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Analytical Study to Assess the Performance and Quality GPRS Network for Some of the Cells in SANA'A

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ABSTRACT

This paper presents an empirical study for the GPRS service efficiency and quality of performance in Yemeni GSM networks. It collects real measurements from several cells and networks in Sana'a city, the capital city of the Republic of Yemen as a case study. The researcher using three cell samples for different regions (Urban area, Suburban area and Open area) of the communication network and then use the key performance indicators (KPIs) and test drive these cells in the capital and in addition to this, the use of leadership that has been collected test log files. Which have the advantages of the most important drive test is a powerful tool for radio frequency (RF) to analyze and resolve network problems. And scanner used tool in the test drive, which is a very good tool for the detection of signal interference.

Keywords: *General Packet Radio Service (GPRS), Mobile Network, Cellular Network, Mobile Network Optimization, Signal Quality, Signal Level.*

1 INTRODUCTION

The first generation of mobile cellular telecommunications systems appeared in the 1980s. The first generation was not the beginning of mobile Communications, as there were several mobile radio networks in existence before then, but they were not cellular systems either. The capacity of these early networks was much lower than that of cellular networks, and the support for mobility was weaker. In mobile cellular networks the coverage area is divided into small cells, and thus the same frequencies can be used several times in the network without disruptive interference. This increases the system capacity. The second-generation (2G) mobile cellular systems use digital radio transmission for traffic. Thus, the boundary line between first- and second generation systems is obvious: It is the analog/digital split. The 2G networks have much higher capacity than the first-generation systems. One frequency channel is simultaneously divided among several users (either by code or time division).

"Generation 2.5" is a designation that broadly includes all advanced upgrades for the 2G networks. These upgrades may in fact sometimes provide almost the same capabilities as the planned 3G systems. The boundary line between 2G and 2.5G is a hazy one. It is difficult to say when a 2G becomes a 2.5G system in a technical sense. Generally, a 2.5G GSM system includes at least one of the following technologies:

1. High-Speed Circuit-Switched Data (HSCSD).
2. General Packet Radio Services (GPRS).
3. Enhanced Data Rates for Global Evolution (EDGE).

HSCSD is the easiest way to speed things up. This means that instead of one time slot, a mobile station can use several time slots for a data connection. In current commercial implementations, the Maximum is usually four time slots. One time slot can use either 9.6-Kbps Or 14.4-Kbps speeds. This is a relatively inexpensive way to upgrade the data capabilities, as it requires only software upgrades to the network. The biggest problem is the usage of scarce radio resources. Because it is circuit switched, HSCSD allocates the used time slots constantly, even when nothing is being transmitted. In contrast, this same feature makes HSCSD a good choice for real-time applications, which allow for only short delays. With this technology, the data rates can be pushed up to 115 Kbps, or even higher if one can forget error correction. GPRS is especially suitable for non-real-time applications, such as e-mail and Web surfing. The implementation of a GPRS system is much more expensive than that of an HSCSD system. The network needs new components as well as modifications to the existing ones. The first commercial launches for GPRS took place in 2001.The third 2.5G improvement to GSM is EDGE. Originally this acronym stood for Enhanced Data rates for GSM Evolution, but now it translates into Enhanced Data rates for Global Evolution, as the EDGE idea can also be used in systems other than GSM. The idea behind EDGE is a new modulation scheme called eight-phase shift keying (8PSK).It increases the data rates of standard GSM by up to threefold, The maximum data rate of EGPRS using eight time slots (and adequate error protection) is 384 Kbps. EDGE is an attractive upgrade for GSM networks, as it only requires a software upgrade to base stations If EDGE is used with GPRS, then the combination is known as enhanced GPRS (EGPRS). This system was developed over time to include data communications by packet data transport via general packet radio services (GPRS) and enhanced data rates for GSM evolution (EDGE). Further improvements were made when the 3GPP developed third generation (3G) UMTS standard followed by fourth generation (4G) LTE advanced standard [5].

