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Title: **Functional Division between UTRAN and CN contribution**

Document for: **Decision**

1 Introduction

This contribution lists the functions at the Iu access points and the functional division between the CN and UTRAN. The list of functions is currently missing from section 5 of [1].

This contribution is a revised version of contribution R3-99A59.

Unfortunately, due to lack of time, it was not possible to coordinate this contribution with the author of contribution R3-99A00 and the companies that expressed interest in the review of this proposal.

Compared to the previous version, the relations of the functions to the RANAP elementary procedures has been removed, since this proposal did not receive very much support at the last meeting.

2 Iu functions and functional split

2.1 General

This section defines the functional split between the core network and the UMTS radio access network. In addition, the possible interaction between the functions are defined. The functional split is shown in Table 1.

Table 1. The Iu interface functional split.

Function	UTRAN	CN
RAB management functions:		
RAB establishment, modification and release	X	X
RAB characteristics mapping Iu transmission bearers	X	
RAB characteristics mapping Uu bearers	X	
RAB queuing, pre-emption and priority	X	X
Radio Resource Management functions		
Radio Resource admission control	X	
Broadcast Information	X	X
Rate Adaptation		
Rate Adaptation for External Network		X
Iu link Management functions:		
Iu signalling link management	X	X
ATM VC management	X	X
AAL2 establish and release	X	X
AAL5 management	X	X
GTP-U Tunnels management	X	X
Buffer Management	X	
Iu U-plane (RNL) Management:		
Iu U-plane frame protocol management		X
Iu U-plane frame protocol initialization	X	
Mobility management functions:		
Mobility Management		X
Location information reporting	X	X
Handover and Relocation		
Active cell management, intra RNC	X	
Active cell management, inter RNC when Iur available (intra/inter MSC)	X	
Inter RNC hard HO, Iur not used or not available	X	X
Serving RNS Relocation (intra/inter MSC)	X	X
Inter system hard HO (UMTS-GSM)	X	X
Paging		
Paging triggering		X
Paging execution	X	
Location Management	X	X
Security Functions:		
Data confidentiality		
Radio interface ciphering	X	
Ciphering key management		X

Function	UTRAN	CN
User identity confidentiality	X	X
User Authentication		X
Data integrity		
Integrity checking	X	
Integrity key management		X
Service and Network Access functions:		
CN Signalling data	X	X
Transcoding		X
Call Control and Connection Management		X
CS Data- Network Interworking function		X
SMS Point to Point		X
Supplementary Services		X
Charging		X
UE Tracing	X	X
UE Positioning reporting	X	X
Multimedia		X
Iu Co-ordination functions:		
Paging coordination	X	
Relocation coordination	X	
Security mode control coordination	X	

2.2 RAB management Functions

2.2.1 RAB establishment, modification and release function

The RAB, Radio Access Bearer, is defined to be set-up between UE and CN. Depending on subscription, service, requested QoS etc. different types of RABs will be used. It is the CN that controls towards the UTRAN the establishment, modification or release of a RAB.

The RAB identity is allocated by CN and is locally significant over one Iu signalling instance.

RAB establishment, modification and release is a CN initiated function.

RAB establishment, modification and release is a UTRAN executed function.

RAB release request is a UTRAN initiated function, triggered when UTRAN fails to keep the RAB established with the UE.

2.2.2 RAB characteristics mapping to Uu bearers function

The RAB characteristics mapping function is used to map the radio access bearers to the Uu bearers. The mapping is performed during the establishment of the RAB. UTRAN shall perform the mapping between the bearers.

RAB mapping to Uu transmission bearers is a UTRAN function.

2.2.3 RAB characteristics mapping to Iu transport bearers

The RAB characteristics mapping function is used to map the radio access bearers to the Iu interface transport bearers. The mapping is performed during the establishment of the RAB.

UTRAN shall perform this mapping between the bearers if AAL2 is used, since it is the UTRAN that establish the AAL2 connections.

In case of RAB towards the IP domain, UTRAN shall perform the mapping between the radio access bearers and the IP layer.

RAB characteristics mapping to Iu transport bearers is a UTRAN function.

