TSG-RAN meeting #28 RP-050371
Québec City, Quebec, 1–3 June 2005

# Presentation of Specification to TSG or WG

**Presentation to:** **TSG RAN Meeting #28**

**Document for presentation:** **TR 25.913 v2.0.0 Requirements for Evolved UTRA and UTRAN**

**Presented for:** **Approval**

**Abstract of document:**

This version of the requirement TR for LTE, TR25.913, captures the all text proposals agreed in the LTE meeting in Quebec. A following topic is still open in this version, however, the TR is almost completed and this version is submitted to RAN#28 for approval.

**Changes since last presentation to TSG Meeting #27:**

This version captured all text proposals agreed in the LTE meeting in Quebec.

**Outstanding Issues:**

Open topics

- Section 9 Requirements for E-UTRAN Architecture and Migration
  No text proposal on requirements for migration.

**Contentious Issues:**

None

# 3GPP TR 25.913 V2.0.0 (2005-05)

*Technical Report*

## 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Requirements for Evolved UTRA and UTRAN (Release 7)

Keywords

Evolved UTRA and UTRAN

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# Contents

# Foreword

This Technical Report has been produced by the 3rd 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.

# 1 Scope

This document is related to 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.

This document provides guidance and collects requirements which an evolved UTRA and UTRAN system should meet.

# 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 TD RP-040461: "Proposed Study Item on Evolved UTRA and UTRAN".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

**<defined term>:** <definition>.

## 3.2 Symbols

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

<symbol> <Explanation>

## 3.3 Abbreviations

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

| | |
|---|---|
| CS | Circuit Switched |
| DRX | Discontinuous Reception |
| E-UTRA | Evolved UTRA |
| E-UTRAN | Evolved UTRAN |
| HSDPA | High Speed Dowlink Packet Access |
| MIMO | Multiple Input Multiple Output |
| NAS | Non Access Stratum |
| QoS | Quality of Service |
| PS | Packet Switched |
| TCP | Transmission Control Protocol |

UE User Equipment

# 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 Objectives

The objective of Evolved UTRA and UTRAN 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. Thus the study should focus on supporting services provided from the PS-domain. In order to achieve this, studies should be carried out in at least the following areas:

- Related to the radio-interface physical layer (downlink and uplink):
  - e.g. means to support flexible transmission bandwidth up to 20 MHz, introduction of new transmission schemes and advanced multi-antenna technologies
- Related to the radio interface layer 2 and 3:
  - e.g. signalling optimization
- Related to the UTRAN architecture:
  - identify the most optimum UTRAN network architecture and functional split between RAN network nodes, not precluding considerations on the functional split between UTRAN and CN
- RF-related issues

The targets for the evolution of the radio-interface and radio-access network architecture should be:

- Significantly increased peak data rate e.g. 100 Mbps (downlink) and 50 Mbps (uplink)
- Increase “cell edge bitrate” whilst maintaining same site locations as deployed today
- Significantly improved spectrum efficiency ( e.g. 2-4 x Rel6)
- Possibility for a Radio-access network latency (user-plane UE – RNC (or corresponding node above Node B) - UE) below 10 ms
- Significantly reduced C-plane latency (e.g. including the possibility to exchange user-plane data starting from camped-state with a transition time of less than 100 ms (excluding downlink paging delay))
- Scaleable bandwidth
  - 5, 10, 20 and possibly 15 MHz
  - [1.25,] 2.5 MHz: to allow flexibility in narrow spectral allocations where the system may be deployed
- Support for inter-working with existing 3G systems and non-3GPP specified systems
- Further enhanced MBMS
- Reduced CAPEX and OPEX including backhaul
- Cost effective migration from Rel-6 UTRA radio interface and architecture
- Reasonable system and terminal complexity, cost, and power consumption.
- Support of further enhanced IMS and core network
- Backwards compatibility is highly desirable, but the trade off versus performance and/or capability enhancements should be carefully considered.
- Efficient support of the various types of services, especially from the PS domain (e.g. Voice over IP, Presence)
- System should be optimized for low mobile speed but also support high mobile speed
- Operation in paired and unpaired spectrum should not be precluded
- Possibility for simplified co-existence between operators in adjacent bands as well as cross-border co-existence

# 6 Capability-related requirements

## 6.1 Peak Data Rate

E-UTRA should support significantly increased instantaneous peak data rates. The supported peak data rate should scale according to size of the spectrum allocation.

