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Frequency Division Duplex (FDD)
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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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1 Scope

The present document has been produced in the scope of the study item on "HSPA Evolution" [2]. The objective of the study item is to develop a framework for the evolution of the FDD mode of the 3GPP HSPA WCDMA-based radio-access technology beyond Release 7.

The present document lists the constraints for the FDD HSPA Evolution beyond release 7 and an assessment of technical proposals and their respective, achievable performance and complexity.

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.
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[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TD RP-060217: "Work Item Description on Scope of future FDD HSPA Evolution".

Suppote Team note: Reference [2] is not legitimate.

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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].

HSPA: In the present document, the acronym **HSPA** (High Speed Packet Access) is used to qualify the FDD mode features HSDPA (High Speed Downlink Packet Access) and Enhanced Uplink as defined in the Release 7 version of the 3GPP Specifications.

Backward Compatibility: In the present document, **Backward Compatibility** means the ability of an HSPA infrastructure to simultaneously allocate radio resources on one single carrier to post-release 7 terminals and terminals compliant with previous releases of the 3GPP specifications without performances degradation for either type of terminal. It is understood that in that case the performance enhancements targeted in this document would only apply to post-release 7 terminals and that the full potential of system performance enhancements would only be achievable if all terminals operating simultaneously on a single carrier were post-release 7 terminals.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

CAPEX	Capital expenditure
CS	Circuit Switched
DRX	Discontinuous Reception

HSPA	High Speed Packet Access
LTE:	Long Term Evolution
MIMO	Multiple Input Multiple Output
NAS	Non Access Stratum
OPEX	Operational expenditure
QoS	Quality of Service
PS	Packet Switched
TCP	Transmission Control Protocol
UE	User Equipment

4 Introduction

The Study Item Description on "HSPA Evolution" [2] was approved by the 3GPP TSG RAN #31 plenary meeting in March 2006.

The importance of on-going and future efforts to enhance the capabilities and performance of HSPA-based radio networks is widely recognised by 3GPP operators. HSPA networks will form an integral part of future 3G systems and as they evolve, should provide a smooth migration path towards LTE. HSPA operators are just as interested in the potential performance and cost savings which may be achieved through HSPA Evolution as they are in the future LTE system.

Critical elements of such evolution should include reduced latency, higher user data rates, improved system capacity and coverage and reduced cost for the operator while maintaining the highest possible level of backward compatibility.

5 Objectives

Beyond Release 7, the following elements should be considered as guiding principles for HSPA Evolution:

1. HSPA Spectrum Efficiency, Peak Data Rate and Latency should continue to evolve favourably. The tradeoffs necessary to achieve performance comparable to LTE in 5 MHz should be analyzed;

2. HSPA and its evolution should facilitate the joint technology operation with LTE and offer a smooth migration path towards LTE (Long Term Evolution). The possibility to adopt common elements or a common functional split with LTE and the possibility to re-use the evolved Core Network defined as part of the System Architecture Evolution (SAE) study should be analyzed as well;

3. Evolved HSPA should be able to operate as a packet-only network based on utilization of the high speed data channels only (HS-DSCH, E-DCH and associated channels);

4. HSPA Evolution shall be backward compatible in the sense that legacy terminals (R99-DCH and HSPA mobiles) shall be able to share the same carrier with terminals implementing the latest features of the HSPA Evolution track without any performance degradation;

5. Ideally, existing infrastructure should only need a simple upgrade to support the features defined as part of the HSPA Evolution.

Thus, the study should focus on improving the system performances for services delivered through the PS-domain including voice and multimedia conversational services.

In relation to this study item, TSG-RAN should establish a reference performance set for HSPA release 7. Rather than relying on new simulation results, it is recommended that this performance set is derived from on-going activities related to the performance evaluation of new enhancements like HSDPA MIMO or LTE. This reference performance set should be used to set the absolute performance targets for HSPA Evolution and to evaluate the potential improvements provided by solutions proposed in the scope of the study.

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6 Constraints and requirements

NOTE: This chapter will capture text on the constraints for HSPA evolution including on legacy issues, backward compatibility, architecture, impact on LTE, Node B and UTRA, software and hardware upgrades, complexity issues, acceptable impacts on UE's, protocol reuse/requirements, signalling and physical channel limitations, etc.

