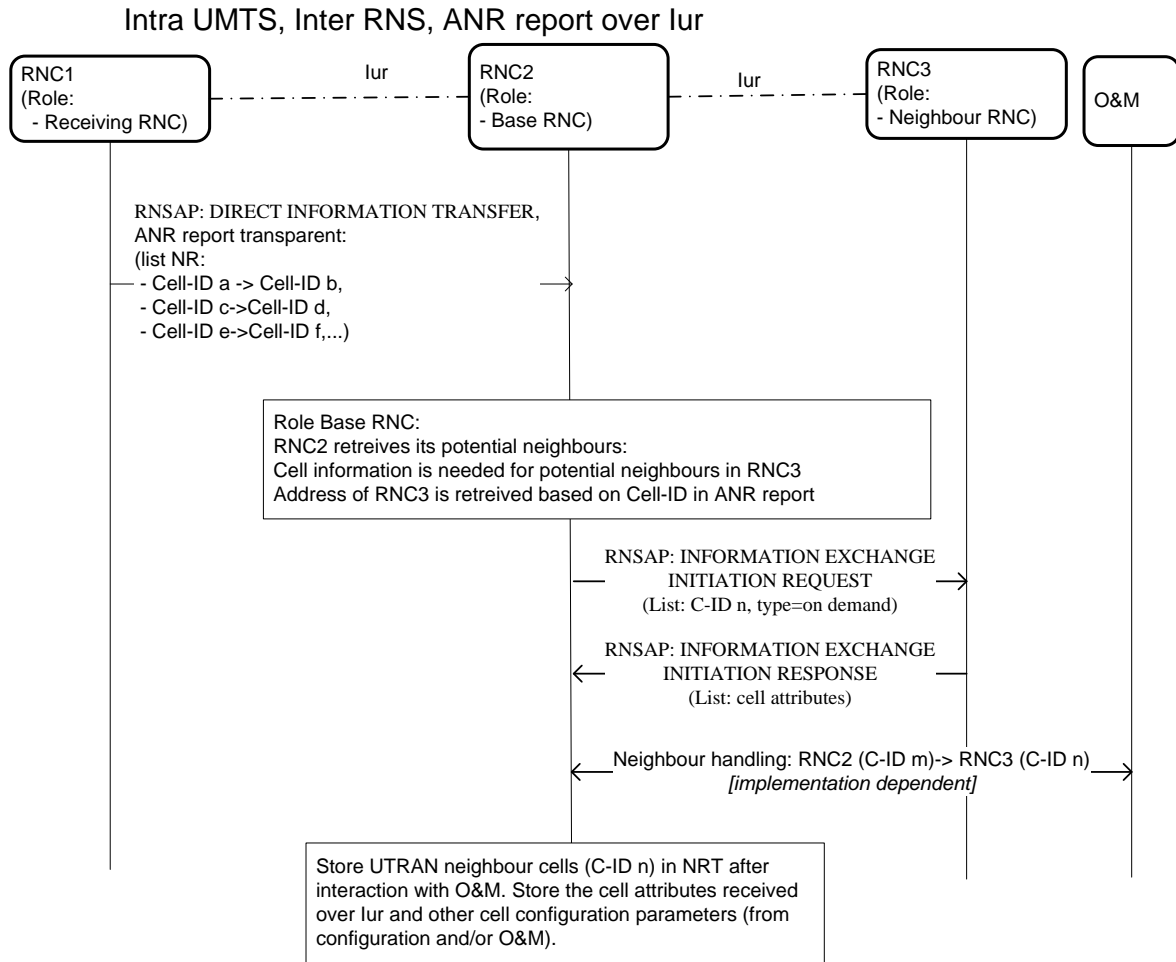


Figure 4.2.1.1-1 ANR Report over Uu for UTRAN cells

#### 4.2.1.2 ANR Report over lur for UTRAN cells

On reception of an ANR report from another RNC using the RNSAP Direct Information Transfer procedure, the Base RNC uses the globally unique cell identities and L1 information in the ANR report, and optionally also configuration in the RNC/O&M, to determine if the ANR report contains any potential neighbour cells. If any of these potential neighbour cells is controlled by another RNC the RNSAP Information Exchange Initiation procedure may be used to request cell information from the neighbour RNC. In addition the Base RNC may interact with O&M before a neighbour relation is be stored in the NRT as shown in the figure below:



**Figure 4.2.1.2-1 ANR Report over lur for UTRAN cells**

A Base RNC may control the information flow for ANR reporting over Lur. The suspension and resume are initiated from Base RNC to Receiving RNC using class 2 RNSAP procedure (Information Transfer Control procedure, defined in 5.1.2). The suspension may be performed per single cell basis or the whole cells under control of Base RNC. The ANR reporting is resumed again with initiating resume procedure for a certain target in the message.