The survey of the literature above, some writers have suggested several ways to improve key performance indicators available. However, these methodologies were not implemented an improvement in the network. However, to our knowledge, there is no comprehensive research work that combines all of the key performance indicators and disk tests to evaluate the performance of GPRS operational mobile networks. Despite this, there is a research study on the performance evaluation and optimization of GSM mobile network to rely in the city of Aligarh [7].

The aim of the study to assess the quality and efficiency of the performance of the cellular network GPRS system in the city of Sana'a through key performance indicators and in addition to the use of leadership that has been collecting test log files. Which has the advantages of the most important engine test is a powerful tool for radio frequencies to analyze and resolve network problems. And a tool in the driving test, which is a very good way to detect the signal interference scanner used. To be obtained on the quality and efficiency of the performance of the network.

2 STEPS TO ASSESS THE EFFICIENCY OF THE CELLULAR NETWORK

2.1 The Samples Of GPRS Networks:

As it is that all cellular communications network made up of cells or three types of cells. Therefore, samples were taken from these cells, namely:

2.1.1- Urban Area:

Which are areas that can contain many buildings, such as "built cities," or big cities. And earth elements are very important here as a result of the high level of congestion.

2.1.2- Suburban Area:

Which areas may not be overcrowded, but it may be where villages or highways, and with a few trees and buildings. These elements may be more important to be taken into consideration in this type of environment

2.1.3- Open Area:

It can be a barrier-free zones, at least open between the sender and the future space. And be so slim earth elements are not taken into account.

2.2 Key Performance Indicator

KPIs are used to evaluate the performance of an operational GSM & GPRS network. The most common KPIs are listed:

- **Rx-Lev Sub In Service (dBm):** Same as Rx-Lev Sub (dBm) but valid only when the phone is in idle, dedicated, packet idle, or packet dedicated mode. Not valid when in limited service or no service mode.
- **Rx-Qual Full:** Received signal quality (Full value), calculated from the bit error**.**
- **Neighbor Rx-Lev (Sorted):** Received signal strength of neighbors, sorted in descending order.
- **ARFCN TCH:** Absolute Radio Frequency Channel Number of Traffic Channel.
- Valid only in dedicated mode and only for channels where no frequency hopping is used.
- **BER/Timeslot(0-26%):** Bit error rate for each used timeslot. Valid for data services only.
- Argument: 0 represents the first used timeslot (not TS 0).

- **Cell EGPRS Support:** EDGE supported/not supported in the cell. This information is available also to non-EDGE phones.
- **EGPRS BEP (Mean):** Mean value of bit error probability as reported in the Layer 3 message EGPRS Packet Downlink Ack/Nack.
- **Network Mode Of Operation**: Handling of paging in the network.
- All paging on GPRS channels; (Gs signaling interface present).
- All paging on PCH; no Gs.
- All circuit-switched paging on PCH, all packet-switched paging on PPCH; no Gs.
- **Call Setup Success Rate (CSSR):** It is a measure of call setup success rate of attempted calls by subscribers in a cell and it should me minimum 98% in a good network.
- **BER Actual (0-26%):** Bit error rate, calculated taking DTX into account, i.e.
- **FER Sub (0-100%):** Frame erasure rate, Sub value. For the calculation.

Note that there are so many parameters used by the program and its partial and primary role.

2 .3 Carrying out of the measurements on site Territory measurement route

The test route first defined is transferred to the measuring team either on paper maps or electronically. So for example the use of the software makes it possible to define the route on a computer and to download it electronically to the vehicle's GPS. All operators are simultaneously tested .

Every measuring equipment GPRS is set to make a continuous call to a dedicated answering machine placed on the network of the operator under test. The call enables the monitoring of the operator's network. This answering machine must pick up when the call is made and maintain the call as long as it is not dropped by the measuring equipment. During the test all the parameters of the call are registered (signaling data exchanged between the GPRS and the network) by the measuring equipment and can be visualised by the technician who checks that the test is progressing well.

Having completed the test drive the recorded data can be processed. The two useful parameters are Rx-Lev and Rx-Qual. The data must be exported in a format compatible with the GIS application .

