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Technical Report

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Contents

Foreword

This Technical Report (TR) has been produced by the 3rd Generation Partnership Project (3GPP), Technical Specification Group RAN.

The contents of this TR 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 m.x.y

where:

m the first digit indicates:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

y the third digit is incremented when editorial only changes have been incorporated into the specification.

1 Scope

The purpose of this document provides the current status of the work "*Intra Domain Connection of RAN Nodes to Multiple CN Nodes: Overall System Architecture*" within 3GPP TSG RAN WG3.

Currently an RNC can only be connected to one MSC and/or one SGSN (the same restriction applies to BSCs also). This can bring about inefficient usage of hardware and disproportionate spread of signalling loads across a network.

This Work Item concentrates primarily on a solution where a (standardised) routing *function* in the RNC/BSC enables the connection of multiple MSCs/SGSNs to an RNC/BSC (both A/Gb mode and Iu mode). It is hoped that this will bring about a reduction in mobility management signalling and improved efficiency in hardware utilisation.

It describes agreed requirements related to the Work Task, and split the Work Task into "Study Areas" in order to group contributions in a consistent way. It discusses the impact upon RAN3 specifications, and identifies the affected specifications. If information needs to be communicated to groups outside of TSG RAN WG3, it is recorded in this document. When solutions are sufficiently stable, the CRs to the various impacted RAN3 specifications can be issued.

It also describes the schedule of the Work Task.

The document is a 'living' document, i.e. it is continuously updated and presented to all 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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] TSGS#10(00)0619 Work Item Description: Intra Domain Connection of RAN Nodes to Multiple CN Nodes: Overall System Architecture
[2] TS 23.236 Intra-domain connection of Radio Access Network (RAN) nodes to multiple Core Network (CN) nodes

Editors Note - A formal review of the references is required.

3 Definitions, Symbols, and Abbreviations

3.1 Definitions

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

NAS Node Selection Function: The function used to assign specific network resources (i.e. MSC-server or SGSN) to serve a UE and subsequently route the traffic to the assigned network resource.

Network Resource Identifier The Network Resource Identifier (NRI) uniquely identifies an individual CN node out of all CN nodes are assigned to serve a UE.

Pool Area: A Pool Area is a collection of one or more MSC or SGSN serving areas within which a UE may roam without need to change the serving CN node (i.e. MSC-server or SGSN). A Pool Area is served by one or more CN nodes in parallel. All the cells controlled by a RAN node (i.e. RNC or BSC) belong to the same one [or more] pool area[s].

RAN node service area: This area contains all the cells controlled by the RAN node (i.e. RNC or BSC).

CN Node MSC-Server/SGSN

RAN Node BSC/RNC

3.2 Symbols

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

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3.3 Abbreviations

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

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4 Introduction and Motivation

4.1 Task Description

The work task is described in the contribution [1], which has been agreed at TSG-RAN#10.

The purpose of this new work item is to enable a 'more flexible' Iu interface, whereby RNCs and BSCs can be connected to more than one MSC-server/SGSN.

4.2 Rationale for NNSF

3GPP has incorporated the GSM architecture whereby one BSC can only connect to one MSC-server. Using this GSM based architecture approach, there could be a significant wastage of hardware e.g. where a BSC has 40% of the capacity of an MSC-server, 2 BSCs may only be connected to that MSC-server – leaving 20% MSC-server capacity not utilised.

Regarding network signalling traffic, with more MSC-server/SGSNs in a network, there are more inter-MSC-server/SGSN registration updates. The signalling associated with these inter MSC-server/SGSN updates causes additional load on CN signalling: MSC-servers, SGSNs, HLRs, and on the radio interface signalling channels.

The ability to connect RNCs and BSCs to more than one MSC-server and to more than one SGSN could reduce this signalling load, and moreover, the ability to provide load sharing between MSC-servers/SGSNs would further improve the efficiency of hardware utilisation.

An area where the possible outcome includes improved signalling load distribution and increased efficiency of network nodes, is one that is very appealing. Although this document shall not detail the impacts upon GSM/GPRS/GERAN it should be stated that any solution should consider both GSM and UMTS.

