

Optimization of HPSA+ Capacity of Mobile Networks

James K. Tamgno*, Imane S.O-T.A. Alidou*, Claude Lishou**

*RSI Research Group, ESMT, Dakar Senegal

**LTI Laboratory, UCAD, Dakar Senegal

james.tamgno@esmt.sn, imaan.ald@gmail.com, clishou@ucad.sn

Abstract — This paper summarizes the sum total of research carried out to find an alternative against the difficulties and complex conditions that undergoes mobile operators in the acquisition of 4G license in order to satisfy the increasing needs of customers to use an appropriate mobile broadband in Senegal. With the explosion of the smartphones, the increasing capacity of the needs for the consumers to the use of the social networks, mobile services and applications, the keen demand of remote loading of data in real time, the need the performances of the network is essential, it with an aim of offering a broader access to services more sophisticated and more accessible like the access high flow to Internet. In spite of the difficulty in obtaining the 4G license with authorities, the operators more precisely Sonatel (Orange Senegal) which already offers on the 3G services based on access Internet has high flow, always seeks a means of satisfying their customer better and better.

Keywords – 3G; Performance; QoS; Optimization; PKIs, HSPA; HSPA+.

I. INTRODUCTION

Mobile networks are constantly evolving both technically and technologically.

This evolution is done in a context obviously marked by the growing needs of consumers and the digital development.

Then, in order to ensure the quality of services, operators are constantly facing new challenges and challenges.

In particular, Orange Senegal should continually optimize its network to ensure better performances. For this reason, it was the question for us during our research to determine an optimization solution of the capacity of its HSPA network.

Operators are encouraged to deploy more efficient networks by the increase of demand in the telecommunications' sector and the growing needs of consumers

Orange Senegal can't upgrade for 4G Network as the license has not been granted then there is a need of an alternative solution to allow the clients to use high data rates. In our case, it will be the enhancement of the current network's performance

A. Context and motivations

1) Issues of quality of service of a 3G network

The constantly changing needs have led to the adoption and evolution of different mobile network technologies. Then, there were the 1G (AMPS, TACS, ETACS) then 2G and its various developments namely GSM, GPRS, EDGE and 3G which is currently used (ie HSDPA, HSUPA, HSPA +).

2) Methodological approach

Our goal is to examine the existing network of Orange and optimize its performance. To achieve this goal, we had to answer these questions:

- How to analyze and identify the optimization requirements?
- What optimization's strategy adopt?
- How to measure the impact of this optimization?

To answer these questions a method was elaborated with these steps:

- Identification of flow factors for each technology
- Highlighting the limits of the existing network;
- The proposal of techniques to improve throughput
- Impact evaluation of this improvement on the network.

B. Analysis of the performance and of the limits of the network 3G network

To determine the optimization requirements of the 3G radio network Orange Senegal, an analysis was performed with the help of Huawei's tools: PRS and M2000. From this analysis, it emerged that interference and overload are the principal issues of that network. In mot cells, the data rate obtained in downlink is less than 42 Mbps/s for all the users. In uplink, it is less than 5.76 Mbps/s for all the users of that cells.

II. ANALYTICAL APPROACH

A. Optimization of the capacity of the network: migration of HSPA to HSPA+

Following these results, solutions have been proposed to optimize the network.

For the uplink, these solutions are:

1) *Dynamic Target RoT Adjustment*

Dynamic Target RoT Adjustment is a feature that will permit to reduce the uplink interference. It automatically adjust the maximum value of the target load of a cell based on its needs. [5]

2) *16 QAM*

Uplink 16QAM modulates 4 bits/symbol whereas the original QPSK modulates only 2 bits/symbol. As a result, uplink 16QAM doubles the rate to 11.5 Mbit/s. [2]