Intra UMTS, Inter RNS, ANR report over lur Suspend/Resume

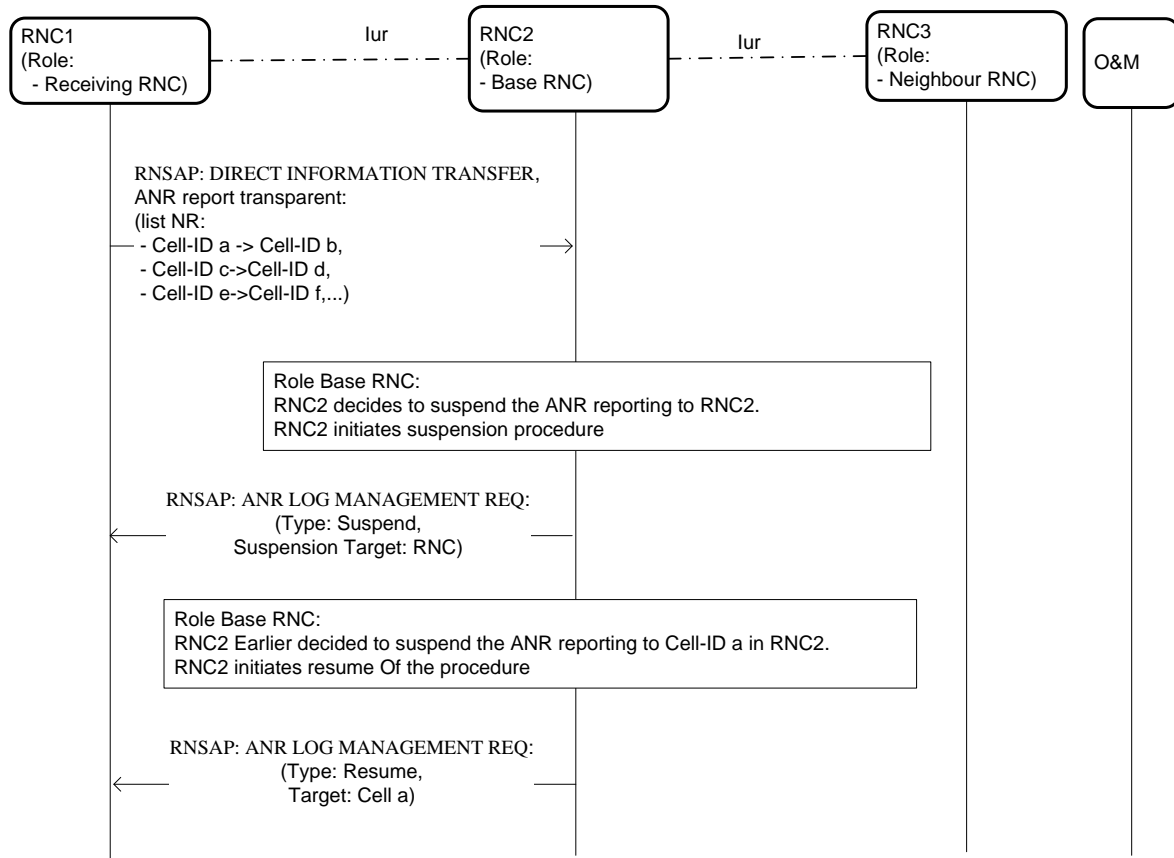


Figure 4.2.1.2-2 ANR Report suspension and resume

4.2.1.3 ANR Report over lur for IRAT cells

On reception of an ANR report containing IRAT neighbour cells from another RNC, using the RNSAP Direct Information Transfer procedure, the Base RNC uses the globally unique cell identities and L1 information in the ANR report, and optionally also configuration in the RNC/O&M, to determine if any of these IRAT neighbour cells are potential neighbour cells. The RNC retrieves the necessary information about these potential neighbour IRAT cells from configuration in the RNC/O&M. In addition the Base RNC may interact with O&M before a neighbour relation is stored in the NRT as shown in the figure below:

Inter RAT – ANR report received over Iur

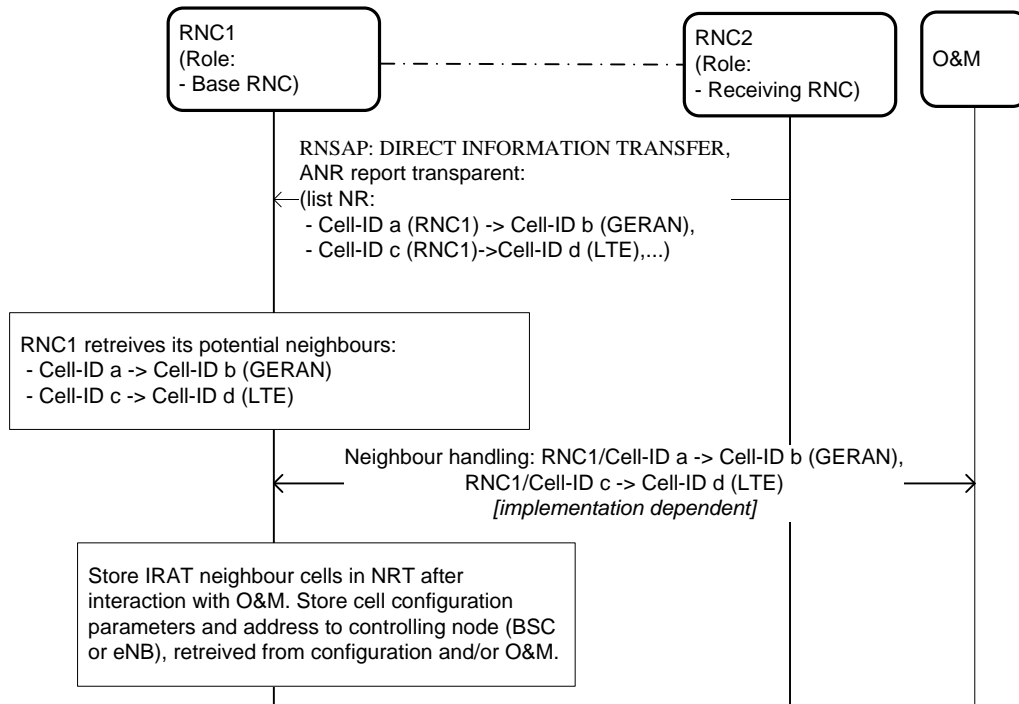


Figure 4.2.1.3-1 ANR Report over Iur for IRAT cells

*[The working assumption is that ANR report reports are forwarded in current RNSAP IE "L3 Information".]*

## 4.2.2 Iur Connectivity does not exist between some RNCs involved in ANR

This chapter describes the handling in the Receiving RNC when the ANR function can not rely on Iur connectivity between the involved RNCs.

### 4.2.2.1 ANR report over Uu for UTRAN cells

When receiving an ANR report over Uu the Receiving RNC uses the globally unique cell identities in the report to determine the network address of the Base RNCs that are controlling the Base UTRAN cells. The network address of this Base RNC is retrieved using configuration in the Receiving RNC and/or O&M. If any Base RNC involved in the logged neighbour relations in the ANR report is another RNC than the Receiving RNC, and no Iur connectivity exists to this RNC, the Receiving RNC may report the neighbour relation to O&M.

On reception of an ANR report over Uu the Receiving RNC uses the globally unique cell identities and L1 information in the ANR report, and optionally also configuration in the RNC/O&M, to determine if the ANR report contains potential neighbours to the cells controlled by the Receiving RNC. If any of these potential neighbour cells is controlled by another RNC without Iur connectivity, the configuration in the RNC/O&M may be used to determine the necessary cell information. In addition the Base RNC may interact with O&M before a neighbour relation is stored in the NRT.