6.1 Constraints

a) HSPA Evolution should be capable of being implemented through a re-use of the release 7 RAN architecture. However, proposals to modify the RAN architecture should also be considered within the scope of HSPA Evolution, provided full interworking to a legacy release 7 architecture is supported.

b) The RAN-CN functional split can be reviewed providing that it results in significant performance and/or improvements and facilitate the migration towards LTE/SAE without significant complexity increase.

c) Evolved HSPA should have a minimum impact on Node Bs, to allow for simple upgrades; Reuse of the existing Node B hardware by HSPA Evolution is essential. This does not preclude hardware upgrades to support additional functionality (e.g. to increase processing power, RNC functionality, etc.).

d) Evolved HSPA protocol architecture shall have minimum impact on UEs especially in terms of complexity, to allow for easy introduction.

e) R99-DCH and legacy HSPA UEs shall be able to share the same carrier with terminals implementing the latest features of the HSPA Evolution without any performance degradation.

f) Intra- and inter-system mobility performance shall be no worse than R7.

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6.2 Requirements

6.2.1 Requirements for the UTRAN architecture

a) Should provide a low complexity, low cost and smooth migration of HSPA towards evolved UMTS (SAE/LTE).

b) Should reduce user plane latency to legacy (R5,6 & 7) & beyond R7 terminals.

c) Should reduce control plane latency to beyond R7 terminals and, if low complexity cost effective means can be found, also to legacy terminals.

d) Simplification and reduction of the number of nodes should be considered.

e) Connection of evolved HSPA RAN to SAE CN (UP &/or CP) should be considered.

f) Should consider mobility between non 3GPP access systems and evolved HSPA.

g) Should consider IW with CS domain to support legacy CS services.

h) Should consider proposals to lower backhaul costs.

i) Indicative achievable performance values - see table 6.2.1-I.

Table 6.2.1-I: Indicative view on the achievable performance

Performance Item	Release 6 Anticipated	**HSPA Evolution Target**	Description of Measurement
Round Trip Delay (PING) & UP Latency	**<100 ms**	**<50 ms**	PING measured once PDP Context is established and Device is in CELL_DCH

Packet Call Set Up	**May exceed 1000 ms**	**<500 ms**	Cold start. Measured from the RRC Connection Request sent by a Terminal previously in PMM_Idle to the completion of the PDP Context Establishment Procedure
CP Latency Dormant to Active	**May exceed 1000 ms**	**<100 ms**	Time needed to transition the UE from a Dormant state like CELL_PCH or URA_PCH to CELL_DCH (Active with a RAB/RB set Up) with or without having to (re-) establish a PDP Context

Note: The values in this table are indicative views of how much HSPA could be improved at the time of starting the study. These values are for information only.

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6.2.2 Requirements for the UTRA

a) Changes that deliver higher spectrum efficiency should be considered, within the constraints specified in the clause 8.

b) Should reduce user plane latency to legacy (R5,6 & 7) & beyond R7 terminals.

c) Should reduce control plane latency to beyond R7 terminals and, if low complexity cost effective means can be found, also to legacy terminals.

d) Should consider how to provide efficient QoS support for all traffic classes preferably in a manner that is backwards compatible with legacy terminals.

e) Should consider changes that, where it makes sense, deliver benefits to legacy terminals as well as beyond R7 terminals.

f) Any changes to the terminal should maximally build on the extensive developments and testing efforts of R5, 6 & 7.

7 Technical Proposals and Assessment

The table 7 outlines the agreed metrics which should be used to describe/evaluate/compare each of the different architecture alternatives.

