

Requirement Specification

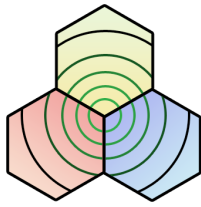
Visualization of LTE Cellular Networks in a JAVA-Based Radio Network Simulator

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Version 1.0

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JAVA-Based Radio Network Simulator

PROJECT IDENTITY

2011 HT, Visualization of Cellular Networks in a JAVA-Based Radio Network Simulator
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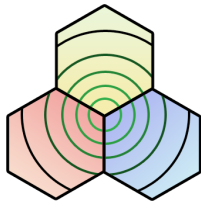
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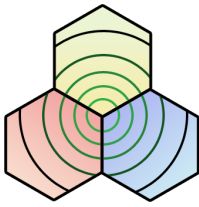
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Contents

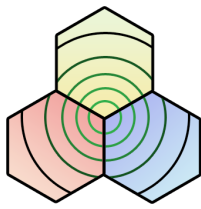
1. INTRODUCTION	5
1.1. PURPOSE	5
1.2. INVOLVED PARTIES	5
1.3. USAGE	5
1.4. BACKGROUND INFORMATION	5
1.5. DEFINITION OF TERMS	5
2. OVERVIEW OF THE SYSTEM	6
2.1. DESCRIPTION OF THE SYSTEM	6
2.2. PRODUCT COMPONENTS	6
2.3. DEPENDENCY OF OTHER SYSTEMS	6
2.4. INCLUDED SUBSYSTEMS	6
2.5. WHAT IS NOT INCLUDED	7
2.6. DESIGN PHILOSOPHY	7
2.7. GENERAL REQUIREMENTS OF THE COMPLETE SYSTEM	7
3. THE GUI SUBSYSTEM	8
3.1. DESCRIPTION OF THE GUI SUBSYSTEM	8
3.2. INTERFACES	8
3.3. DESIGN REQUIREMENTS	9
4. THE LOG PARSER SUBSYSTEM	9
4.1. DESCRIPTION OF THE LOG PARSE SUBSYSTEM	9
4.2. EXTERNAL INTERFACES	9
4.3. FUNCTIONAL REQUIREMENTS OF THE PARSER SUBSYSTEM	9
5. LTE COMPONENTS SUBSYSTEM	9
5.1. DESCRIPTION OF LTE COMPONENTS SUBSYSTEM	9
5.2. INTERFACES	9
6. THE GENERIC VISUALIZATION LIBRARY SUBSYSTEM	10
6.1. DESCRIPTION OF THE GENERIC VISUALIZATION LIBRARY SUBSYSTEM	10
6.2. INTERFACES	10
7. ECONOMY	10
8. DELIVERY	10
9. DOCUMENTATION	10
10. EDUCATION	11
11. MAINTANABILITY	11
12. REFERENCES	11



**Visualization of LTE Cellular Networks in a
JAVA-Based Radio Network Simulator**

Document history

Version	Date	Changes	Sign	Reviewed
0.1	13 Sep 2011	First draft	PS	JL
0.2	18 Sep 2011	Second draft, style updates as well as requirement additions/changes	PS	HA
0.3	22 Sep 2011	Added LTE to project name, removed requirement 33 and updated requirement 34 (previously 35).	PS	JL, ER
1.0	28 Sep 2011	Approved, added req. 49-51	PS	JL



Visualization of LTE Cellular Networks in a JAVA-Based Radio Network Simulator

1. Introduction

This is the Requirement Specification for a project that is a part of the course TSKS05 at Linköping's University in cooperation with Ericsson Research. The main part of the project is to be performed at Ericsson Research in Mjärdevi, Linköping.

1.1. Purpose

The purpose of this project is to design and implement visualization components capable of illustrating a complex and dynamic output of a LTE radio network system simulator.

1.2. Involved parties

Customer: Ericsson Research
Sponsor and supervisor: Johannes Lindblom, ISY
Examiner: Lasse Alfredsson, ISY
Experts, ISY: Lecturers and PhD students at the division of Communication Systems

Customer contact and supervisors at Ericsson: Håkan Andersson and Martin Hessler
Project group: Students in the course TSKS05

1.3. Usage

The visualization components can be used for research, debugging or educational purposes, both by Ericsson employees at several different departments and by Ericsson customers.

1.4. Background information

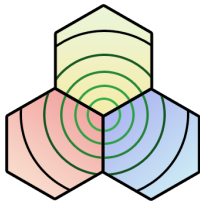
Radio access technologies for cellular mobile networks depend upon a number of technologies to function. These technologies are continuously being evolved at Ericsson Research. There are a number of reasons for this, such as demands for higher data rates, improved coverage, improved capacity and lower power consumption.