Example: Utran network without lur connectivity between some of the RNCs

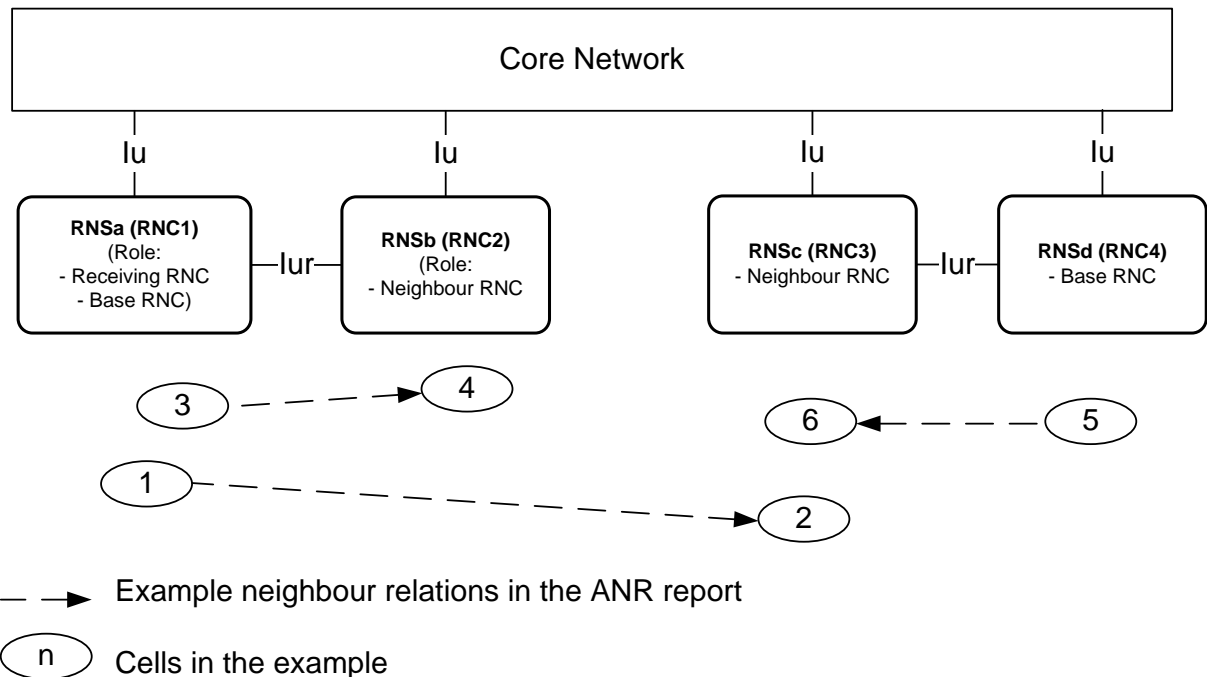


Figure 4.2.2.1-1 Example: UTRAN network without Iur between some of the RNCs

Example of the handling in a receiving RNC (RNC1) when there is no Iur connectivity to some of the RNCs included in the ANR report.

The RNC1 receives an ANR report over Uu:

- UE ANR Report sent to RNC 1:
  - B.C1(RNC1) -> N.C2(RNC3)
  - B.C3(RNC1) -> N.C4(RNC2)
  - B.C5(RNC4) -> N.C6(RNC3)

In the role of a receiving RNC, the RNC 1 uses the RRC Cell-ID in the ANR report to retrieve the addresses of the CRNCs involved in neighbour relations of the ANR report as Base RNC (from configuration and/or O&M). RNC 1 reports the entry B.C5(RNC4) -> N.C6(RNC3) to O&M<sup>1</sup> as there are no Iur connectivity between RNC 1 and RNC 4.

RNC 1 identifies the neighbour relations in which RNC1 is involved: B.C1(RNC1) -> N.C2(RNC3), B.C3(RNC1) -> N.C4(RNC2). For B.C3(RNC1) -> N.C4(RNC2) the actions in 4.2.1.1 are performed. For B.C1(RNC1) -> N.C2(RNC3) the cell N.C2(RNC3) is configured as an external cell in RNC1<sup>1</sup> and the necessary cell information is already known to RNC1, hence after O&M interaction the neighbour relation B.C1(RNC1) -> N.C2(RNC3) is stored in the NRT.

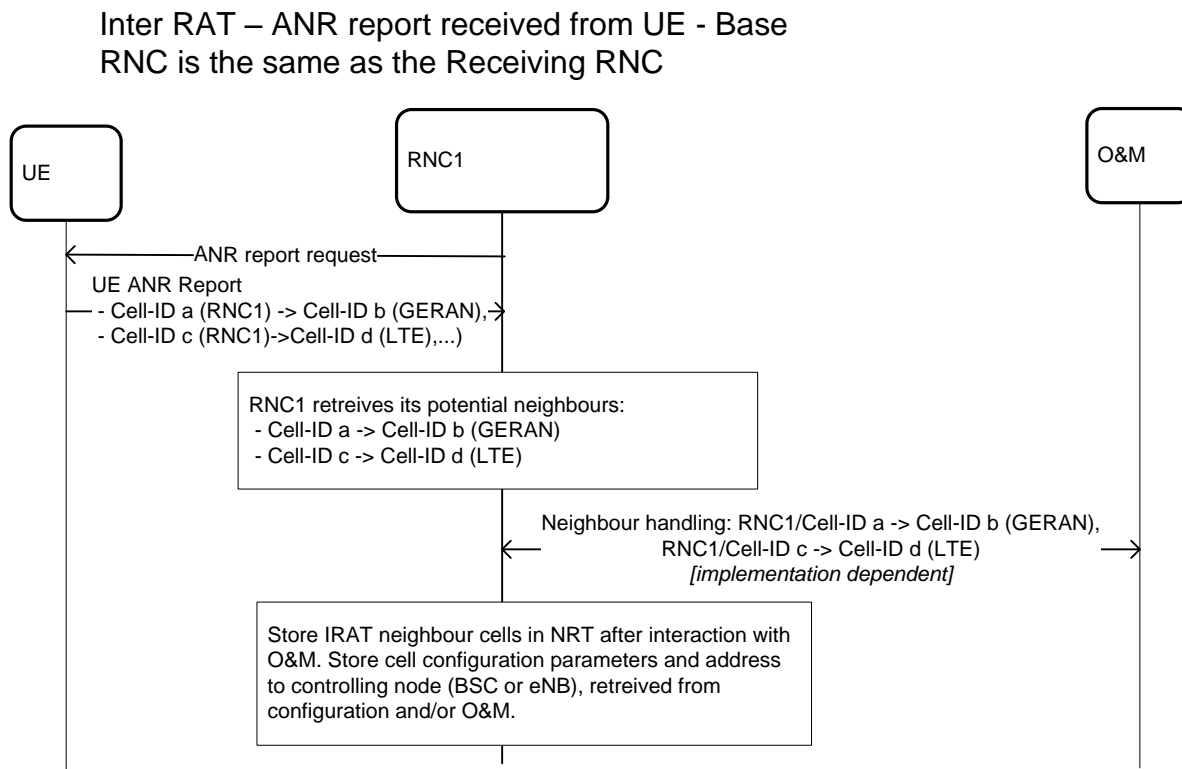
### 4.2.3 ANR Report over Uu for IRAT cells - with and without Iur

