

# Automation of Radio Parameter Assessment by Developing a GIS Application for Radio Networks Optimization

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**Abstract:** Cellular networks are a radio network with high capacity voice and data communication networks, are one of the most powerful engines in the telecommunications market and become the lifeline of communications. The radio access network uses radio signals to connect the cellular device of subscribers with the core network and give advanced features to subscribers, in order to offer subscribers a good quality of communication, it is necessary to assure the better functioning of the network taking into consideration several parameters which are variable and which must be permanently adapted to the radio link. that's why operators are trying to offer a better quality of service to avoid anomalies that could degrade the functioning of the network and therefore cause radio optimization problems. This paper aims to optimize the radio part of cellular networks, by creating a macro developed in Mapbasic to extract figures that represent the distribution of radio coverage and radio link quality in a geographical map in order to generate measurement reports after the analysis of the Drives test. The results of the work done in the mobile network for an integration of new site confirm the validation of our application.

**Keywords:** Cellular network, Drive Test, TEMS Investigation, Radio optimization, Mapbasic, GIS, Software Engineering, RNO.

## 1. Introduction

The cellular network is a telecommunications system specifically designed for mobile equipment and which must meet the constraints of the subscriber's mobility in the network [1]. Cellular networks have allowed certain types of communication to take place on a large scale, which were impossible and very limited. In order to gain the satisfaction of their customers [2], operators try their best to guarantee a good quality of service, maintain and improve it in case of degradation due to the various anomalies that appear in the functioning of the network [3]. Whatever the cellular network, it presents different radio optimization problems. The origin of these anomalies requires a thorough analysis [4]. This radio optimization begins first of all with the Drive Test phase, these additional measures could detect and localize where is possible the network problems be to get more informations and also make the appropriate changes, and then he goes through the investigation phase [5], which consists in knowing the causes of these problems to finally find an effective solution [6]. The data measured during the Drive Test operation is stored on servers external to the company, The engineers then have to retrieve this data and process it to generate a measurement report. But this causes a time problem in the generation of reports [7].

This paper allows to develop a macro under Mapbasic which offers the possibility to extract figures that represent the radio coverage distribution and radio link quality in a map, and on the other hand to analyze them

in order to propose actions to improve the quality of the link between the mobile and the BTS. The rest of the paper is organized as follows: Section 2 presents the process of optimizing cellular networks. Section 3 presents a DT report generation tool developed under MapBasic. Section 4 present one example concerning the voice part for the GSM network. Section 5 presents a conclusion and some directions for future research.

## 2. Radio Optimization

Radio optimization is a very important step in improving the performance of telecommunications networks. It resolves the best solutions and the implementation of an activity with maximum efficiency or the identification and rectification of performance problems [6]. It's to assure that the network functions in optimal performance and the defined quality of service constraints. This is completed by implementing corrective measures to correct the network problems [8]. Thus, the optimization of a cellular network is validated by two objectives: Optimize the quality of service provided to users and increase the volume of traffic transported by the network with existing equipment [3].

The radio optimization process shown in Fig 1, starts with monitoring network performance through statistics, data collected by counters, used to calculate its Key Performance Indicators (KPIs).