Note that the peak data rates may depend on the numbers of transmit and receive antennas at the UE. The targets for downlink (DL) and uplink (UL) peak data rates are specified in terms of a reference UE configuration comprising:

a) Downlink capability – 2 receive antennas at UE

b) Uplink capability – 1 transmit antenna at UE

For this baseline configuration, the system should support an instantaneous downlink peak data rate of 100Mb/s within a 20 MHz downlink spectrum allocation (5 bps/Hz) and an instantaneous uplink peak data rate of 50Mb/s (2.5 bps/Hz) within a 20MHz uplink spectrum allocation. The peak data rates should then scale linearly with the size of the spectrum allocation.

In case of spectrum shared between downlink and uplink transmission, E-UTRA does not need to support the above instantaneous peak data rates simultaneously.

## 6.2 Latency

### 6.2.1 C-plane latency

Significantly reduced C-plane latency

a) transition time (excluding downlink paging delay and NAS signalling delay) of less than 100 ms from a camped-state, such as Release 6 Idle Mode, to an active state such as Release 6 CELL_DCH, in such a way that the user plane is established.

b) transition time (excluding DRX interval) of less than 50 ms between a dormant state such as Release 6 CELL_PCH and an active state such as Release 6 CELL_DCH.

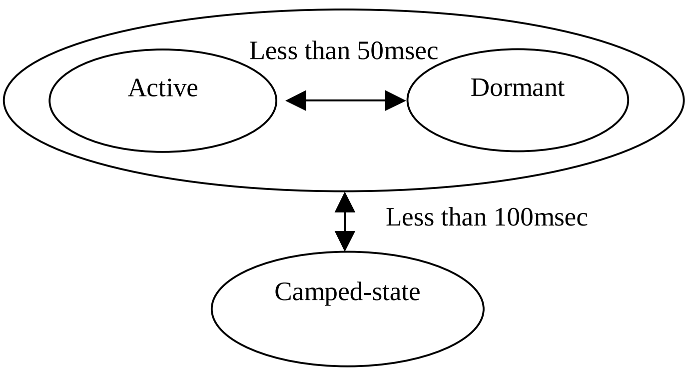


Figure 6.1 an example of state transition

#### 6.2.1.1 C-plane Capacity

The system should be able to support a large number of users per cell with quasi instantaneous access to radio resources in the active state. It is expected that at least 200 users per cell should be supported in the active state for spectrum allocations up to 5 MHz, and at least 400 users for higher spectrum allocation. A much higher number of users is expected to be supported in the dormant and camped state.

### 6.2.2 U-Plane Latency

Following definitions apply to user-plane latency requirements:

**U-Plane Delay Definition** – U-plane delay is defined in terms of the one-way transit time between a packet being available at the IP layer in either the UE/RAN edge node and the availability of this packet at IP layer in the RAN edge node/UE. The RAN edge node is the node providing the RAN interface towards the core network.

Specifications shall enable an E-UTRA U-plane latency of less than 5 ms in unload condition (ie single user with single data stream) for small IP packet, e.g. 0 byte payload + IP headers E-UTRAN bandwidth mode may impact the experienced latency

Note: This requirement, more specifically the exact definition of latency, may be revisited and further clarified once there is a 3GPP system end-to-end requirement agreed and the overall system architecture is settled, including the RAN and core network functional split. This means that the network entities between which the U-plane latency requirement of E-UTRA and E-UTRAN applies, will finally be defined at a later stage.

# 7 System performance requirements

It is assumed that the different system performance targets defined in section 7.1 and 7.2 should be achieved with a single system configuration of E-UTRA and UTRA (i.e. same system configuration used for average/cell edge user throughput or spectral efficiency).

## 7.1 User Throughput

All the targets below are important, however the cell edge targets are significant since they impact the dimensioning of the network and help deliver a more uniform user experience across the cell area. For these reasons, and considering that the average throughput and spectral efficiency will benefit significantly from MIMO and improved orthogonality whereas cell edge performance might not, the cell edge targets are more challenging than the average throughput and spectral efficiency.

The upper limits of the target ranges should also be given serious consideration in order that E-UTRA is as competitive as possible.

Downlink

Target for user throughput per MHz at the 5 % point of the C.D.F., 2 to 3 times Release 6 HSDPA.