3) *DC-HSUPA*

DC-HSUPA is a 3GPP defined technology that combines the multi-carrier technology and HSUPA in the uplink. The multi-carrier technology allows multi-carrier aggregation to provide a higher bandwidth for data transmission. DC-HSUPA significantly increases the uplink rate, greatly improving user experience. DC-HSUPA allows a UE to transmit data simultaneously on two uplink adjacent carriers that provide the same coverage. When used with uplink 16QAM, DC-HSUPA can provide a 23 Mbit/s uplink peak rate. [4]

For the downlink, these solutions are:

4) *Flexible Dual Carrier*

As mobile communication services continue to develop, users have increasingly high requirements for downlink throughput. Multi-carrier HSDPA technologies enable UEs to set up, HSDPA connections with multiple carriers, which increases the single-user downlink throughput. The Flexible Dual Carrier HSDPA feature dynamically uses instantaneous idle resources in a cell, increasing the UE data rate and system capacity. In the case of three carriers, this feature increases the UE data rate by up to 20% when UEs are processing burst services. [1]

5) *MIMO 2X2*

MIMO is an antenna technology for wireless communications in which multiple antennas are used on both the transmitter and the receiver. MIMO can increase transmission rates through spatial multiplexing and improve channel quality through space diversity without increasing transmits power or bandwidth. HSPA+ uses 2x2 MIMO in the downlink to increase single-user throughput and system capacity. 2x2 MIMO uses two antennas on the transmitter and two antennas on the receiver and permit to reach 84 Mbps/s. [3]

In order to ensure proper migration to HSPA +, we propose a procedure to follow for the deployment of features:

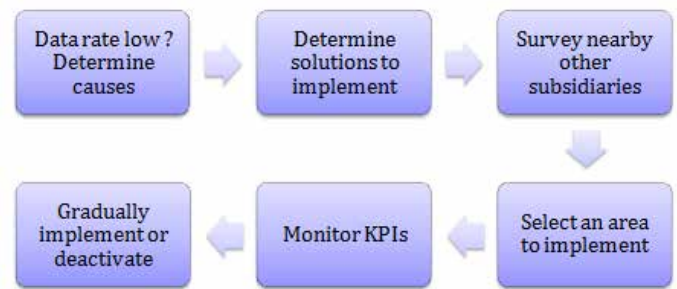


Figure 1. Procedure

B. Design and modeling the application to measure the impact of the optimization

To monitor the impact that could have on the solutions of the network load, an application has been designed. This system will have as inputs KPIs from the M2000 server and generate outputs such as reports and curves.

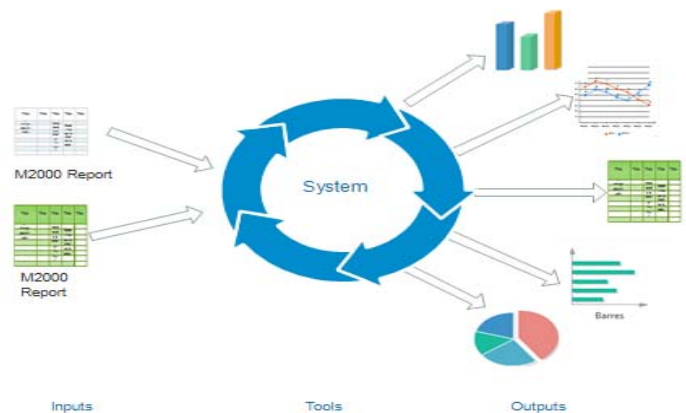


Figure 2. Architecture

To collect data on the server M 2000, an ftp client will be created and it will collect information automatically.