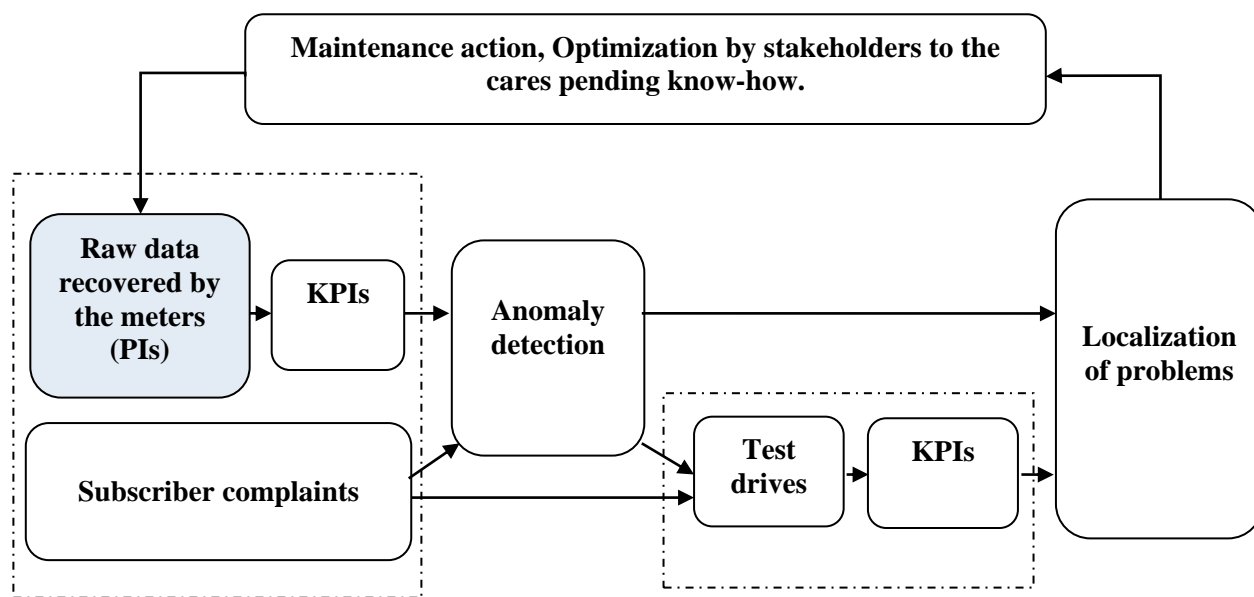


Fig. 1: Diagram of the radio optimization process [11].

The analysis of these KPIs allows selecting the position of anomalies, then localizing the problem in order to involve actions to be undertaken to optimize our network. While, the indicators are insufficient to detect problems on the network, so Drive Tests will be carried out to better understand the causes. The process can also be triggered by subscriber complaints if the operator's supervisory system does not. Corrective actions are concluded from the KPI analysis after the channeling of the pblems [9]. After validating and implementing actions, we will go back the loop from the start to ensure that the detected anomalies are approved.because sometimes the improvements that are made can led to problems in other parameters [10-13]. Statistics and drive Tests are the main methods used to monitor network performance.

### 3. DT Report Generation Tool

To obtain the figures illustrating the actual radio status of the GSM/LTE networks of a specific area according to the selected radio parameters, it is necessary:

- Firstly, record the Test Drive LogFile via TEMS Investigation software.
- Then, export it under the Mapinfo software.

However, this operation causes a time problem in the generation of measurement reports.

Developing an application has become easier with the help of various software programs and online tools. As a result, we thought about creating an application that allows to present the desired radio parameters in a map in order to generate drive test reports and that are used by the post-processing (reporting) team. While creating an application which is a macro developed under Mapbasic, allows to extract the figures requested by the post-processing team in an automatic way in order to realize radio measurement reports.

The application contains three types of drive test reports, the first of which is a swap operation in GSM network ( the 1st mobile (MS2) is designed for long calls, the 2nd mobile (MS3) in Idle mode), the second report is an integration of new site in GSM network (signal level distribution for each sector, quality link and signal level for long call mode and signal level for short call mode), and the last report is an integration of new site in LTE network (RSRP and RSRQ distribution for Clockwise and Anticlockwise, PCI physical Cell ID and DL &UL distribution).

The flowchart of the macro is presented as follows (Fig. 2):