When receiving an ANR report over Uu where neighbour cell(s) are in another RAT, the Receiving RNC performs the forwarding of the report to Base RNCs over Iur as described in chapter 4.2.1.1 or, in case of no Iur connectivity

<sup>1</sup> These operations in RNC 1 is an implementational options used in this example.

between Receiving RNC and Base RNC, handles the IRAT neighbour relation as described in 4.2.2.1. Reception over Iur of an ANR report containing IRAT neighbour cells are described in 4.2.1.3.

When an RNC receives an ANR report over Uu containing IRAT neighbour cells, and if the Receiving RNC is also the Base RNC, it retrieves the necessary information for neighbour IRAT cells from O&M and/or the information of the ANR logs and determines if any of these IRAT neighbour cells are potential neighbour cells. In addition the Base RNC may interact with O&M before the neighbour relation is stored in the NRT.



**Figure 4.2.3-1 ANR Report over Uu for IRAT cells**

## 5 Functions and Procedures

The ANR for UTRAN supports the following functions:

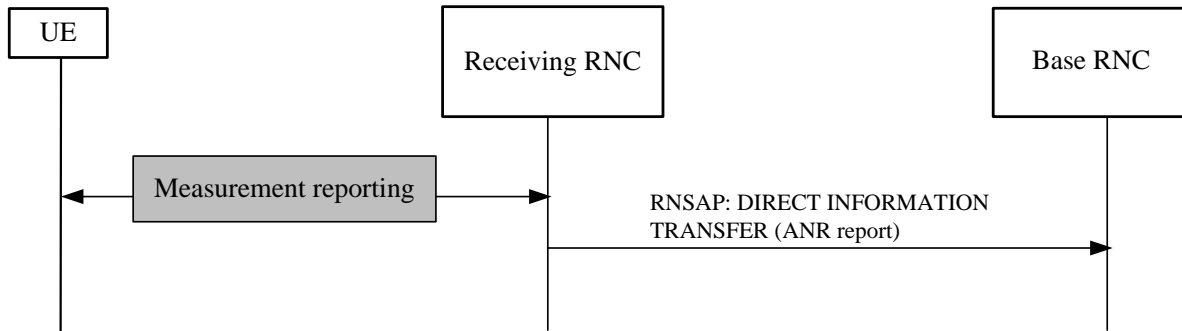
- ANR Management
- Neighbour cell configuration
  - Neighbour cell configuration for Intra-RNS cells
  - Neighbour cell configuration for Inter-RNS cells (with Iur)
  - Neighbour cell configuration (without Iur)
- ANR Logging configuration
  - Configuration parameters
  - Configuration validity
- Measurement Collection
- Measurement Reporting
- UE Capabilities

## 5.1 ANR Management

The ANR Management function provides means for an RNC, which receives an ANR report over the Uu interface, to distribute the report to other RNCs involved in the neighbour relations contained in the report as Base RNCs. The function also enables RNC for suspending and resuming ANR report over Iur.

### 5.1.1 ANR Report Forwarding

The ANR Report Forwarding uses RNSAP Direct Information Transfer procedure for sending of the ANR Report received over the Uu interface to the involved Base RNCs.