2.2.4 RAB queuing, pre-emption and priority function

The priority level of a RAB is determined by the CN based on e.g. subscription information, QoS information etc.. Accordingly, the CN shall request RAB establishment or modification with an indication of the priority level and the pre-emption capability of that RAB and the queuing vulnerability. Queuing and resource pre-emption shall be performed by UTRAN accordingly.

RAB queuing, pre-emption and priority handling is a UTRAN controlled function.

RAB queuing, pre-emption and priority setting is a CN function.

2.3 Radio Resource Management over Iu

2.3.1 Radio resource admission control

This function is used at radio access bearer establishment and it is divided in two parts:

a) Subscription based admission control

When CN receives a request to establish or modify a radio access bearer, the CN verifies if the subscriber is allowed to use a radio access bearer with the requested parameters. Based on the verification the CN will accept or reject the request. This part is called "Subscription based admission control" and it is handled by the CN.

b) Radio resource admission control

When UTRAN receives a request to establish or modify a radio access bearer from the CN, the current radio resource situation is analysed and the admission control either accepts or rejects the request. This part is called "Radio resource admission control" and it is handled by the UTRAN. If the request is queued, this part is handled by the RAB queuing, pre-emption and priority function.

Part b) is only performed if CN accept the request to establish a radio access bearer

2.3.2 Broadcast information management

This function consists in the broadcast from network toward UE of some information in the coverage area of the whole network or different parts of the network.

There are two kinds of Broadcast information management. UTRAN broadcast information and CN broadcast information management. All UTRAN broadcast information management shall be handled locally within UTRAN. All CN related broadcast information is controlled by CN. UTRAN executes the broadcast of CN information.

2.4 Rate adaptation for external networks

The rate adaptation function is used to adapt the radio interface data transmission rates with the terrestrial link transmission rates and with the external networks (such as PSTN and ISDN) rates.

The Rate adaptation for external network is a CN function.

2.5 Iu link Management functions

2.5.1 Iu Signalling Link Management function

The Iu signalling link management function provides a reliable transfer of the radio network signalling between UTRAN and CN. Both CN and UTRAN manage the function.

This function is in particular responsible for Iu signalling connection establishment, which can be established either by the CN or the RNC and for Iu signalling connection release, which is controlled by CN possibly upon UTRAN request.

2.5.2 ATM Virtual Connection Management function

This function refers to handling of ATM Virtual Connections (VCs) between CN and UTRAN.

This function shall be used to establish, maintain and release the ATM VCs. For permanent VCs, it is regarded to be an O&M function.

This function also includes the selection of a Virtual Circuit to be used for a particular RAB. The selection of ATM VC upon an Iu radio access bearer service request, shall be done by UTRAN. The selected VC shall fulfil the requirements of the request. AAL5 adaptation layer will be used over a virtual circuit for signalling. AAL5 and AAL2 adaptation layers will be used over virtual connections for user data. The VC may consist of several sublinks: such as SCCP connections, AAL2 connections or IP flows.

2.5.3 AAL2 connection establish and release function

This function is used to establish and release the AAL type 2 connections between CN and UTRAN upon an Iu radio access bearer service request. Both UTRAN and CN are taking part in the establishment of AAL2 connection. UTRAN shall initiate the establishment. UTRAN shall perform the release of the AAL2 connection upon request of the CN. The use of AAL2 for Iu transmission bearers depends on type of CN.

2.5.4 AAL5 management function

AAL5 connections between CN and UTRAN shall be pre-configured at system initialisation. Basic configuration is PVCs. For user data, SVC is possible.

The AAL5 management is a function handled by both the CN and the UTRAN.

2.5.5 GTP-U tunnels management function

This function is used to establish and release GTP-U tunnels between CN and UTRAN upon a radio access bearer service request. This involves assigning a tunnel identifier for each direction and the creation of a context containing the tunnel information. The use of GTP-U for Iu transport bearers depends on type of CN.

2.5.6 Buffer Management

This function includes buffers to store received packet data units that at reception can not be processed due to e.g. congestion. In UTRAN, there must be a buffer management function handling received packets from the peer CN node.

The used mechanism is not in the scope of this document and not relevant to be standardised.

Buffer management is a UTRAN function.