5 Requirements

This section will contain the requirements to support the NNSF work item. Different sub-sections may contain different types of requirements.

5.1 General Requirements

Where the NAS Node Selection Function is implemented, the following are requirements:

1. During initial access or if the NRI is not known within the RAN node, the RNC/BSC shall be able to select any CN node such as the SGSN/MSC-Server within a Pool Area or group of Pool Areas.

2. Once the UE belongs to a pool area the RNC/BSC using the NNSF shall be able to select the appropriate CN node i.e. an SGSN/MSC-Server - based on the routing information provided by the UE during the initial non-access stratum signalling.

3. All RNCs/BSCs and SGSNs/MSC-Servers (using the NNSF) should be able to co-exist with all RNCs/BSCs and SGSNs/MSC-Servers NOT using the NNSF.

4. The solution shall enable the reduction of signalling within the core network (e.g. reduction of the HLR signalling traffic).

6 Study Areas

This section shall document the disussion(s) and solution(s) if a Network were to implement this function.

6.1 NNSF Overview

6.1.1 General

The Intra Domain Connection of RAN Nodes to Multiple CN Nodes introduces functionality e.g. a routing mechanism which enables the RAN nodes to route signalling messages to different CN nodes within the CS or PS domain, respectively.

The Intra Domain Connection of RAN Nodes to Multiple CN Nodes introduces the concept of “Pool Areas”. Within a Pool Area a UE may roam freely (in either connected or idle mode) without the need to change the CN serving node.

The usage of this ‘Pool Area’ concept aims to reduce inter CN node updates, handovers/relocations and reduce HLR updating signalling.

6.1.2 Pool Area

A Pool Area:

- is comparable to the serving area an MSC or SGSN , and may be a collection of one or more MSC or SGSN serving areas.
- Unlike an MSC or SGSN service area, a Pool Area is typically served by more than one CN node (MSCs or SGSNs) in parallel which share the traffic of this area between each other.
- Pool Areas may overlap.
- A Pool Area is an area within which a subscriber may roam without a need to change the serving CN node.
- The complete serving area of a RAN node (RNC or BSC) belongs to one or more Pool Area(s).
- The serving area of a RAN node may belong to multiple Pool Areas which can occur when multiple overlapping Pool Areas include this RAN node service area.
- The Pool Areas of the CS and of the PS domain are configured independently with the granularity of RAN node serving areas.
- If Location Areas (LAs) or Routing Areas (RAs) span over multiple RAN node serving areas then all these RAN node serving areas have to belong to the same Pool Area.