**Figure 5.1.1-1 ANR Report Forwarding**

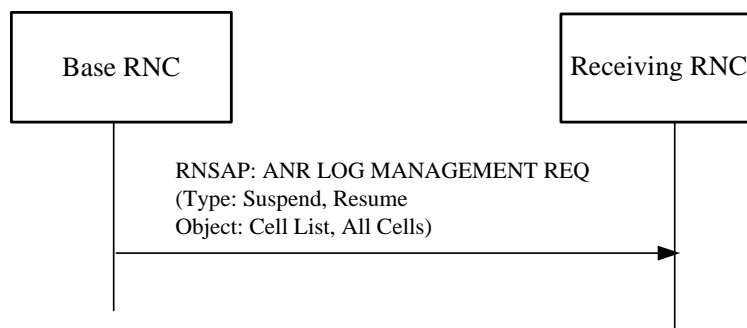
Using the RNSAP: Direct Information Transfer procedure, the RNC receiving an ANR report over Uu may forward the ANR report to RNCs involved as Base RNCs in neighbour relations of the ANR report. The ANR report received in the RRC message over Uu is transparently forwarded in the RNSAP message. The receiving RNC extracts the neighbouring ANR cell information concerning the Base RNC from the Logged ANR Report Info list contained in the ANR Report over Uu, and includes the whole RRC message in RNSAP *L3 Information IE*.

#### Abnormal conditions :

When an RNC receives an ANR report outside the defined services of the ANR Report Distribution function, or if the ANR Report Distribution from the sender of the report has been suspended as described in 5.1.2, local error handling in the receiving RNC should be invoked.

### 5.1.2 ANR Report Distribution Controlling

The ANR Report Distribution Controlling function uses a new RNSAP procedure, Information Transfer Control procedure, for suspending and resuming ANR log reporting over Iur. An RNC receiving ANR report over Iur suspends (or resumes) ANR Reports over Iur for particular cells or for all cells in the initiating RNC.



**Figure 5.1.1-2 ANR Report Distribution Controlling (Suspend/Resume)**

The ANR report over Iur is resumed again using the same procedure with resume indication for any particular cells or all cells belong to initiating RNC.

## 5.2 Neighbour Cell Configuration

The Neighbour Cell Configuration function supports configuration of new neighbour cell relations between:

- cells controlled by the same RNC
- cells controlled by different RNCs
- UTRAN cells and cells controlled by LTE or GERAN

For the case of inter RNS and inter RAT neighbour cells, the neighbour cell may also be configured in the Base RNC. Such cell is called external cell in this chapter.

### 5.2.1 Neighbour Cell Configuration for Intra-RNS cells

At the reception of the ANR report over Uu interface, or at the reception of RNSAP: DIRECT INFORMATION TRANSFER message that contains an ANR report, the CRNC may configure new neighbour cell relations between the cells it controls.

### 5.2.2 Neighbour Cell Configuration for Inter-RNS cells (with Iur)

For configuration of neighbour cell relations and external cells when the Base UTRAN Cell and the Neighbour Cell are in different RNS, the Base RNC may use Iur to fetch the necessary cell information of the neighbour cell from neighbour RNC. The Neighbour Cell Configuration function uses RNSAP: Information Exchange Initiation procedure to fetch this cell information of the potential neighbour cell from the neighbour RNC.

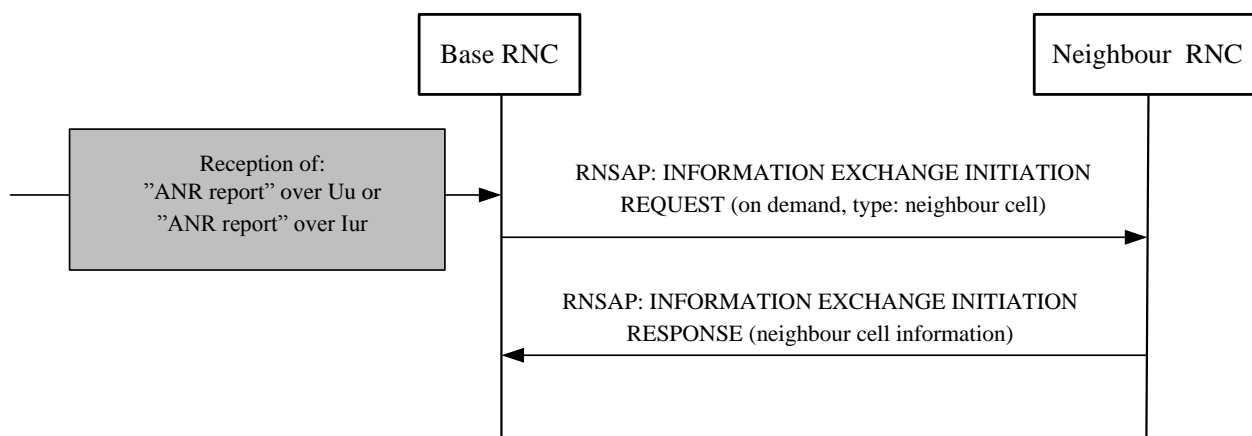


Figure 5.2.2-1 Neighbour Cell Configuration using Iur

Base RNC requests cell information required to configure the neighbour cell relation from the CRNC of potential neighbour cells using the RNSAP Information Exchange Initiation.