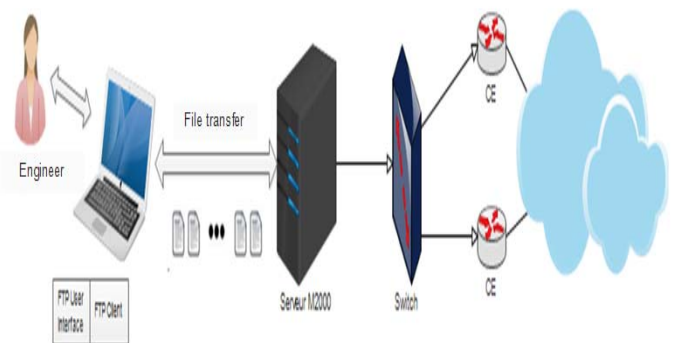


Figure 3. Collection scheme

The functions of our application will be presented as an UML use case diagram. There are two types of user:

- Simple user
- Administrator

For the simple user:

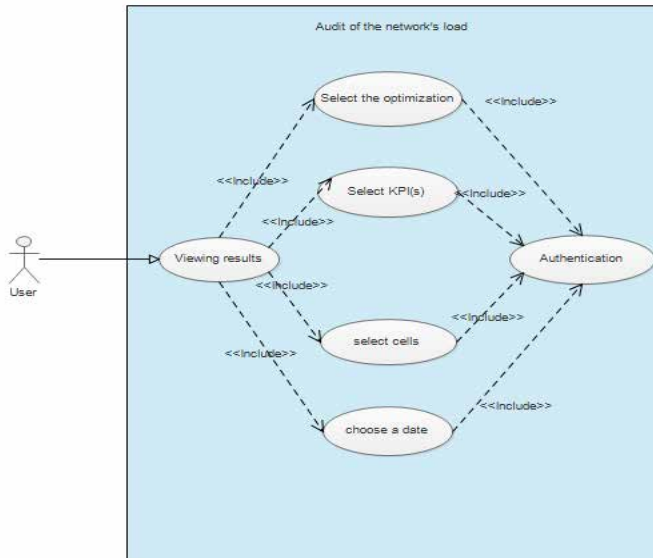


Figure 4. Simple user use cases

Concerning the simple user, his functions are

- Login
- Check the network load
- Select the KPI (s)
- Select cells
- Select optimizations
- Choose the timeframe

For the administrator:

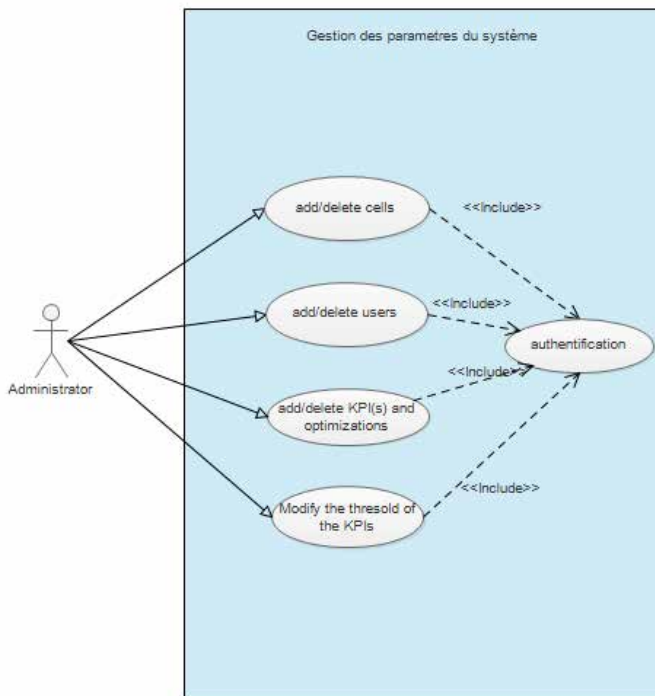


Figure 5. Administrator use cases

Concerning the administrator, his functions are:

- Login
- Add user: add users with their login and password

- Delete a user: it will delete all information related to a user account
- Add one or many KPI (s): add one or more KPI (s) listed
- Delete one or many KPI (s) he may or several KPI (s) of the list
- Add one or many cells: add one or more cells in the list
- Delete one or many KPI (s) he can remove one or more cells of the list
- Add one or many optimization (s) add to the list one or more optimizations
- Delete one or many optimization (s) he can remove Optimizations or more of the list.

The sequence diagram of our system is the representation of graphic interactions between actors and the system in chronological order.