Target for averaged user throughput per MHz, 3 to 4 times Release 6 HSDPA Both targets should be achieved assuming Release 6 reference performance is based on a single Tx antenna at the Node B with enhanced performance type 1 receiver in UE whilst the E-UTRA may use a maximum of 2 Tx antennas at the Node B and 2 Rx antennas at the UE.

The supported user throughput should scale with the spectrum bandwidth.

Uplink

Target for user throughput per MHz at the 5 % point of the C.D.F., 2 to 3 times Release 6 Enhanced Uplink (deployed with a single Tx antenna at the UE and 2 Rx antennas at the Node B).

Target for averaged user throughput per MHz, 2 to 3 times Release 6 Enhanced Uplink (deployed with a single Tx antenna at the UE and 2 Rx antennas at the Node B).

Both should be achievable by the E-UTRA using a maximum of a single Tx antenna at the UE and 2 Rx antennas at the Node B. Greater user throughput should be achievable using multiple Tx antennas at the UE.

The user throughput should scale with the spectrum bandwidth provided that the maximum transmit power is also scaled.

## 7.2 Spectrum Efficiency

E-UTRA should deliver significantly improved spectrum efficiency and increased cell edge bit rate whilst maintaining the same site locations as deployed today.

Spectrum efficiency needs to be significantly increased as followings:

Downlink

In a loaded network, target for spectrum efficiency (bits/sec/Hz/site), 3 to 4 times Release 6 HSDPA This should be achieved assuming Release 6 reference performance is based on a single Tx antenna at the Node B with enhanced performance type 1 receiver in UE whilst the E-UTRA may use a maximum of 2 Tx antennas at the Node B and 2 Rx antennas at the UE.

Uplink

In a loaded network, target for spectrum efficiency (bits/sec/Hz/site), 2 to 3 times Release 6 Enhanced Uplink (deployed with a single Tx antenna at the UE and 2 Rx antennas at the Node B). This should be achievable by the E-UTRA using a maximum of a single Tx antenna at the UE and 2Rx antennas at the Node B.

## 7.3 Mobility

The E-UTRAN shall support mobility across the cellular network and should be optimized for low mobile speed from 0 to 15 km/h. Higher mobile speed between 15 and 120 km/h should be supported with high performance. Mobility across the cellular network shall be maintained at speeds from 120 km/h to 350 km/h (or even up to 500 km/h depending on the frequency band). Voice and other real-time services supported in the CS domain in R6 shall be supported by E-UTRAN via the PS domain with at least equal quality as supported by UTRAN (e.g. in terms of guaranteed bit rate) over the whole of the speed range. The impact of intra E-UTRA handovers on quality (e.g. interruption time) shall be less than or equal to that provided by CS domain handovers in GERAN.

The mobile speed above 250 km/h represents special case, such as high speed train environment. In such case a special scenario applies for issues such as mobility solutions and channel models. For the physical layer parameterization E-UTRAN should be able to maintain the connection up to 350 km/h, or even up to 500 km/h depending on the frequency band.

The E-UTRAN shall also support techniques and mechanisms to optimise delay and packet loss during intra system handover.

## 7.4 Coverage

E-UTRA should be sufficiently flexible to support a variety of coverage scenarios for which the performance targets of section 7.1, 7.2 and 7.3 should be met assuming the reuse of existing UTRAN sites and the same carrier frequency. Reference scenario shall be defined that are representative of current UTRAN deployments.

When defining reference scenarios to determine whether the targets outlined in this chapter are achieved, especially those for cell edge performance, it should be taken into account that these are based on the assumption of a C/I limited scenario. For C/N limited scenarios (e.g. deep indoor) the improvement expected over HSDPA/Enhanced Uplink Release 6 is not as substantial

E-UTRA should support the following deployment scenarios in terms of maximum cell range:

- up to 5 km: performance targets defined in section 7.1, 7.2, and 7.3 should be met.

- up to 30 km: slight degradations in the achieved performance for the targets defined in section 7.1 and more significant degradation for the targets defined in the section 7.2 is acceptable however mobility performance targets defined in section 7.3 should be met.

- up to 100 km: should not be precluded by the specifications.

## 7.5 Further Enhanced MBMS

E-UTRA systems should support enhanced MBMS modes compared to UTRA operation.

Further requirements applicable to MBMS systems are:

As for the unicast case, E-UTRA should be capable of achieving the target performance levels when operating from the same site locations as existing UTRA systems.