2.6 Iu U-plane (RNL) Management Functions

2.6.1 Iu U-plane frame protocol mode selection function

The Iu UP in the Radio Network Layer provides modes of operation that can be activated on RAB basis. For a given RAB, the Iu UP operates either in a Transparent or in Support mode. Iu U-plane frame protocol mode is selected by the CN.

This function is a CN function.

2.6.2 Iu U-plane frame protocol initialization

Iu U-plane frame protocol is initialised by the UTRAN.

2.7 Mobility Management Functions

2.7.1 Mobility Management

The mobility management is used to maintain the information in the CN about the location of the terminal. The function is needed for support of UE roaming and for support of UE terminating traffic. All Mobility Management signalling between UE and CN are transferred transparently through UTRAN, except paging.

For Mobility Management purposes, the location information shall be at Location and Routing Area level.

2.7.2 Location information update function

Functionality within the CN, such as Charging, needs information about the present location of active UE, i.e. UE with established signalling connection. The Location information update function is used to transfer this information from the UTRAN to the CN. It is the UTRAN responsibility to send this information initially at the signalling connection establishment for an UE and at any change of the UE location as long as the signalling connection exists. For Mobility Management purposes, the location information shall be at Location and Routing Area level.

2.7.3 Handover and Relocation functions

2.7.3.1 Active Cell Management, intra RNC

This functionality includes procedures for adding and removing cells controlled by one RNC to and from the active set. The handovers may be hard or soft. This functionality is handled by UTRAN and it does not involve the CN.

2.7.3.2 Active Cell Management, inter RNC, when Iur is available

This functionality includes procedures for adding and removing cells controlled by an other RNC to and from the active set. This is possible only when Iur interface is available between the RNCs in question. As long as the Iur is available, the RNCs may be controlled by different MSCs, i.e. both intra and inter MSC cases are applicable. The handovers may be hard or soft. This functionality is handled by UTRAN and it does not involve the CN.

2.7.3.3 Inter RNC hard HO function, Iur not used or not available

This functionality includes procedures for handover from one RNC to other RNC when Iur interface is not used or is not available, i.e. soft handover is not possible. The connection is switched in the CN, so both UTRAN and CN are involved. Both intra and inter CN entity cases are applicable.

2.7.3.4 Serving RNS Relocation function

This functionality allows moving the Serving RNS functionality from one RNC to an other RNC, e.g. closer to where the UE has moved during the communication. The Serving RNS Relocation procedure may be applied when active cell management functionality has created a suitable situation for it. Both UTRAN and CN are involved.

2.7.3.5 Inter system Handover (e.g. GSM-UMTS) function

Inter system handover is performed when a mobile hands over between cells belonging to different systems such as GSM and UMTS. This may imply also a change of radio access type. For intersystem handover between UMTS and GSM, the GSM procedures are used with the GSM network. Both UTRAN and CN are involved.

Note: The GSM BSSMAP procedures are outside the scope of this specification.

2.7.4 Paging

2.7.4.1 Paging triggering function

The Core Network shall, when considered necessary, trigger the paging in the UTRAN system.

2.7.4.2 Paging execution function

The paging function shall be executed by UTRAN.

2.7.5 Location Management

The location management is used to maintain the information about the location of the terminal.

The location management of an idle terminal is handled within the CN at the level of Location/Routing Area. The UTRAN controls the location management of active terminals, i.e. the UTRAN knows which cells/URA are used by the active terminal.

2.8 Security Functions

2.8.1 Data Confidentiality

2.8.1.1 Radio interface ciphering function

The radio interface shall be ciphered upon request of the Core Network. Both Signalling and user data may be subject to ciphering. The ciphering shall be done within UTRAN.

2.8.1.2 Ciphering key management function

The ciphering key and the permitted algorithm shall be supplied by the CN. UTRAN selects the used algorithm.

Note: This is assumed to be like in GSM. This needs to be confirmed by S3.

2.8.1.3 User identity confidentiality function

Over a radio path a temporary identity shall be used instead of the permanent identity. The translation of the temporary identity to permanent identity shall mainly be handled by CN. Also the RNC has ability to use temporary identity for the user (RNTI).

Alternative text:

The UMTS user identity confidentiality is obtained by using a temporary UE identity rather than the permanent UE identity (i.e. IMSI) over the radio path.