1.5. Definition of terms

All the requirements in this document are defined according to table 1.

Req. No. x	Original Changed	Description of requirement x	Priority 1 (highest) - 3 (lowest)
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Table 1 - Format of Requirement Specification



2. Overview of the system

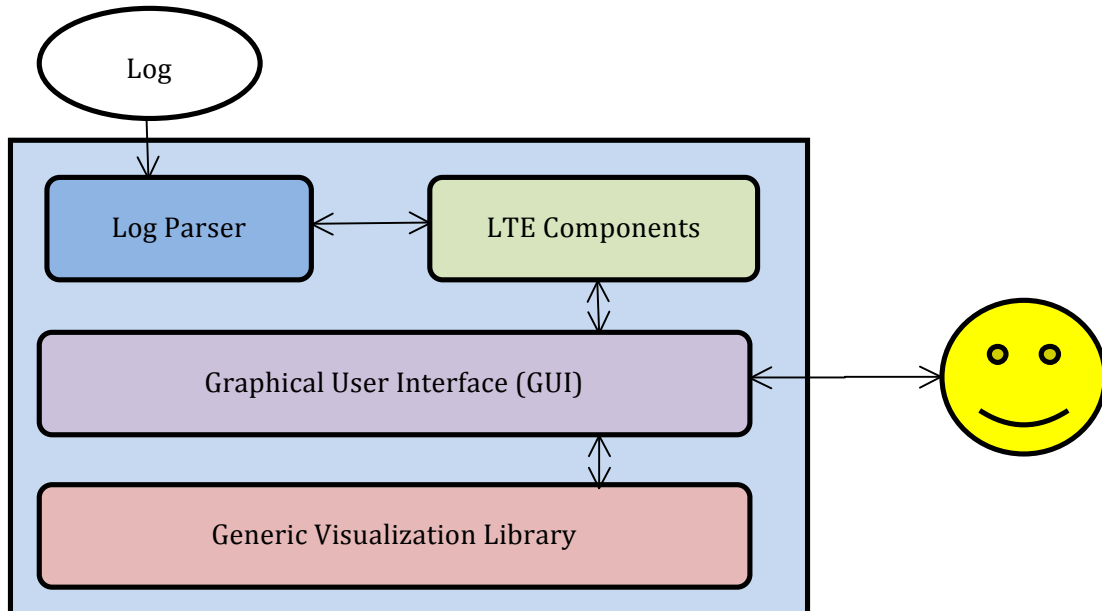


Figure 1. An overview of the system

2.1. Description of the system

The system is a visualization tool for the LTE radio network system. The input to the system is logging data from an LTE simulator and the output is the selected visual components.

2.2. Product components

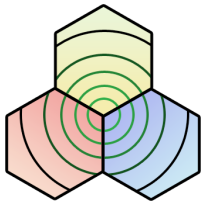
The product is a single software system, written in Java. The system will be a stand-alone Java application but will also be integrated within the simulator. Along with the application source code, a user manual and a technical documentation will be produced. The project will be presented both orally and written, and in the form of a poster. A project web page will also be published.

2.3. Dependency of other systems

The system will depend on the format of the simulator's output. Changes in the simulator's output should, as far as possible, only require updates in the Log Parser subsystem.

2.4. Included subsystems

The system consists of four (4) subsystems, the log parser, the LTE Components subsystem, the GUI subsystem and the Generic Visualization Library subsystem. These are explained in greater detail below.



**Visualization of LTE Cellular Networks in a
JAVA-Based Radio Network Simulator**

2.5. What is not included

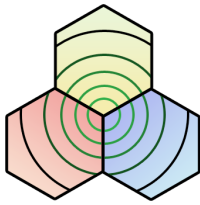
The system merely provides visualization tools and does not include the simulation part. Hence, the correctness of the used simulator is vital to the usefulness of this system.

2.6. Design philosophy

The software will be designed using object-oriented programming. The code will conform to the Ericsson coding conventions. The code should re-use generic code in an as large extent as possible in order to minimize the burden of implementing new functionality.