For example, a (30m x 30m) grid is superimposed on the measurement route. The average of the Rx-Lev and Rx-Qual values measured inside a square are calculated and the averages are associated with the center of the square. This results in a file in ASCII format, in which each line is composed of the coordinates in latitude/longitude of the center of the square and of the parameters Rx-Lev and Rx-Qual associated with that square.

- Measurement routes of the highways

These routes are carried out in the same way as the territory measurement routes. The exportation of data is however made by superimposing a grid of (60m x 60m) instead of (30m x 30m) on the route. This takes account of the higher speed of the measurement vehicle.

2 .4 Assessment of the measurements along the route

The files from the measuring equipment are imported to the data processing software. It is necessary to assess the measuring data. For that purpose the measurements made on site are compared to the declaration of the operator. This comparison results in the definition of the measured coverage indexes.

2 .5 Calculation of the measured index for the territory measurement routes

The 30m x 30m grid is superimposed on the 50m x 50m grid on which the calculations are carried out. The average of all the values in a square of 50m x 50m is worked out and associated with the centre of this square. It should be noted that the grid spacing used for the measurements should preferably be the same as used for the coverage predictions however sufficient care has to be taken in order to avoid a systematic 'offset' gap between the measured data and the theoretical data.

The following operations are carried out on the file containing the route referred to on the 50m x 50m grid:

For every square the value '1' is assigned if the decision thresholds are exceeded (in our example,

Rx-Lev ≥ 18 (step) and Rx-Qual ≤ 5), otherwise the value '0' is assigned.

3 THE RESULTS OF KPI

Assess the performance of the GPRS network in the city, and it is appointed and improve the value of the efficient functioning of the cells through key performance indicators and disk tests. On the one hand, the key performance indicators give us detailed statistics on the number of events in the cells on the other hand, disk tests show a realistic experience for the customer which is more important.

To achieve this, we used a program (TEMS investigation data collection Version 10.0.5)

TEMS is used a lot of factors that are assembled by the test drive. The most important criteria is the received signal level Rx-Lev and received signal Rx-Qual quality is the power of the received signal in units of dB. Uses Rx-Lev to determine the quality of a voice call or data session during an ad hoc mode (by value Rx-Lev).

The typically -104 dBm of the cell has been minimal for the Rx-Lev accepted the appointment. While it considered the value of Rx-Lev -60 dB excellent value. For customers to be able to access the GPRS network, it is highly recommended that there be adequate coverage with acceptable quality. Rx-Qual used to estimate the quality of the service GPRS network is measured in terms of bit error rate (BER) before channel decoding. Through value Rx-Qual value is a measure of the quality of service and are awarded by the scope of GPRS 0-7, where 0 is the best quality and 7 is the worst.

3.1 Urban Area:

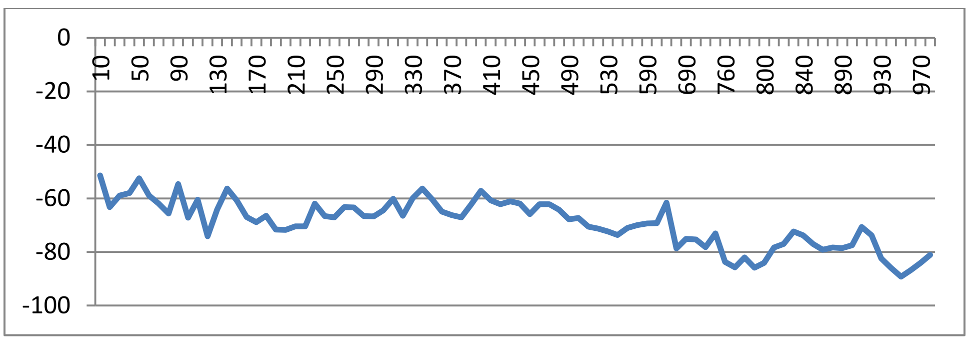

Fig. 1. The Relationship Between Distance And RX-LEV-Sub In This Cell.