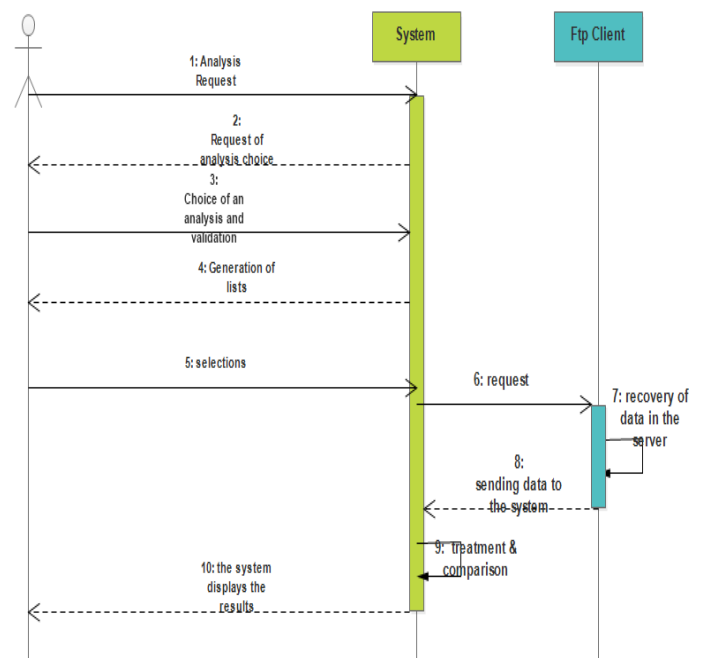


Figure 6. Sequence diagram

The sequence diagram of the system and our user proceeds as follows:

1. The user tells the system to be analyzed;
2. The system asks the user to choose a type of analysis;
3. The user selects an analysis and valid;
4. The system generates lists and asks the user to select items in those lists;
5. The user selects one or more items in the lists and valid;
6. The system sends a request to the FTP server to retrieve data from the server M2000;
7. FTP client retrieves the file and returns to the system;
8. The system processes data for each KPI compares the values obtained with the threshold values;
- And the system adds two columns to the table received and inserts the thresholds for each KPI and the results of the comparison;
- It then displays the table to the user;
9. The user can then look at the chart and choose whether to display it as a graph;

10. In this case it instructs the system to display a graph him;
11. The system asks the user to choose a graphic form;
12. Following the rest of the user, the system displays the graph;

To give an overview of the different interfaces of the application, a model was made:

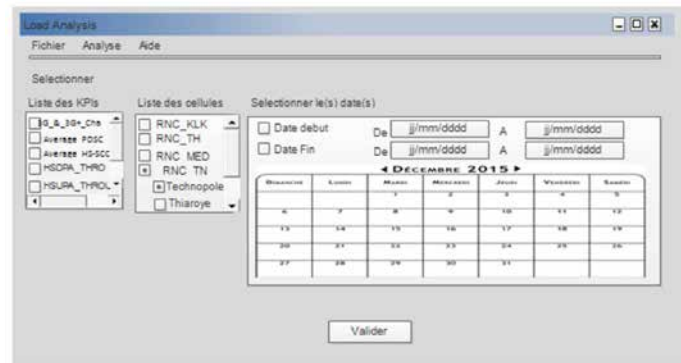


Figure 7. KPI's analysis

After having chosen an analysis type (KPI or Optimization), this interface of our application presents the KPI's analysis phase. The user must enter his login and password previously configured by the engineer.

It may be an analysis based on the KPIs or on the optimization

❖ KPIs Analysis

This analysis enables to

- View the values of KPIs achieved during a period and compare them to the threshold values
- View and compare the values of KPIs for 2 periods and compare them to the threshold values of KPIs

❖ Optimization Analysis

This analysis enables to view and compare the values of KPIs relating to each optimization before and after the implementation of optimization and compare them to the threshold values of KPIs.