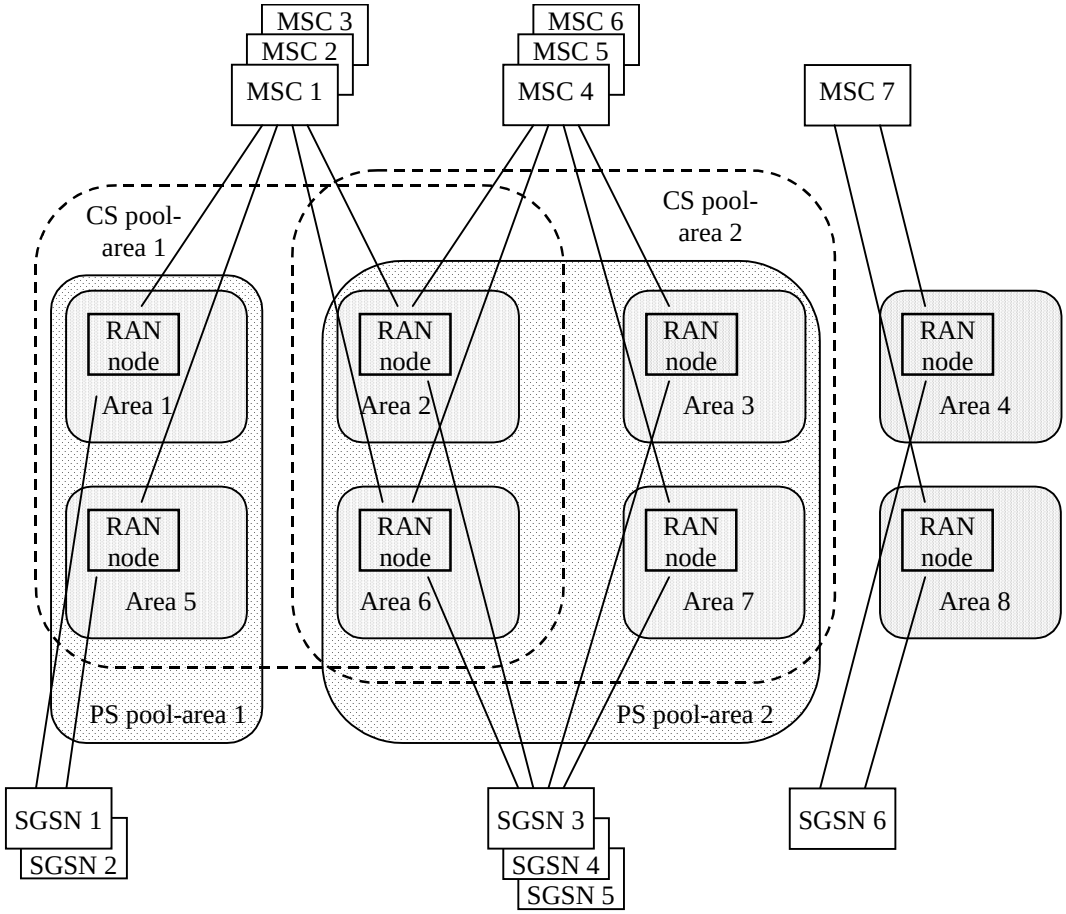

Figure 1: Pool Area configuration example

6.1.3 NAS Node Selection Function

The NAS Node Selection Function will be used in RAN nodes and potentially in CN nodes. In the RAN node the function selects the specific CN node (i.e. MSC or SGSN) to which initial NAS signalling messages are routed. The NRI identifies the specific CN node.

If no CN node address is configured for the derived NRI or if no NRI can be derived (e.g. the UE indicated an identity which contains no NRI) then the NAS Node Selection Function selects an available CN node (e.g. according to pre-determined load balancing) and routes the message to the selected CN node.

The NAS Node Selection Function in the RAN node derives the NRI from the IDNNS IE (see TS 25.331) when the UE is supported in Iu mode.

6.1.4 Network Resource Identifier

The Network Resource Identifier (NRI) identifies uniquely an individual CN node out of all CN nodes which serve in parallel a Pool Area. In areas where Pool Areas overlap the NRI identifies uniquely a CN node out of all CN node which serve all these overlapping Pool Areas, i.e. an NRI identifies uniquely a CN node within a RAN node.
NB The NRIs of the CS and the PS domain are independent of each other as the PS and the CS domain CN nodes are addressed independently. More than one NRI may be assigned to a CN node.

The NRI is part of the temporary identity TMSI (CS domain) or P-TMSI (PS domain) which is assigned by the serving CN node to the UE. Each CN node which support the "Intra Domain Connection of RAN Nodes to Multiple CN Nodes" is configured with its specific one or more NRI(s). The (P-)TMSI allocation mechanism in the CN node generates (P-)TMSIs which contain a configured NRI in the relevant bit positions.

In Iu mode the MS provides an Intra Domain NAS Node Selection (IDNNS) [2] in the Access Stratum part of the [RRC] INITIAL DIRECT TRANSFER message to the RAN node (RNC or BSC). The IDNNS contains a

routing parameter with a fixed length of 10 bits. This routing parameter transports the NRI value. In addition the IDNNS contains an indication from which identity (TMSI, IMSI, IMEI, ...) the routing parameter is derived.

6.1.5 Load Balancing

The aim of implementing the NNSF is to balance the load between the available CN nodes. The load-balancing algorithm is implementation specific.

6.2 Functional Impact

6.2.1 NNSF Impact

The role of the RNC in implementing the NAS Node Selection Function is described below:

6.2.1.1 RNC Functions

The RNC provides the NAS Node Selection Function. The NAS Node Selection Function derives from the NRI the address of the specific CN node for the relevant domain (CS or PS). The association between NRI values and CN node addresses is configured in the RNC (O&M).