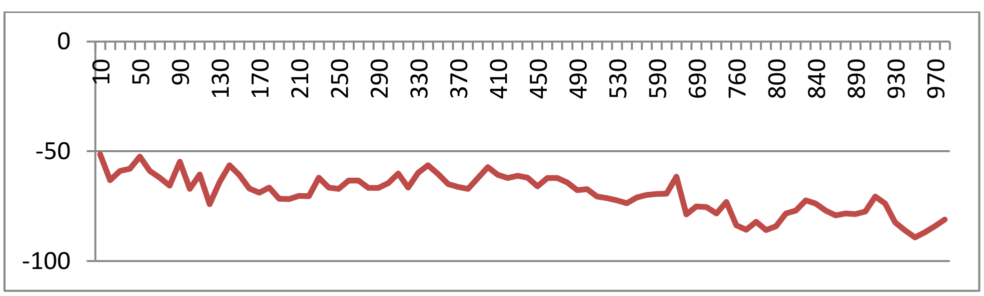

Fig. 2. The Relationship Between Distance And Rx-Qual In This Cell.

3.2 Suburban Area:

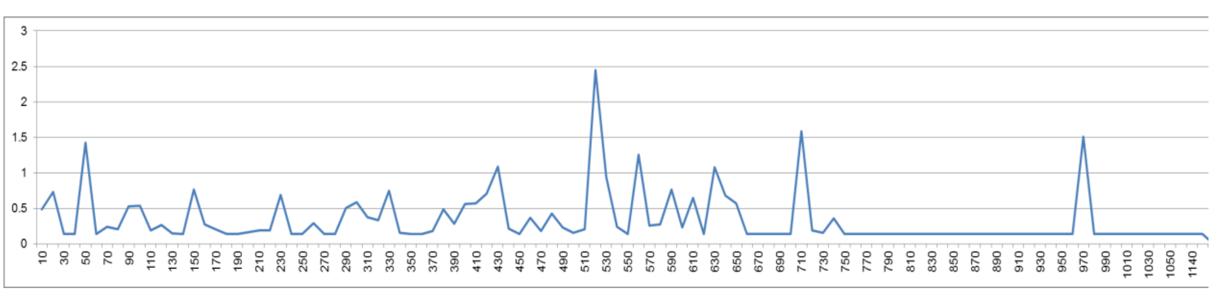

Fig. 3. The Relationship Between Distance And RX-LEV-Sub In This Cell.

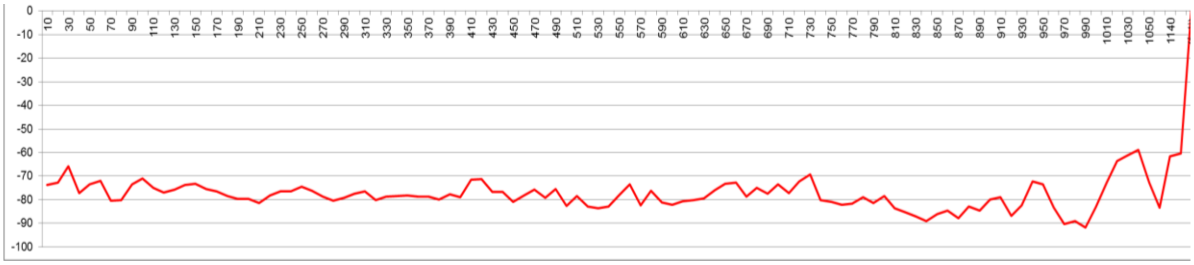

Fig. 4. The Relationship Between Distance And Rx-Qual In This Cell.