The image below shows the resulting table after running an analysis



Figure 8. HSDPA cell Throughput (Kb/s)

The image below shows the resulting graph after running an analysis

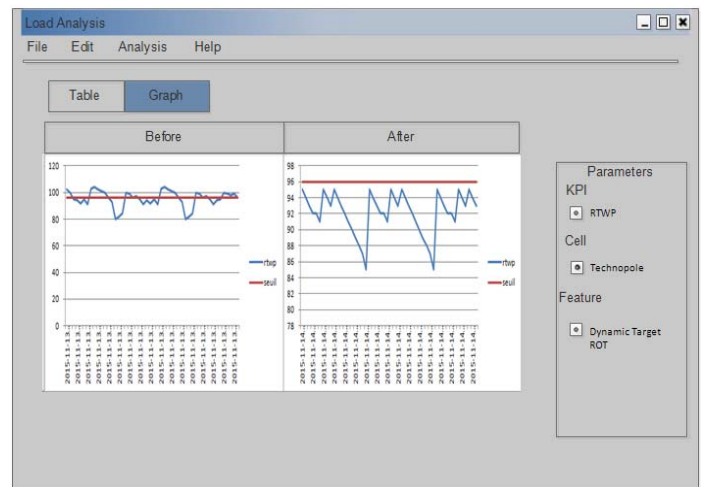


Figure 9. KPI/Cell/Feature parameters before and after

To produce various reports to:

On the one hand to represent indicators of a third generation network associated with the network load;

And secondly to represent specific network indicators to be monitored after each optimization

The execution of the application is done according to the process described in the following diagram.

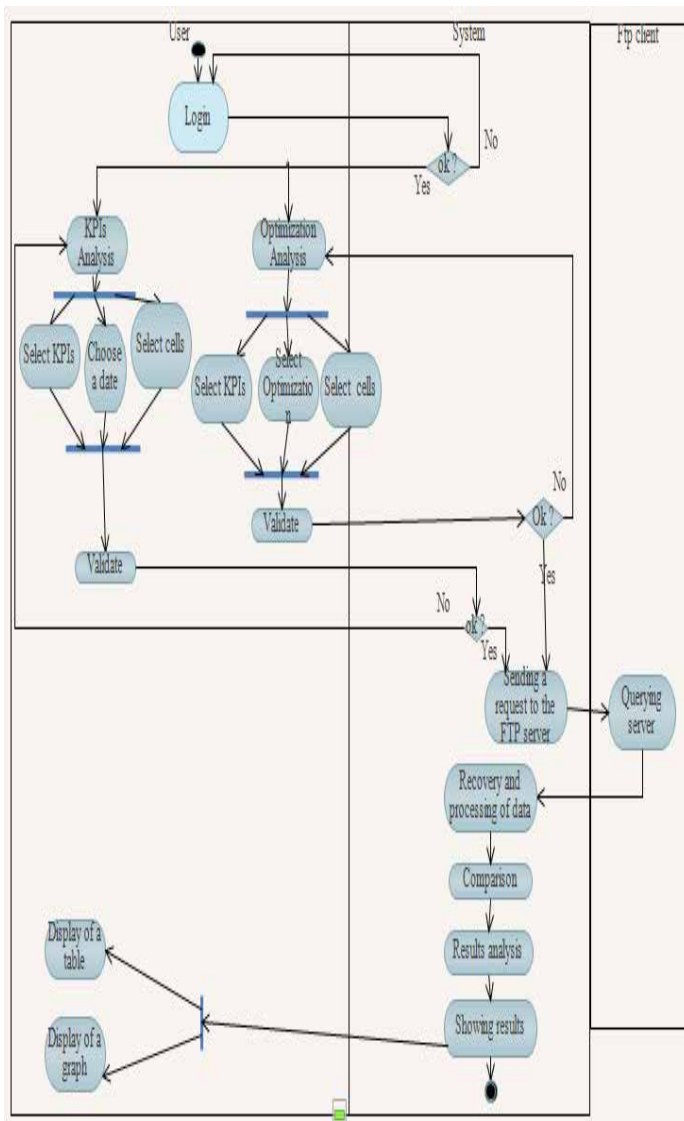


Figure 10. Algorithm structure

III. DISCUSSION AND SOME CHALLENGES OF THE APPLICATION AND THE PERFORMANCE ANALYSIS

Although the proposed technique provides high flow rates, they require much in terms of both financial resources (especially MIMO) capability that (load generated at different network devices).

