**Planning report for examination thesis at IDA**

**Authors**

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**Preliminary title**

Test Data Post-Processing and Analysis of LA & HARQ

**Problem formulation**

Ericsson does not currently have any tool or functionality to make analysis of layer 1 data in a more in-depth way. The way IODT works is that they manually looks at log files of potential problem in the link between UE and EnodeB, these files often contain a lot of data and can be quite hard to analyze. The other way they study data is to look at it in real time in a command window where the data is going with a very high speed, so it is very easy to miss relevant data when you are analyzing functionality in a UE or EnodeB. How can we make this way of working more efficient? How can we help testers to look at data in the link between the UE and enodeB in a more presentable way than in a log file or in real time?

There is also a need to look at and compare different UE’s performance to each other or performance on the same UE with different setups, but there is no current way to do this in an easy and suitable way. How can we make this work easier and more efficient?

To answer these questions Ericsson needed a new visualization tool that would allow the testers to study large amount of data effectively and more in depth and also be able to compare different UE’s with each other. The tool will consist of graphs that can show the dependencies between signals in layer 1.The graphs will be 2 dimensional, with e.g. interference on one axis and throughput on the other. Ericsson thinks this is convenient because they have done this way in previous documents[[1]](#footnote-1) in the same area of study. You should also be able to load data from different UE’s (or the same UE with different setup), plot them both in the same graph and compare them to each other.

In order for us to choose a suitable tool for presenting data we used the following guide lines:

* Can the testers perform some work with our tool?
* Can our tool provide functionality that is useful to the testers?
* Can a tester perform a set of tasks faster with our tool than without it?
* Is our tool easy to use?
* Can you do a relevant analysation with our tool?

**Our initial approach**

We will receive data from Ericsson in form of a log file, on a disk. We will analyze this data (with the help of i.e. Matlab or some other suitable tool) in the perspective of SNR, (Signal-to-noise ratio), SINR (Signal-to-interference-noise ratio) and throughput amongst other things to see if the algorithms are meeting the requirement of the 3GPP standards. We will interview relevant employees at Ericsson and ask them what the most important tasks are to accomplish, how they will use our work, the purpose etc. We will do the interviews in focus group because there is a lot of knowledge spread out over different staff at Ericsson that are involved in the thesis work and they also might have different opinions of what they think we should accomplish. Therefore we believe that this method will be the most effective in the sense that we can both ask them how they want things to be done and also ask about technical difficulties that we might get stuck at. When the work is done we will compare the result with the 3GPP standard.

**Our current approach and tasks we have canceled**

Our approach was in the beginning to receive the data as a log file were the data was decoded and presented in a readable way. This was unfortunately impossible, we could only extract data as a raw file from the enodeB. So our new approach was to make an extension to a plugin to an already existing tool at Ericsson that is used for testing. This also led to that we didn’t choose MATLAB to develop our tool in. The plugin is used for decoding the raw file to readable data. The reason why we didn’t do our own plugin in the testing tool is because we felt it would take a lot of time and work to decode the raw file and store it in a readable way. We also planned to make an analysation for the purpose to show that we were able to make an analysation with our tool. Our initial plan was to look at which MCS’s are used at different SINR value (see thesis report). But we got stuck at that we couldn’t hard code the MCS in the enodeB, so we skipped that analysis.

Our current analysis plan is to look at the BLER target in the LTE system. The current target is at 10% and it is believed that this is the best target. What we want to see is how the throughput is behaving if you switch this value. So we will run different simulations with different BLER target, plot the data in the same graph and compare them to each other. Since it might be quite difficult to separate the curves, (since the might be close to each other) and see which one is the best (optimal). We also plan to build an automatic analyser in our tool that will calculate plotted data to see which BLER target is the optimal in a throughput sense.

If we have time we will try to make our tool to work in real time. It can take some time to store data as raw file, decode the file and plot the data. It would go faster to show it in real time. There is functionality in the test tool that we make our tool in to look at data in real time. So this is something we could possible do. But this we will only start working on if we feel that we are done with our current tasks, since we believe that it might be quite difficult to complete.