Table 7: HSPA Architecture Evaluation Matrix

Target	**Alt1:** **Current architecture**	**Alt 2:** **CRNC in NodeB**	**Alt 3:** **Iu UP in NodeB**	**Alt 4:** **RNC in NodeB**
Security	No Impacts	No Impacts	For the CP - No Impact. For the UP, S3 Findings: - Additional Physical Security OR - Additional Platform Security	S3 Findings: - Additional Physical Security OR - Additional Platform Security OR - Combination of both

			OR - OR Combination of both required	required
Reduce U Plane Latency	No Change	Reduction expected in DL AND if Outer ARQ in NodeB (pending RAN2 decision)	Reduction expected where MDC is not in use (UP radio protocols terminating in the NodeB)	Reduction expected where MDC is not in use (UP radio protocols terminating in the NodeB)
Reduce C Plane Latency *(RRC Setup)*	No Change	No Change	No Change	Reduction expected (CP radio protocols terminating in the NodeB)
Specification Impact	No Change	Medium	Major	FFS – See Note 6
Impact upon CN Node(s)	No Change	Changes to Relocation Procedures	Signalling increase due to mobility foreseen. Performance in handling greater number of Iu (without OTS) or Iu/& Gn (with OTS) instances	Signalling increase due to mobility foreseen. Performance in handling greater number of Iu (without OTS) or Iu/& Gn (with OTS) instances
Impact upon RAN	No Change	NodeB assumes CRNC functionality. No change to legacy RNC.	NodeB assumes RNC UP functionality. New interface between SRNC & NodeB	NodeB assumes all RNC functionality. Impacts upon legacy RNC (Iur interface number and additional processing). Iub handling removed
Interworking with Legacy UEs **(includes CS Domain handling)**	No Impact	No Impact upon UE. No Impact upon routing of CS Services.	No impact upon UE. CS Services require routing to legacy SRNC.	No impact upon UE. CS Services require routing to legacy SRNC.
Efficiency of MDC Support	As Today	As Today	Possible, MDC occurs in NodeB and CP Signalling required to SRNC. But efficiency depends upon transport network topology and transport technology.	Possible (MDC occurs in NodeB) but efficiency depends upon transport network topology and transport technology.
Scalability	As Today	As Today	UP processing scales independently (Direct NodeB ⇔ CN connection) with transport network capacity.	UP processing scales independently (Direct NodeB ⇔ CN connection) with transport network capacity.
Last Mile Bandwidth Usage (due to eHSPA Arch)	As Today	As Today	MDC Combining in NodeB (for UL) will bring an increase in Last Mile Bandwidth (depending upon Network Topology). New interface towards SRNC will imply additional traffic on last mile.	MDC Combining in NodeB (for UL) will bring an increase in Last Mile Bandwidth (depending upon Network Topology)
Interruption time / User experience.	As Today	As Today	More frequent SRNS Relocations expected.	More frequent SRNS Relocations expected. Increased CS call setup delay expected.
User Throughput Increase (as a function of RTT)	As Today	Decreased RTT (DL) leads to increased User throughput.	Decreased RTT leads to increased User throughput.	Decreased RTT leads to increased User throughput.
RRM support	As Today	Single cell RRM as today. Multi-cell (inter NodeB)	As Today	Single cell RRM as today. Multi-cell (inter NodeB)

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		RRM not supported in a centralised node.		RRM not supported in a centralised node.
Number of CP & UP Nodes **(*DRNC not considered, CS Services not considered*)**	2 Nodes (CP UP)	2 Nodes (CP UP)	2 Nodes (1 CP, 1CPUP)	1 Nodes (CP UP)

NOTES:

1. *Reduce C Plane Latency* refers to RRC Setup.
2. *Number of CP and UP Nodes* does not consider DRNC situation or CS services.
3. At the time of writing, inclusion of a metric which describes the ease or otherwise of incorporating L1 L2 improvements against each architecture option is not included due to any such improvements not specified or described as yet. This does not prevent inclusion of such a metric in the future should any L1 L2 improvements from other WGs be forthcoming.

7.1 Architectural solutions

7.1.1 Current Release 6 Architecture - Alt 1

The UTRAN consists of a set of Radio Network Subsystems connected to the Core Network through the Iu.

A RNS consists of a Radio Network Controller one or more Node Bs and optionally one SAS. A Node B is connected to the RNC through the Iub interface.

The RNC is responsible for the Handover decisions that require signalling to the UE.