Ultimately, we have achieved our objectives and are satisfied. For the efficiency and reliability optimization solutions presented are measurable.

VI. CONCLUSION

The main objective of this plan was to offer resolutions to optimize the capacity HSPA+ of a network of third generation and measure impact. To acquire significant results, we analysed the performances of this network and identified its borders, and offered the realization of functionalities and technologies. Accompanied with their strategy of implementation, these

resolutions will allow to attain debit sides in the order of 84 Mbits/s and of 23 Mbits/s in downlink and in uplink respectively. We also conceived an application the not functional and functional needs of which were represented. She will allow to measure the impact of these optimizations in network because offered techniques can have negative consequences to network. Our application is therefore a practical resolution, which will allow to avoid a treatment of raw information. Although offered techniques allow to acquire high debit sides, they ask in terms of as well financial means (particularly for technology MIMO) which capacitaires a lot (load generated at the level of the different equipment of network).

After all is said and done, we reached our targets and are satisfied there. Because effectiveness and reliability of the introduced resolutions of optimization are measurable.

But in the long term, it would be preferable to evolve towards the 4G because the performances, which it gives, are considerable. His perspectives will make take a new development in the mobile network of SONATEL.

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Dr. James K. Tamgno, As a senior lecturer at ESMT, This author became a Member (M) of IEEE in 2012, he obtained my Ph.D in may 2013 at University Cheikh Anta Diop of Dakar. My researches focused on Promotion of African's languages and dialects and Contribution to a Wider Accessibility of ICT, by Circumventing Language Barriers and Lessening the Impact of Illiteracy or Disability. Previously I have gotten a M.Sc. in Engineering Science from Cheikh Anta DIOP University of Dakar, studied numerical analysis and mathematics at Yaoundé I University of Yaoundé, and worked as a research scientist at Ecole Supérieure Mutinationale des Télécommunications (ESMT) of Dakar.



Pr. Claude LISHOU is Professor of Universities at the Ecole Supérieure Polytechnique of Cheikh Anta Diop University in Dakar (Senegal). He teaches several disciplines ranging from industrial computing to new generation networks in the electrical engineering and computer engineering sections. Director of the Virtual Platform of the UCAD,

coordinates the information system and oversees the strategy of open and distance training at his university. He leads an internationally renowned research and development laboratory dedicated to the use of ICT in education and training, environment, energy, transport, e-governance. On the scientific level, he is the author and co-author of several publications in scientific journals with international circulation. Professor LISHOU is a member of several scientific societies, member of editorial committees of scientific journals, member of the Networks of Information and Communication Technologies for teaching and research, Editor in chief of the Journal of Sciences for Engineers . For more than two decades, he has supervised and supported dozens of engineers and researchers in these areas, especially in western Africa. A recognized expert in the development of ICT applications and services, he divides his time between teaching, research and consulting with international organizations (OIF, AUF, UNDP, UNESCO, UNCTAD...).



Imane S.O-T.A. ALIDOU became a Member (M) of IEEE in 2015. While her growing up, graduated as a telecommunications engineer at ESMT Dakar – Senegal. In 2017, she got a specialized master in business management at Telecom Bretagne Rennes - France. Her most important internship experiences are the one for the engineering school graduating at Orange Dakar Senegal and the other for the specialized master at Alten Sèvres France. She actually works as a network engineer for AFD tech in Paris, France. The company is involved in design projects, evolution of

information systems and networks of large companies. As a network support engineer she is responsible of the management of the network of large companies.