**Literature base**

The main source of information will come from Ericsson’s internal documents, lectures and online lectures. The online lectures are accessible from Ericsson’s web page with learning material. The lectures will be held at Ericsson in Linköping. To find information that will not be handed out by Ericsson, and that we feel is necessary to complement, we will use the [IEEE Xplore : digital library](https://login.e.bibl.liu.se/login?url=http://ieeexplore.ieee.org/) and [Electronics and communications abstracts](https://login.e.bibl.liu.se/login?url=http://search.proquest.com/electronicscomms?accountid=12109) databases because these have relevant articles in the LTE area. For information related to MATLAB (functions and other documentation) we will use <http://www.mathworks.se/>.

Possible keywords: HARQ , up/downlink, Link Adaptation, SINR, SNR, QAM, eNodeB, Channel Layers, CQI, Throughput, FDD, TDD, Scheduling, OFDM, OFDMA, Channel Models.

We will need literature that explains the LA (Link Adaptation) and HARQ (Hybrid Automatic repeat request) algorithms. For this we have the document 36.300-C20, Part V, p. 42-53. This section describes the HARQ and LA algorithms. This information is important for us to understand when we develop the analyzer tool.

We will look at the SINR, SNR, and throughput for different channel models so we will have to find information about different channel models. Since we haven’t got enough literature about this from Ericsson we will search the databases mentioned earlier for more information.

We will need manuals about how to use the UE’s (user equipment’s) when connecting a UE to a base station. This will be handed out by involved test engineers at Ericsson.

Lists of commands how to configure the lab equipment. This will be handed out by involved test engineers at Ericsson.

We need to find literature of evaluation and efficiency of algorithms in the air interface (HARQ and LA). For this we will also use the [IEEE Xplore : digital library](https://login.e.bibl.liu.se/login?url=http://ieeexplore.ieee.org/) and [Electronics and communications abstracts](https://login.e.bibl.liu.se/login?url=http://search.proquest.com/electronicscomms?accountid=12109) databases.

We will use the article <http://ieeexplore.ieee.org.e.bibl.liu.se/stamp/stamp.jsp?tp=&arnumber=6692708> and <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1490770> , to learn about the efficiency of harq algortihms.

We will use the article

<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=797134>, to understand more how CNR (carrier to noise ratio) and delay spread are effecting the throughput when different modulation schemes are used.

We will use the article <http://ieeexplore.ieee.org.e.bibl.liu.se/stamp/stamp.jsp?tp=&arnumber=6692708>, to learn about the efficiency of harq algortihms.

The literature we will use to determine how to run the focus group(s) is

Zane K. Quible, A Focus on Focus Groups, Stillwater, Oklahoma State University, 1998.

(<http://eds.b.ebscohost.com.e.bibl.liu.se/eds/pdfviewer/pdfviewer?sid=3b9035f3-a423-49c9-bf6c-b4d3c2eb8e06%40sessionmgr114&vid=1&hid=104>)

Books available at Ericsson:

Academic Press 3G Evolution HSPA and LTE for Mobile Broadband 2nd Edition Oct 2008 eBook-DDU, Part IV

This part describes more in depth the transfer protocols in the physical layer. It also lists the requirements for LTE under different circumstances.

Ericsson Academy LTE L11 Air Interface

This compendium gives us all information about the physical layer (transmission between UE and eNB).

It will also give us an understanding about how signal are sent in the physical layer.

**Time plan**

Preliminary halftime report date: 2014-11-19

Preliminary Oral presentation: 2015-02-27

By the end of the halftime report we expect to have a not complete (but mostly working ) analyzer tool. We expect to have deep knowledge about mostly all LTE knowledge that is useful to us in our project.

We also expect to have written around half of the final report.

See attached file “Project Time Plan” for the actual time plan in excel format.

1. Downlink Link Adaptation Analysis - LTE Verizon Testbed.doc [↑](#footnote-ref-1)