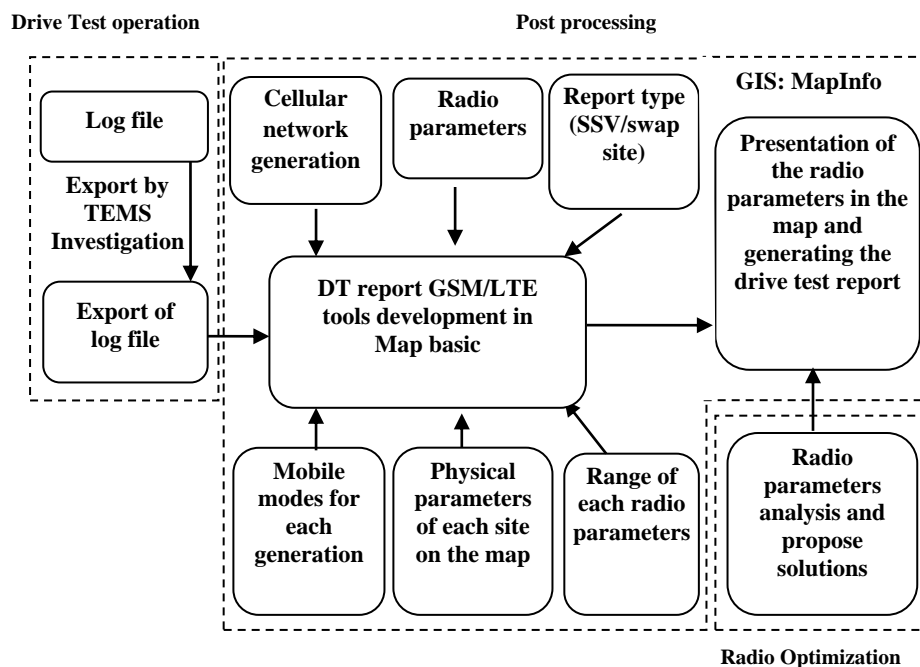


Fig. 2: Diagram of the developed tool.

The state of the radio part of the cellular network in a specific area is presented by the radio parameters recorded in a ".log" file during the drive test operation, these parameters must be exported in a ".tab" file via the TEMS investigation software so that we can display it at the GIS.

After importing file "Export log file" to macro expanded. It is imperative to import the GPS points and azimuths for each site into the GIS, so that we can correctly present the cellular network relays in the map.

The presentation of the radio parameters obtained by the export of log file in the card requires a classification which depends on the one hand, the intervals of the radio parameters fixed by the telephone operator (these intervals will be presented in the VI session). And on the other hand, the specific parameters namely: type of radio parameter that we want to display (Rxlevel, Cell ID, etc.), type of drive test report (SSV or swap site), type of cellular network (GSM, LTE) and the mobile mode used in the test drive operation for each network. These specific parameters will be presented in detail in the table I.

TABLE I: Radio parameters for each mobile mode.

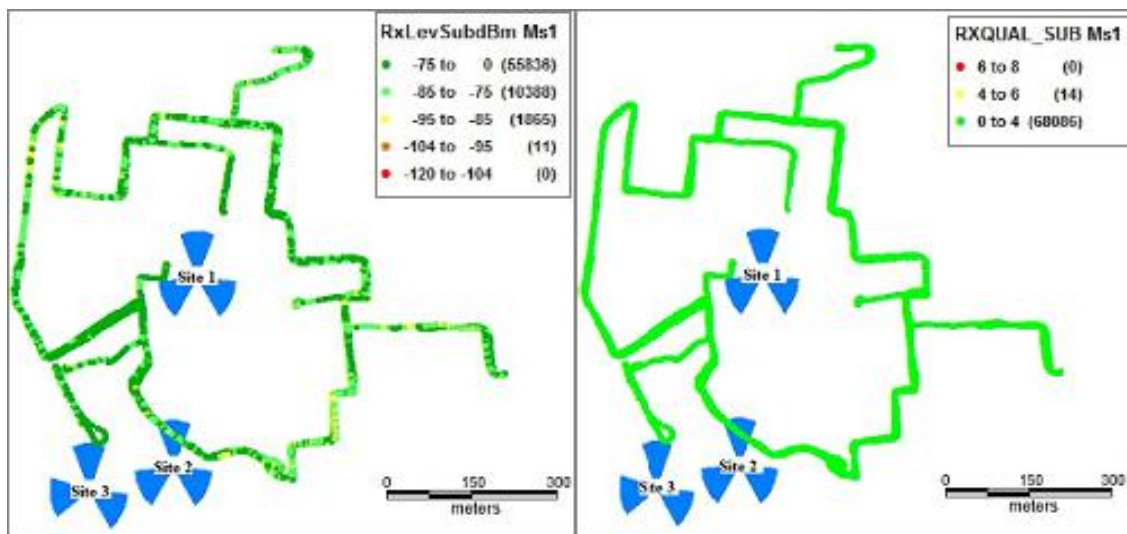
Type report	Mobile mode	Events and distribution of radio parameters
Swap site GSM	Short call (MS1)	Serving cell ID + events
	Long call (MS2)	Serving cell ID + events Rxlevel sub,Rxqual sub, C/I worst Timing advance,Speech quality index.
	Idle mode (MS3)	Serving Cell ID + events Idle mode Rxlevel Idle mode
	Data (MS4)	DL Throughput, UL Throughput
SSV GSM	Short Call (MS1)	Rxlevel sub,Rxqual sub
	Long Call (MS2)	Rxlevel sub Sector A, Rxlevel sub Sector B, Rxlevel sub Sector C Rxlevel sub All Sectors
SSV LTE	Idle Mode (MS1)	RSRP Distribution Clockwise, RSRQ Distribution Clockwise PCI Physical Cell ID DL LTE Phy throughput PDSCH clockwise UL LTE Phy throughput PUSCH anti-clockwise
	Actif Mode (MS2)	RSRP Distribution Anticlockwise, RSRQ Distribution Anticlockwise SINR, PCI Physical Cell ID