3.3 Open Area:

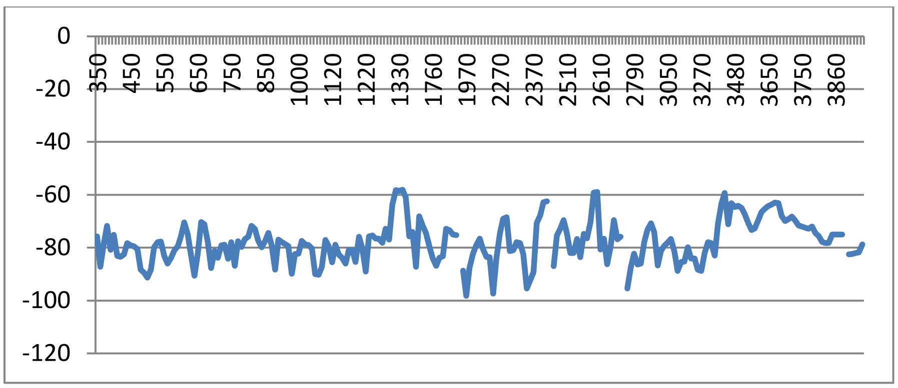

Fig. 5. The Relationship Between Distance And RX-LEV-Sub In This Cell.

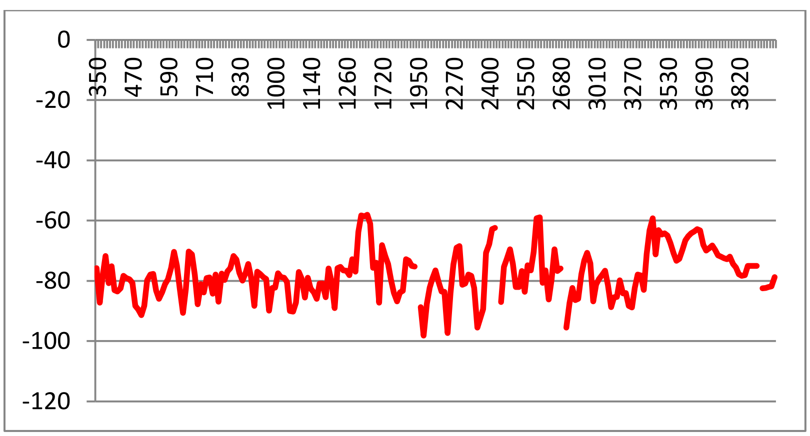

Fig. 6. The relationship between distance and Rx-Qual in this cell.

4 CONCLUSION

This paper describes a study to analyze the GPRS network of some cells of the cellular system GPRS network in Sanaa, the capital of the Republic of Yemen to assess the efficiency and quality of performance and optimization of the system network (GPRS) as a case study. Two methods are used to evaluate the performance of the network, namely: drive test and KPIs. Through the analysis of the three cells, we get the following:

- Urban area: According to Figure 1 & 2, most of the samples within a period of -75 to 0 dBm with an average -85 dB. Note that the number of samples with Rx-Lev less than -75 dB is almost negligible. and Rx-Qual is very good.

- Suburban Area: According to Figure 3 & 4, most of the samples within a period of -85 to 0 dBm with an average -85 dB. Note that the number of samples with Rx-Lev less than -85 dB is almost negligible. And a sharp rise in the value of about -

85 dB comes from the fact that this area is the most congested areas and signal quality is Excellent.

- Open Area: According to Figure 5 & 6, about 75% of the samples have excellent quality corresponding to signal quality value of 0. In addition, about 5% of the samples have poor quality corresponding to Rx-Qual values of 5 and 7. Therefore, we can say that Rx- Qual excellent.

We get that the quality and efficiency of cellular network performance Sana'a excellent because poor performance is negligible.

5 RECOMMENDATIONS

The increasing urban population and in the last period make us expect a weak signal and the same in the capital Sana'a to it. Therefore, It can be a process of improvement, in two stages:

1. Manual optimization process:
Start manual optimization capabilities in the process of analysis and plan ongoing relationship. It gives two results that are new frequencies plan for both BCCH frequencies and tack, and plan new neighbor relationship.

2. Automatic optimization process using the OSS optimization tools:
After obtaining the results of the manual process improvement is made to the OSS optimization tools. And we get this on the main output, a frequency plan for BCCH and TCH channels with less interference.
We also recommend the use of a program MapInfo Professional for analyzing and scanner tool used in drive test program beside with program TEMS 10.0.5.

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