The RNC routes the initial NAS signalling messages according to the NRI and the “domain indicator” (CS or PS) to the relevant CN node if a CN node address is configured in the RNC for the specific NRI and the requested domain (CS or PS).

If no CN node address is configured in the RNC for the requested NRI or if the provided identity contains no NRI then the RNC routes the initial NAS signalling message to a CN node selected from the available CN nodes which serve the related domain (CS or PS).

The selection mechanism is *implementation dependent* and should preferably balance the load between the available CN nodes.

6.2.2 Impact on UTRAN Architecture

The addition of this *function* should be described in the appropriate UTRAN Architecture specification, however no direct impact on *actual* UTRAN architecture e.g. new interfaces, new network elements is foreseen in the introduction of this function (with the exception of Iu Connectivity – see below).

6.2.3 Impact on the Iu Interface

At present for R99/R4, there is a restriction on the connectivity of a UTRAN access point to the CN where by there may not be more than one Iu-CS (R99 only) or Iu-PS interface to the respective CS and PS domains. Should NNSF be implemented this restriction would need to be amended to state that multiple Iu interfaces (Iu-CS or Iu-PS) may be present.

6.2.4 Impact on RANAP – Paging

In case the RNC receives a CS PAGING message with IMSI only, the RNC shall upon reception temporarily store the MSC/VLR-identity of the node that issued the paging message. [Note, that the PAGING message containing a CS domain identifier may be sent via Iu-PS as well.

The *CN Global-ID* IE (recently added to RANAP (R4) for TrFO purposes) is appropriate in this situation.

6.2.5 Impact on RANAP – Initial UE Message

The RNC using the NNSF shall route the INITIAL UE MESSAGE according to the mechanism described in 6.1.3. In the exceptional case described in 6.2.4, the RNC shall utilise the memorised MSC/VLR-identity for routing the INITIAL UE MESSAGE.

If the RNC receives a CS-paging via the Iu-PS interface it shall use the MSC/VLR identity provided within the PAGING message for routing the INITIAL UE MESSAGE.

6.2.6 Impact on RANAP – Definition of the 'Default CN Node'

The definition of the *Default CN Node* IE needs to be re-evaluated. There might also be changes necessary in the respective Elementary Procedure (EP) description referring to the Default CN Node.

6.2.7 Impact on RANAP – Backwards compatibility

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7 Benefits & Drawbacks

This section is intended to list the known advantages and disadvantages of the NNSF Work Item.

7.1 Advantages

7.2 Disadvantages

8 Agreements

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.

9 Specification Impact and Associated Change Requests

This section will discuss the impact of the NNSF Work Item on current RAN3 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.

9.1 25.401 UTRAN Overall Description

9.2 25.410 Iu General Aspects & Principles

9.3 25.413 UTRAN Iu Interface RANAP Signalling

10 Communication with Other Groups

This section will list topics, which require correspondence with other groups, and the status of those communications.

10.1 Correspondence with TSG SA WG2

During RAN3 Meeting #24 the a liaison was sent to SA WG2 regarding: 'The handling of Page responses in the event of MSC/VLR failure'

This liaison can be found in T-doc R3-013067.

11 Project Plan

11.1 Schedule

Date	Meeting	Scope	[expected] Input	[expected]Output

11.2 Work Task Status

	Planned Date	Milestone	Status
1.			
2.			

12 History

Document history		
V0.0.0	2001-03	Document outline.
V0.0.1	2001-03	Initial 'skeleton' version of TR approved. No TR number allocated as yet. Minor changes made to the WI description in Section 1: 'Scope'.
V0.0.2	2001-04	Addition of TR number to Document Title page & Headers, removal of Abbreviations in Title etc.
V0.0.3	2001-11	Updated with T-docs discussed and approved by the Iu SWG at RAN3 Meeting #24 in New York City, USA. The documents where original proposals were made (and amended where appropriate for inclusion to this TR) were: R3-013018 R3-013019 R3-013020 R3-013021
V0.1.0	2001-11	Approved (no comments)
V1.0.0	2001-11	Version agreed at RAN3#25 to be submitted to RAN#14.
Rapporteur for 3GPP RAN TR 25.875 is:		
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