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TECHNICAL REPORT

Universal Mobile Telecommunications System (UMTS);
LTE;
Feasibility study for evolved Universal Terrestrial Radio Access (UTRA) and Universal Terrestrial Radio Access Network (UTRAN)
(3GPP TR 25.912 version 15.0.0 Release 15)

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1 Scope

This present document is the technical report for the study item "Evolved UTRA and UTRAN" [1]. The objective of the study item is to develop a framework for the evolution of the 3GPP radio-access technology towards a high-data-rate, low-latency and packet-optimized radio access technology.

2 References

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[1] 3GPP TD RP-040461: "Proposed Study Item on Evolved UTRA and UTRAN".

[2] 3GPP TR 25.814: "Physical Layer Aspects for Evolved UTRA".

[3] 3GPP TR 23.882: "3GPP System Architecture Evolution: Report on Technical Options and Conclusions"

[4] 3GPP TR 25.913: "Requirements for Evolved UTRA (E-UTRA) and Evolved UTRAN (E-UTRAN)"

[5] 3GPP TR 25.813: "Evolved UTRA (E-UTRA) and Evolved UTRAN (E-UTRAN): Radio Interface Protocol Aspects."

[6] 3GPP TD RP-060292 R3.018: "E-UTRA and E-UTRAN; Radio access architecture and interfaces."

[7] Recommendation ITU-R SM.329-10: "Unwanted emissions in the spurious domain"

[8] 3GPP TD R4-060660: "E-UTRA Radio Technology Aspects V0.1.0", NTT DoCoMo

[9] 3GPP TD R4-051146: "Some operators requirements for prioritisation of performance requirements work in RAN WG4"

[10] 3GPP TD R1-070674: "LTE physical layer framework for performance verification" Orange, China Mobile, KPN, NTT DoCoMo, Sprint, T-Mobile, Vodafone, Telecom Italia.

3 Definitions, symbols and abbreviations

3.1 Definitions

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3.2 Symbols

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3.3 Abbreviations

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

ACK Acknowledgement

ACLR	Adjacent Channel Leakage Ratio
aGW	Access Gateway
AM	Acknowledge Mode
ARQ	Automatic Repeat Request
AS	Access Stratum
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
C/I	Carrier-to-Interference Power Ratio
CAZAC	Constant Amplitude Zero Auto-Correlation
CMC	Connection Mobility Control
CP	Cyclic Prefix
C-plane	Control Plane
CQI	Channel Quality Indicator
CRC	Cyclic Redundancy Check
DCCH	Dedicated Control Channel
DL	Downlink
DRX	Discontinuous Reception
DTCH	Dedicated Traffic Channel
DTX	Discontinuous Transmission
eNB	E-UTRAN NodeB
EPC	Evolved Packet Core
E-UTRA	Evolved UTRA
E-UTRAN	Evolved UTRAN
FDD	Frequency Division Duplex
FDM	Frequency Division Multiplexing
GERAN	GSM EDGE Radio Access Network
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile communication
HARQ	Hybrid ARQ
HO	Handover
HSDPA	High Speed Downlink Packet Access
ICIC	Inter-Cell Interference Coordination
IP	Internet Protocol
LB	Load Balancing
LCR	Low Chip Rate
LTE	Long Term Evolution
MAC	Medium Access Control
MBMS	Multimedia Broadcast Multicast Service
MCCH	Multicast Control Channel
MCS	Modulation and Coding Scheme
MIMO	Multiple Input Multiple Output
MME	Mobility Management Entity
MTCH	MBMS Traffic Channel
NACK	Non-Acknowledgement
NAS	Non-Access Stratum
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PA	Power Amplifier
PAPR	Peak-to-Average Power Ratio
PCCH	Paging Control Channel
PDCP	Packet Data Convergence Protocol
PDU	Packet Data Unit
PHY	Physical layer
PLMN	Public Land Mobile Network
PRB	Physical Resource Block
PSC	Packet Scheduling
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
RAC	Radio Admission Control
RACH	Random Access Channel
RAT	Radio Access Technology
RB	Radio Bearer