E-UTRA should provide enhanced support for MBMS services. Specifically, E-UTRA support for MBMS should take the following requirements into account:

a) **Physical Layer Component Re-use** – in order to reduce E-UTRA terminal complexity, the same fundamental modulation, coding and multiple access approaches used for unicast operation should apply to MBMS services, and the same UE bandwidth mode set supported for unicast operation should be applicable to MBMS operation.
b) **Voice and MBMS** – the E-UTRA approach to MBMS should permit simultaneous, tightly integrated and efficient provisioning of dedicated voice and MBMS services to the user.
c) **Unpaired MBMS Operation** – the deployment of E-UTRA carriers bearing MBMS services in unpaired spectrum arrangements should be supported

## 7.6 Network Synchronisation

It is expected that the system performance requirements defined in this TR should be achieved in a network deployment not using any inter-site time synchronisation. However optimisations based on inter-site time synchronisation should be supported provided these bring sufficient benefits.

# 8 Deployment-related requirements

## 8.1 Spectrum Flexibility

a) Support for spectrum allocations of different size

1. E-UTRA shall operate in spectrum allocations of different sizes, including 1.25 MHz, 2.5 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz. in both the uplink and downlink. Operation in paired and unpaired spectrum shall be supported.

2. Unnecessary fragmentation of technologies for paired and unpaired band operation shall be avoided. This shall be achieved with minimal additional complexity.

b) Support for diverse spectrum arrangements

1. The system shall be able to support (same and different) content delivery over an aggregation of resources including Radio Band Resources (as well as power, adaptive scheduling, etc) in the same and different bands, in both uplink and downlink and in both adjacent and non-adjacent channel arrangements.

2. The degree to which the above requirement is supported is conditioned on the increase in UE and network complexity and cost.

3. A "Radio Band Resource" is defined as all spectrum available to an operator.

## 8.2 Spectrum Deployment

E-UTRA is required to cope with following scenarios:

a) Co-existence in the same geographical area and co-location with GERAN/3G on adjacent channels.

b) Co-existence in the same geographical area and co-location between operators on adjacent channels.

c) Co-existence on overlapping and/or adjacent spectrum at country borders.

d) E-UTRA shall be possible to operate standalone, i.e. there is no need for any other carrier to be available.

e) All frequency bands should be allowed following release independent frequency band principles

Note: In case of border co-ordination requirement, other aspects such as possible scheduling solutions should be considered together with physical layer behavior.

## 8.3 Co-existence and Inter-working with 3GPP RAT

The following requirements are applicable to inter-working between E-UTRA and other 3GPP systems:

a) E-UTRAN Terminals supporting also UTRAN and/or GERAN operation should be able to support measurement of, and handover from and to, both 3GPP UTRA and 3GPP GERAN systems correspondingly with acceptable impact on terminal complexity and network performance.

b) E-UTRAN is required to efficiently support inter-RAT measurements with acceptable impact on terminal complexity and network performance, by e.g. providing UE's with measurement opportunities through downlink and uplink scheduling.

c) The interruption time during a handover of real-time services between E-UTRAN and UTRAN is less than 300 msec

d) The interruption time during a handover of non real-time services between E-UTRAN and UTRAN should be less than 500 msec

e) The interruption time during a handover of real-time services between E-UTRAN and GERAN is less than 300 msec

f) The interruption time during a handover of non real-time services between E-UTRAN and GERAN should be less than 500 msec

g) Non-active terminals (such as one being in Release 6 idle mode or CELL_PCH) which support UTRAN and/or GERAN in addition to E-UTRAN shall not need to monitor paging messages only from one of GERAN, UTRA or E-UTRA

Reduction in network and terminal complexity and cost by not mandating support for the measurements and handovers to/from GERAN/UTRAN should be considered.

Note: The interruption times above are to be considered as maximum values. These values may be revisited when the overall architecture and the E-UTRA physical layer has been defined in more detail.