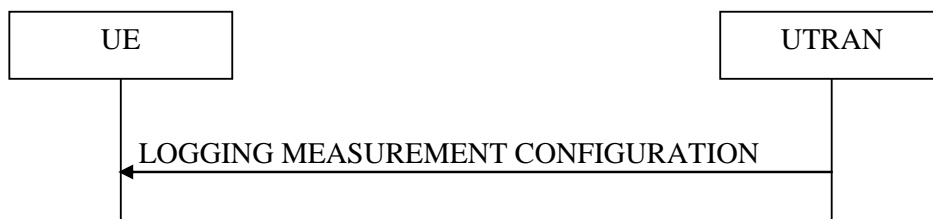
### 5.2.3 Neighbour Cell Configuration (without Iur)

At the reception of the ANR report over Uu, or at the reception of a RNSAP: DIRECT INFORMATION TRANSFER message that contains an ANR report, the Neighbour Cell Configuration function configures inter RNS and/or inter RAT neighbour cell relations and external cells in the RNC. For the necessary cell information of the neighbour cell in neighbour RNC, neighbour BSS or neighbour eNB, the Base RNC uses local configuration and/or O&M.

## 5.3 ANR Logging configuration

ANR logging is configured with Logged Measurements Configuration procedure, as shown in Figure 5.3-1.





**Figure 5.3-1: ANR Logging configuration with Logging measurement configuration message**

UTRAN initiates the ANR logging procedure to UE by sending ANR logging configuration in the Logging measurement configuration message as defined in TS 25.331.

### 5.3.1 Configuration parameters

- ANR logging threshold for Intra-RAT:
  - ANR logging relative threshold. If the measured signal strength/quality of a detected cell exceeds the threshold relative to signal strength/quality in the serving cell, the UE shall treat the detected cell as candidate for one log entry in its ANR log. The detailed usage and value range of ANR logging relative threshold is defined in TS 25.304 and TS 25.331.
  - ANR logging absolute threshold. If the measured signal strength/quality of a detected cell exceeds the absolute threshold, the UE shall treat the detected cell as candidate for one log entry in its ANR log. The detailed usage and value range of ANR logging absolute threshold is defined in TS 25.304 and TS 25.331.

Note: The UTRAN provide an ANR logging absolute threshold and optionally an ANR logging relative threshold in an ANR logging configuration.

- ANR logging duration timer. This configuration parameter defines a timer activated at the moment when UE receives ANR configuration. When the timer expires, the ANR logging is stopped, and the ANR configuration is deleted completely. The details and value range of ANR logging duration timer is defined in TS 25.331.
- ANR logging indicators for Inter-RAT. The detailed usage of ANR logging indicators for Inter-RAT are defined in TS 25.331.

### 5.3.2 Configuration validity

The ANR logging configuration is provided in the UTRA serving cell, and its validity is described below:

- ANR logging configuration is:
  - enabled in IDLE mode, CELL\_PCH and URA\_PCH states in UTRAN.
  - enabled in Cell\_FACH state when second DRX cycle is used in UTRAN
  - valid until ANR logging is disabled as specified in 5.4.
- ANR logging configuration is maintained regardless of RRC state, e.g. during multiple IDLE periods interrupted by IDLE-> Cell\_FACH or Cell\_DCH->IDLE state transitions. The configured ANR logging is enabled as described in first bullet above.
- When UE is not in IDLE mode, CELL\_PCH, URA\_PCH state or Cell\_FACH state when second DRX cycle is used and has a valid ANR logging configuration, the ANR logging duration timer is kept running.
- ANR logging configuration is maintained by the UE regardless of camping RAT. When UE changes the RAT, the ANR logging duration timer is kept running. The configured ANR logging is enabled as described in first bullet above.
- When ANR log is retrieved by UTRAN, UE deletes the ANR configuration and the logged data.

- When UE moves to a new PLMN within its ANR-PLMN List, the ANR logging configuration is maintained.