RBC	Radio Bearer Control
RF	Radio Frequency
RLC	Radio Link Control
RNL	Radio Network Layer
ROHC	Robust Header Compression
RRC	Radio Resource Control
RRM	Radio Resource Management
RU	Resource Unit
S1	interface between eNB and aGW
S1-C	S1-Control plane
S1-U	S1-User plane
SAE	System Architecture Evolution
SAP	Service Access Point
SC-FDMA	Single Carrier – Frequency Division Multiple Access
SCH	Synchronization Channel
SDMA	Spatial Division Multiple Access
SDU	Service Data Unit
SFN	Single Frequency Network
TA	Tracking Area
TB	Transport Block
TCP	Transmission Control Protocol
TDD	Time Division Duplex
TM	Transparent Mode
TNL	Transport Network Layer
TTI	Transmission Time Interval
UE	User Equipment
UL	Uplink
UM	Un-acknowledge Mode
UMTS	Universal Mobile Telecommunication System
UPE	User Plane Entity
U-plane	User plane
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network
VRB	Virtual Resource Block
X2	interface between eNBs
X2-C	X2-Control plane
X2-U	X2-User plane

4 Introduction

At the 3GPP TSG RAN #26 meeting, the SI description on "Evolved UTRA and UTRAN" was approved [1].

The justification of the study item was, that with enhancements such as HSDPA and Enhanced Uplink, the 3GPP radio-access technology will be highly competitive for several years. However, to ensure competitiveness in an even longer time frame, i.e. for the next 10 years and beyond, a long-term evolution of the 3GPP radio-access technology needs to be considered.

Important parts of such a long-term evolution include reduced latency, higher user data rates, improved system capacity and coverage, and reduced cost for the operator. In order to achieve this, an evolution of the radio interface as well as the radio network architecture should be considered.

Considering a desire for even higher data rates and also taking into account future additional 3G spectrum allocations the long-term 3GPP evolution should include an evolution towards support for wider transmission bandwidth than 5 MHz. At the same time, support for transmission bandwidths of 5MHz and less than 5MHz should be investigated in order to allow for more flexibility in whichever frequency bands the system may be deployed

5 Deployment scenario

A very large set of scenarios are foreseen, as stated in 25.913 [4]:

- Standalone deployment scenario: In this scenario the operator is deploying E-UTRAN either with no previous network deployed in the area or it could be deployed in areas where there is existing UTRAN/GERAN coverage but for any reason there is no requirement for interworking with UTRAN/GERAN (e.g. standalone wireless broadband application).

- Integrating with existing UTRAN and/or GERAN deployment scenario: In this scenario it is assumed that the operator is having either a UTRAN and/or a GERAN network deployed with full or partial coverage in the same geographical area. It is assumed that the GERAN and UTRAN networks respectively can have differently levels of maturity.

In order to enable the large number of possibilities, E-UTRAN will support the following:

1) shared networks, both in initial selection and in mobile-initiated (controlled by system broadcast) and network-initiated/–controlled mobility.

2) high-velocity and nomadic mobiles. Mobility mechanisms include a handover mechanism with short latency, short interruption and minimizing of data losses (when the user has high data activity). Hence both high mobile velocities and Conversational QoS can be supported (as elaborated in 13.6).

3) various cell sizes and radio environments. The radio aspects are analyzed in chapter 10, but the specified mobility mechanisms are deemed adequate to support different cell sizes (also mixed) and both planned or adhoc deployments.
Note: ad hoc deployment inherently does not support high user QoS classes.

4) co-operation with legacy systems as required in 25.913 chapter 8.4. In particular Handover to and from GERAN and UTRAN is supported. Handover can be triggered by combinations of radio quality and requested bearer quality. This capability enables all combinations of E-UTRAN and GERAN/UTRAN coverage, ranging from full to partial coverage, overlapping to adjacent coverage and ranging from co-siting (with re-use of equipment) to separate sites for LTE, as required in 25.913 chapter 8.3. It also enables operator control of RAT and QoS selection per user.

5) The requirement on efficiency is to a large extent determined by radio functions (described in chapters 9 and 10, analyzed in chapter 13). However, the designed mobility procedures are (for the intra-E-UTRAN case) potentially considerably faster than the ones in legacy systems and can thus be considered to support the requirement on efficiency (as described in detail in 13.6.2).

E-UTRAN also supports the requirements of:

6) Simplicity, due to only one type of node.

7) Low user data delay, due to low number of nodes in the data path

E-UTRAN shall support IP transport networks and all data link options. E-UTRAN will use separated RNL and TNL QoS. This permits co-use of existing transport networks.

6 Radio interface protocol architecture for evolved UTRA

The E-UTRAN consists of eNBs, providing the E-UTRA U-plane (RLC/MAC/PHY) and C-plane (RRC) protocol terminations towards the UE. The eNBs interface to the aGW via the S1 [5].