# 9 Requirements for E-UTRAN Architecture and Migration

a) A single E-UTRAN architecture should be agreed.

b) The E-UTRAN architecture shall be packet based, although provision should be made to support systems supporting real-time and conversational class traffic.

c) E-UTRAN architecture shall minimise the presence of "Single point of failures" where possible without additional cost for backhaul.

d) E-UTRAN architecture shall simplify and minimise the introduced number of interfaces where possible

e) Radio Network Layer (RNL) and Transport Network Layer (TNL) interaction should not be precluded if in the interest of improved system performance

f) E-UTRAN architecture shall support an end-to-end QoS. The TNL shall provide the appropriate QoS requested by the RNL.

g) QoS mechanism(s) shall take into account the various types of traffic that exists to provide efficient bandwidth utilization: "Control Plane" traffic, "User Plane" traffic, O&M traffic etc.

h) The E-UTRAN shall be designed in such a way to minimize the delay variation (jitter) for e.g. TCP/IP for packet communication.

# 10 Radio Resource Management requirements

This section does not pre-suppose any particular architecture.

## 10.1 Enhanced support for end to end QoS

The E-UTRAN shall be enhanced to support improved QoS control, enabling a more optimal matching of service, application and protocol requirements (including higher layer signalling) to RAN resources and radio characteristics.

## 10.2 Efficient support for transmission of higher layers

The E-UTRAN shall provide mechanisms to support the efficient transmission and operation of higher layer protocols over the radio interface, such as IP header compression.

## 10.3 Support of load sharing and policy management across different Radio Access Technologies

The E-UTRAN shall provide mechanisms to support load sharing and policy management between E-UTRA and other RATs (GERAN, UTRA). To minimise latency when data needs to be transferred, reselection mechanisms to direct UEs towards appropriate RATs when the UEs are in a dormant state, as well as the active state, should be considered. Support for end to end QoS during inter RAT handover should be considered

# 11 Complexity requirements

## 11.1 Complexity requirements for overall system

E-UTRA and E-UTRAN shall satisfy the required performance. Additionally, system complexity shall be minimized in order to stabilize the system & inter-operability in earlier stage and decrease the cost of terminal & UTRAN. For these requirements, the following shall be taken into account:

a) Minimize the number of options

b) No redundant mandatory features

c) Reduce the number of necessary test cases, e.g. Reduce the number of states of protocols, minimize the number of procedures, appropriate parameter range and granularity

## 11.2 Complexity requirements for UE

The E-UTRA and E-UTRAN Requirements should minimize the complexity of the E-UTRA UE in terms of size, weight, battery life (standby and active) consistent with the provision of the advanced services of the E-UTRA/UTRAN.

For these requirements, the following shall be taken into account;

a) UE complexity in terms of supporting multi-RAT (GERAN/UTRA/E-UTRA) should be considered when considering the complexity of E-UTRA features.

b) The mandatory features shall be kept to the minimum.

c) There shall be no redundant or duplicate specifications of mandatory features, or for accomplishing the same task.

d) The number of options shall be minimized. Sets of options shall be realizable in terms of separate distinct UE "types/capabilities". Different UE "types/capabilities" shall be used to capture different complexity vs. performance trade-offs, e.g. for the impact of multiple antennas.

e) The number of necessary test cases shall be minimised so it is feasible to complete the development of the test cases in a reasonable timeframe after the Core Specifications are completed. No unnecessary test cases shall be developed.

# 12 General requirements

## 12.1 Cost-related Requirements

Cost related requirements for the E-UTRA and E-UTRAN are:

a) Backhaul communication protocols should be optimized.

b) The E-UTRAN architecture should reduce and balance the cost of future network deployment by maximizing the usage of existing site locations[, interfaces, and protocols].

c) All the interfaces specified shall be open for multi-vendor equipment interoperability.

d) UE complexity and power consumption shall be minimized/optimized. Complicated UTRAN architecture and unnecessary interfaces should be avoided.

e) More efficient and easy to use OAM&P.

## 12.2 Service-related Requirements

The E-UTRA should efficiently support various types of service. These must include currently available services like web-browsing, FTP, video-streaming or VoIP, and more advanced services (e.g. real-time video or push-to-x) in the PS-domain.

VoIP should be supported with at least as good radio, backhaul efficiency and latency as voice traffic over the UMTS CS networks.

# 13 Change History

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 13/5/'05 | | | | | First version | | 0.0.1 |
| 23/5/'05 | | | | | Revised version according to e-mail discussion | 0.0.1 | 0.0.2 |
| 25/5/05 | | | | | Revised version according to e-mail discussion | 0.0.2 | 0.0.3 |
| 2/6/05 | RAN#28 | RP-050371 | | | Captured the all text proposals agreed in the LTE meeting in Quebec<br><br>Submitted for approval at TSG RAN#28. | 0.0.3 | 2.0.0 |