2.7. General requirements of the complete system

Req. 1.	Original	The application must be written in JAVA.	1
Req. 2.	Original	The code must follow the JavaDoc documentation convention.	1
Req. 3.	Original	The code shall conform to Ericsson’s coding conventions.	1
Req. 4.	Original	JUnit4 unit tests should be implemented to verify correctness for the log parsing logic.	1
Req. 5.	Original	The program shall be able to display visual components as a stand-alone application.	1
Req. 6.	Original	All visual components shall be integrated in the simulator.	1
Req. 7.	Original	The GUI shall use the standard Java classes Swing/AWT.	1
Req. 8.	Original	Visual components shall, when applicable, be time-oriented and support playback functionality (play, pause, stepping and breakpoints).	1
Req. 9.	Original	Visual components shall have the option to skip time frames when the state has not changed.	1
Req. 10.	Original	The program shall support the possibility to go back in time.	1
Req. 11.	Original	The system shall accept log files produced by the given simulator as the input.	1
Req. 12.	Original	The program shall be able to do pixel format export of visual component snapshots to a common bitmap file format e.g. JPEG, PNG, and GIF.	1
Req. 13.	Original	The program shall be able to do vector format export of snapshots to a vector format e.g. SVG.	1
Req. 14.	Original	The system shall be able to visualize the protocol stacks with buffer content (amount of data).	1
Req. 15.	Original	The system shall be able to visualize the deployment and user locations in the form of a map.	1
Req. 16.	Original	The system shall be able to produce a map of the resource grid over frequency and time with the current allocations for a cell.	1
Req. 17.	Original	The system shall be able to produce a plot of the channel estimation with respect to frequency.	2



**Visualization of LTE Cellular Networks in a
JAVA-Based Radio Network Simulator**

Req. 18.	Original	The system shall be able to produce a plot of the power allocation for the channel with respect to frequency.	2
Req. 19.	Original	The system shall be able to visualize the power efficiency of the system in terms of throughput per power.	2
Req. 20.	Original	The system shall be able to visualize HARQ processes.	2
Req. 21.	Original	The system shall be able to visualize what multiple-antenna working mode is being used and the user impact.	2
Req. 22.	Original	The system shall be able to measure and visualize inter-cell interference.	3
Req. 23.	Original	The system shall be able to visualize handover protocol.	3
Req. 24.	Original	The user shall be able to customize which parameters should be visualized in a module.	3

Table 2 – General requirements for the complete system

3. The GUI Subsystem

This section describes the GUI subsystem.

3.1. Description of the GUI subsystem

The Graphical User Interface subsystem handles the interaction between the user and the system. The GUI subsystem manages and organizes the graphical visualizations produced through the resources provided by the generic visualization library. The GUI also detects and acts on user input.

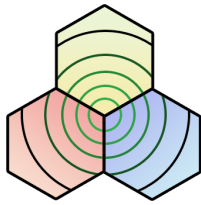
3.2. Interfaces

The GUI subsystem generates the interface for the user to be able to examine the visualized data. The user should be able to interact with the system, e.g. by clicking a visualized base station on a map to display additional information about it.

The following requirements apply to the interface:

Req. 25.	Original	All visualization components shall support zoom (in/out) and panning (only if necessary).	1
Req. 26.	Original	For visualizations related to an entity with multiple instances, e.g. base stations, users etc. that displays information only related to a single entity it should be possible to select and change for which entity information is displayed.	1
Req. 27.	Original	Visualizations shall be accompanied by legend support.	1

Table 3 – Requirements for the interface of the GUI subsystem



3.3. Design requirements

The following requirements apply to the design of the GUI subsystem:

Req. 28.	Original	Visual components shall extend existing GUI class base class (Provided by Ericsson).	1
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Table 4 - Requirements for the design of the GUI subsystem

4. The Log Parser subsystem

4.1. Description of the log parse subsystem

The parser subsystem should interpret the information in the log file and store it in a way suitable for the other subsystems. This means that the parser subsystem is the link between LTE simulator and the visualization system.

4.2. External interfaces

The parser provides a parser interface towards the LTE components subsystem.

4.3. Functional requirements of the parser subsystem

The functional requirements of the parser subsystem are specified in table 6. In addition the parser subsystem has to be able to parse the necessary data in order for the other subsystems to accomplish their functional requirements.

Req. 29.	Original	The tool shall be able to open, filter and parse text-based log files exported as-is from the simulator.	1
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Table 5 - Functional requirements for the parser subsystem

5. LTE Components Subsystem

This section describes the LTE Components subsystem.

5.1. Description of LTE components subsystem

This subsystem sorts and processes the data extracted from the log through the Log Parser and produces data on specific aspects of the LTE system on formats that is suitable for use in visualization.

5.2. Interfaces

The following requirements apply to the interface of this subsystem

Req. 30.	Original	The LTE components uses data provided by the parser and utilizes the GUI to visualize it.	1
Req. 31.	Original	Visualizations shall be accompanied by legend support.	1

Table 6 - Interface requirements for the LTE Components subsystem