## 4. Results

In order to validate our application, we processed an integration of a new site in the GSM network that was triggered by the phone company to improve coverage and add new logical channels to absorb the traffic offered by subscribers in an area. To validate the operation of integrating a new site into the 2G network, we did a drive test after the swap to evaluate signal quality and level. The Drive test necessitates the network to be tested in a defined area in order to provide a real picture of the network performance in that area by using certain tools. The drive test operation offers us the distribution of the parameters in the map that represents the target path of the Drive such as RxLevel, RxQual. In order to facilitate the drive test analysis, we have separated the values of each parameter into levels associated by a color.

### 4.1. Received Signal Level in Idle Mode and Signal Quality in Dedicated Mode

Figure 3.a shows the distribution of the received signal level “RxLevel” in the idle mode on the road, we have classified the RxLevel into five rows as shown in the legend. Whilst the distribution of signal quality Rxquality in dedicated mode on the road is shown in Fig 3.b, "0" in the legend represents the best signal quality and 8 represents the worst. A quality higher than "4" RxQual results in call interruptions, of the Drop Call, of Handover failures, and interference.



a) b)

Fig 3: a) RxLevel in Idle mode on the road

b) RxQuality in continuous communication mode on the road.

#### 4.2. Received Signal Level for Each Sector in Dedicated Mode

The signal level distribution of the sector A/B/C in this area is shown in Fig 4.

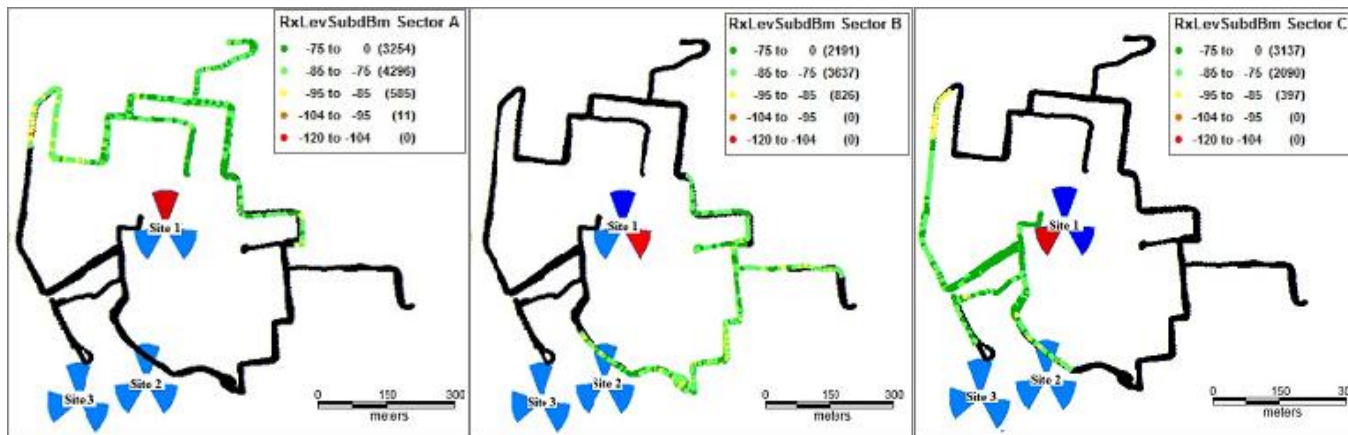


Fig 4: Received signal level in continuous communication mode for sector A/B/C.

### 5. Conclusion

During this article we started by studying the process of optimizing cellular networks. Then, we presented the Drive Test and its equipment. Thereafter, We presented the macro developed under MapBasic followed by example of integration of new site in GSM network. The results obtained by our application are interesting because they facilitate and help the engineer to analyze Drive Test reports and therefore make the necessary and satisfactory optimization of the targeted network. Therefore, the future scope of the optimization tool allows to analyze the 5G network radio part, WIMAX,...etc. And the ability to communicate with a server to generate DT reports.

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