Figure 6.1 below gives an overview of the E-UTRAN architecture where yellow-shaded boxes depict the logical nodes, white boxes depict the functional entities of the C-plane, and blue boxes depict the functional entities of the U-plane.

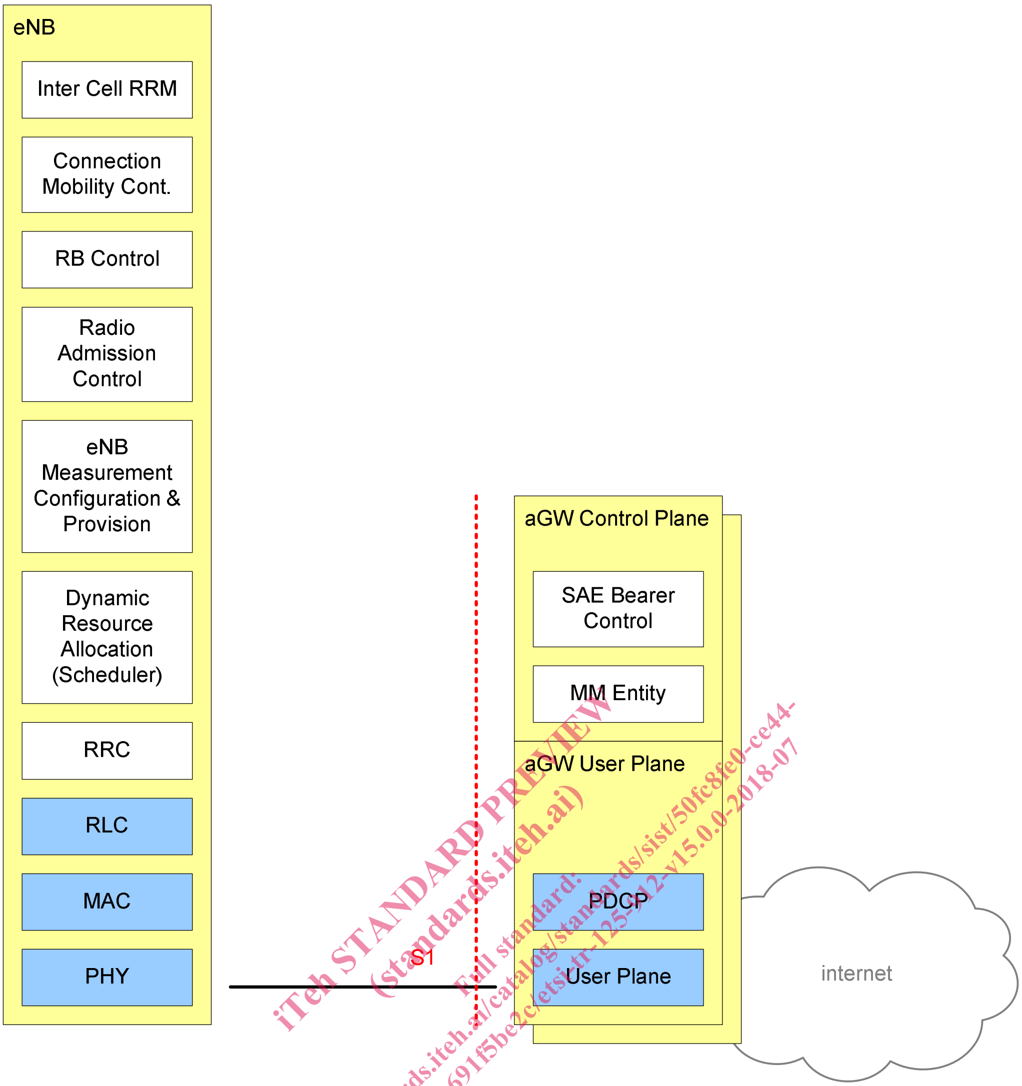

Figure 6.1: E-UTRAN Architecture

The functions hosted by the eNB are:

- Selection of aGW at attachment;
- Routing towards aGW at RRC activation;
- Scheduling and transmission of paging messages;
- Scheduling and transmission of BCCH information;
- Dynamic allocation of resources to UEs in both uplink and downlink;
- The configuration and provision of eNB measurements;
- Radio Bearer Control;
- Radio Admission Control;
- Connection Mobility Control in LTE_ACTIVE state.

The functions hosted by the aGW are:

- Paging origination;
- LTE_IDLE state management;