## 5.4 Measurement Collection

Within a serving cell, the UE may log multiple detected cells if satisfied by the ANR logging threshold and other criteria specified in this section. The UE should ensure that, for a serving cell, the log contains only one entry per detected cell, identified with Cell Id (i.e. Cell Identity in UTRAN, CGI for LTE and GSM).

UE collects ANR measurement results and continues ANR logging according to the ANR logging configuration, and ANR logging shall be disabled if any of the following conditions is met:

- the maximum number of NRs are reached.
- the ANR logging duration timer expires.

Once ANR logging is disabled, the UE stops ANR logging and stops the ANR logging duration timer and the ANR logging configuration is deleted.

Note: The maximum number of NRs to be logged by the UE is hard coded.

During ANR logging, UE should decide when to read the system information blocks of the target detected cell that can be logged by UE, in order to acquire the necessary ANR related information to be logged as defined in TS 25.331. The SI-reading activity in support of ANR is of best effort from UE perspective, and should not impact UE paging or mobility behaviour.

For intra-UTRA case, the UE is allowed to perform ANR logging when camping on any cell belonging to its ANR-PLMN List, as well as to perform ANR measurement and to log any UTRA cell that it can detect.

For logging of intra or inter -RAT neighbors, UE shall not log any neighbouring relationship entry related to CSG cell.

For logging of inter-RAT GERAN neighbors, UE shall only log if the GERAN cell is not included in the neighbour list in SIB11/11bis/12.

For logging of inter-RAT E-UTRAN neighbours, UE shall only log if the E-UTRAN cell is not included in the blacklist for the EUTRAN frequency in SIB19.

When UE camps on certain GSM/GERAN or E-UTRAN cell with valid ANR logging configuration and the ANR logging duration timer is still running, and then UE reselects to a certain target UTRAN cell from the source GSM/GERAN or E-UTRAN cell, UE shall log inter-RAT cell information for the source GSM/GERAN or E-UTRAN cell.

## 5.5 Measurement Reporting

A UE configured to perform ANR logging indicates the availability of ANR logs, by means of a one bit indicator in RRC\_CONNECTION\_SETUP\_COMPLETE, CELL\_UPDATE, URA\_UPDATE and MEASUREMENT\_REPORT (only applicable in case when UE is able to make seamless transition from Cell\_PCH state to Cell\_FACH state) messages.

The network may decide to retrieve the ANR logs based on this indicator in Cell\_DCH or Cell\_FACH states.

In case the network will not retrieve ANR logs, UE should store non-retrieved ANR logs for 48 hours from the moment when the UE receives the logged ANR configuration. There is no requirement to store non-retrieved ANR logs beyond 48 hours. In addition, all related ANR configuration and ANR logs shall be removed by the UE at NAS detach or switch off.

For Logged ANR, UE checks if the RPLMN is the same as one of the PLMNs in the "ANR-PLMN List" before signalling the presence of ANR logs in its memory, and UE checks if the RPLMN is the same as one of the PLMNs in the "ANR-PLMN List" before sending back the ANR logs to the network.

When ANR logs are retrieved, the reported measurement results are deleted.

The ANR log reporting should not prevent reporting two detected cells with the same PSC/Frequency if the Cell-Id is different for the two detected cells.

Note: The UE information request/response procedure is used for ANR log request/reporting. The details for ANR log retrieval is defined in TS 25.331.

## 5.6 UE Capabilities

One UE capability indicator is used to indicate UE support of UTRA ANR, covering both Intra-RAT and Inter-RAT detected cells. The UTRAN ANR logging capability is independent of other logging capability in UE.

## Annex A (informative): Change history

Change history						
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	New
2010-10					TS Skeleton	0.0.0
2011-02					TP As agreed in RAN3#71: R3-110965	0.0.1
2011-02					TP As agreed in RAN3#71: R3-111036	0.0.2
2011-03					Updated with TP agreed in RAN2#73: R2-111655 and editorial correction	0.0.3
2011-03					Submitted to RAN#51	1.0.0
2011-05					Updated with R2-113590, R3-111485 and R3-111620	2.0.0
2011-06	52	RP-110630			Approved at RAN#52	10.0.0
2011-12					MCC editorial corrections: Removal of empty Introduction and Symbols sections.	10.0.1
2012-06	56	RP-120761	0001	1	Updates of ANR Stage 2 Descriptions for EPLMN	10.1.0
2012-06	56	RP-120743	0003	-	Correction of ANR handlings upon UE detach or switch off	10.1.0
2012-09	57	RP-121131	0004		Corrections to ANR Logging configuration	10.2.0
2012-09					Update to Rel-11 version (MCC)	11.0.0
2013-03	59	RP-130236	0005	1	Extend 3G ANR Applicable RRC State	11.1.0