A RNC may include a combining/splitting function to support combination/splitting of information streams

Inside the UTRAN, the RNCs of the Radio Network Subsystems can be interconnected together through the Iur. Iu(s) and Iur are logical interfaces. Iur can be conveyed over direct physical connection between RNCs or virtual networks using any suitable transport network.

The UTRAN architecture is shown in figure 7.1.1-1.

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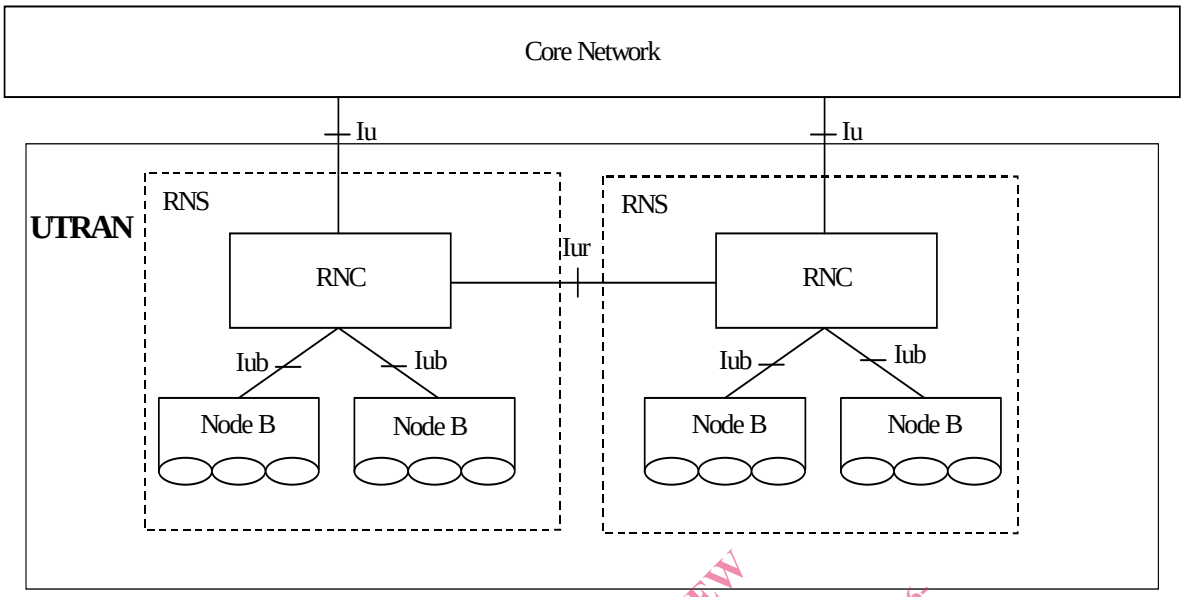


Figure 7.1.1-1: UTRAN Architecture
[Figure 4, TS25.401 Rel-6]

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7.1.2 Iu with enhanced SRNC separate from the enhanced collapsed CRNC/DRNC/Node B – Alt 2

7.1.2.1 General description

The main objective of the HSPA evolution is to improve further the latency and the bit rate with limited and controlled hardware and software impacts (1). Another important aspect is to benefit from these improvements as soon as today and in particular independently of the availability of the SAE core (2).

In the architecture figured out below, the RAN-CN functional split is thus kept to readily reuse the proven Iu interface with no additional delay, testing efforts and painful interoperability issues.(2)

Besides, only the functions which effectively contribute to the reduction of the latency and the increase of bit rate have been moved from the RNC down to the nodeB in order to minimize the hardware and software impacts.(1). These are in particular:

- an RNC RLC mirror function is placed in nodeB to improve the latency induced by repetitions for both the user plane and the control plane,
- the scheduling of all common resources is moved to the nodeB (enhanced scheduler) where they benefit from the HARQ function. The centralized scheduling of common resources in the nodeB also leads to power management optimizations and corresponding gains in bit rate.
- Other enhancements already identified within the R7 study items (signalling enhancements, Continuous Packet Connectivity, delay optimisation for procedures,…)

Moreover, these changes also result in the possible move of the CRNC and DRNC functions into the nodeB which can lead to a simplified architecture as presented in the figure 7.1.2.1-1.