The CN allocates to each visiting UE a temporary identity. This identity is used by the UE when establishing a new connection between the CN and the UE. It is used by the CN when requesting a page.

In addition, UTRAN allocates to each UE with established RRC connection a temporary identity (Radio Network Temporary Identity, RNTI). This identity is used to identify an UE when on common radio channels.

2.8.2 Terminal identity check function

The terminal identity check be provided by the CN. The Iu interface is required to transport necessary request and response messages between the CN and UE.

2.8.3 User Authentication function

The user authentication shall be provided by the CN. The authentication functions are transparent for the Iu Interface, and therefore outside the scope of Iu Interface documents.

2.8.4 Data integrity

2.8.4.1 Integrity checking

The purpose of the integrity check is to make sure that the signalling continues between the same elements as by authentication. The integrity check shall be done within the UTRAN.

2.8.4.2 Integrity key management

The integrity key and the permitted algorithm shall be supplied by the CN. UTRAN selects the used algorithm.

Note: This is assumed to be like in GSM. This needs to be confirmed by S3.

2.9 Service and Network Access Functions

2.9.1 Core Network signalling data transfer function

The PS respective the CS CN signalling data such as Call Control (CC), Session Management (SM), Mobility Management (MM) and Supplementary Services (SS) shall be transparently conveyed over the Iu interface. The signalling information shall be conveyed transparently over the same Iu interface channel that is used for the UTRAN-CN signalling.

2.9.2 Transcoding function

The transcoding functionality is needed for changing the coding of a voice call from one coding scheme to another. The transcoder placement is within the CN. The transcoding functionality is therefore placed in the CN only. Over the Iu interface, transcoded speech shall be treated a data service with specific Quality of Service requirement.

2.9.3 Call Control and Connection Management function

CC/CM messages shall be handled transparently by the Iu interface. The Iu interface provides a transportation link between the core network and the UE.

2.9.4 CS data – Network Interworking function

The network interworking function is used to modify the Iu UP frames to match the requirements of the external network such as PSTN or ISDN. The network interworking function may consist of rate adaptation and/or error correcting link protocol such as GSM RLP.

The network interworking function between the CN and external networks (such as PSTN and ISDN) shall be handled by CN.

2.9.5 SMS Point to Point transfer function

SMS Point to point is a NAS service. SMS PP PDU are transparently transferred across UTRAN.

Usage of SAPI or priority indicator on SMS is FFS.

2.9.6 Supplementary Services transfer function

Supplementary Services that are core network specific shall be handled transparently by the Iu interface.

Usage of priority indicator on SS is FFS.

2.9.7 Charging

Charging shall be handled by CN. The charging may be based on the used radio resources, received Quality of Service or on the amount of transmitted data.

2.9.8 UE Tracing

This feature allows tracing of various events related to the UE and its activities. This is an O&M functionality.

This function uses the following RANAP Elementary Procedures:

- Trace Invocation

2.9.9 Location reporting function

The positioning function performs the determination of the geographical position for an UE. The location reporting function transfer the positioning information between the UTRAN and the CN according to CN commands. This function involves UTRAN and CN.

2.10 Coordination Functions

2.10.1 Paging Coordination function

The two CN domain architecture implies need for a page co-ordination, i.e. handling of page triggered by one CN node when MS has a signalling connection to the other CN node. This page co-ordination is performed by UTRAN. The Common ID is used for this co-ordination. The CN provides the UTRAN with the Common ID.

The paging coordination is a UTRAN function.

2.10.2 Relocation Coordination function

The two CN domain architecture implies need for relocation co-ordination. The description of this function is **TBD**.

The relocation coordination is a UTRAN function.

2.10.3 Security mode control Coordination function

The two CN domain architecture implies need for security mode control co-ordination. . The description of this function is **TBD**.

The security mode control coordination is a UTRAN function.

3 Proposals

It is proposed to add the text and structure in section 2 of this contribution to section 5 of [1].

4 Reference

- [1] 3GPP UMTS 25.410, *UTRAN Iu Interface, General Aspects and principles*, v.0.2.1, Source: Editor
- [2] R3-99A00, Iu Functions, Source: Nokia
- [3] R3-99A59, Ericsson Comments to Iu function contribution; Source: Ericsson