An Investigation of Network Performance in GSM Cellular Networks (Case Study of Benin Metropolis)

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ABSTRACT

The purpose of this article is to evaluate and compare the performance of the GSM cellular network in the country of Nigeria. The primary focus of this study is to evaluate the service quality provided by mobile telephone carriers in Nigeria, with three core GSM network operators serving as case studies in this endeavour. For the purpose of this report, three distinct GSM network providers in Nigeria were evaluated using a variety of key performance indicators (KPIs). For example, Operators A, B, and C. Names have been concealed for reasons of appropriateness. Call Drop Rate, Call Success Rate, Traffic Channel Availability, and Traffic Channel Congestion are the key performance indicators that are being analysed. In order to investigate operators (A, B, and C), an analytical method was employed in conjunction with Microsoft Excel 2013 in order to develop a graphical representation.

Keywords: GSM, Call Drop Rate, Call Success Rate**,** Traffic Channel Availability, and Traffic Channel Congestion.

INTRODUCTION

Within the previous ten years, the global system for mobile communications, generally known as GSM, has demonstrated the impact of technology on Nigerians' everyday lives. The Global System for Mobile Communications (GSM) is without a doubt a powerful tool for bringing about a national revolution. In addition, it has completely altered the frequency and mechanism of information transmission. The most widely used mobile phone standard in the world, according to Wikipedia, is GSM (Global System for Mobile Communications). A total of over three million people in more than 212 countries and territories utilise the GSM mobile phone network. Because of its widespread use, international roaming between mobile phone operators around the world is fairly

common. Mobile phones connect to GSM networks by searching for cells in their immediate vicinity, which is why it is referred to as a "cellular network." It enables the simultaneous transmission of a message, music, video, picture, and text from one cell phone to another, anywhere in the globe, by using a Bluetooth connection.

METHODOLOGY

The following measures were done in the process of doing this research work:

1. A review of some relevant scholarly literature.

The second step is the collection of secondary data from the secondary source.

3. Compilation of source data from the various operators' management companies (OMCs).
4. The presentation of the data that has been gathered
5. A comparison of the data collected from the three distinct operators, using three separate key performance indicators (KPIs).

Using Microsoft Word Excel 2013, conduct an analysis of the data.

METHODOLOGY FOR RESEARCH

Materials and Procedures

In this study, three distinct GSM network operators in Nigeria were evaluated based on a number of key performance indicators (KPI) that were determined. There are three network operators on the University of Benin's campus in Benin City, identified as Operators A, B, and C. Each has an existing network arrangement. A total of four key performance indicator (KPI) factors were analysed. These metrics are the call drop rate, the call success rate, the availability of traffic channels, and the congestion of traffic channels. In order to collect data, different researchers have utilised a variety of ways. For example, driving tests and phone calls from a mobile station have both been used to gather information. I obtained my parameters from a central monitoring centre known as the Operation and Maintenance Center for this study project, which was the most popular and most accurate approach available at the time (OMC). This has been proven to be the most dependable source of data gathering because the network Operation Center (NOC) is directly connected to the base station and mobile switching centre (MSC), which are the most sensitive equipment in the

GSM system. The information gathered was divided into two groups, which were the primary source and the secondary source, respectively.

COLLECTION OF DATA

The information used in this study was gathered from two different sources: the primary source and the secondary source of information. The primary source is the Network Operation Management Center for three GSM services operators (Operator A, Operator B, and Operator C), whose names have been withheld for the sake of confidentiality, who provide services to the University of Benin Ugbowo campus and its environs, while the secondary source is the Nigeria Communication Commission's data base (NCC). It was decided to utilise the analytical method to examine the operators (A-B-C), and then to carry out an optimization modelling process using Excel Microsoft 2013 for the analysis in order to build the graphical diagram. The information was gathered over a period of fifteen weeks between the months of March and June of this year. The call setup success rate, the call drop rate, the TCH congestion rate, and the TCH availability rate are the parameters that will be compared in this section.

RESULT AND DISCUSSION

Data Presentation And Comparison

Table 1: Data for call drop rate.

CALL DROP RATE. (%)			
Weeks	**Operator A**	**Operator B**	**Operator C**
Week 1	0	1	3
Week 2	4	0	1
Week 3	0	0	0
Week 4	2	0	1
Week 5	2	0	0
Week 6	1	0	0
Week 7	0	0	0
Week 8	0	1	0
Week 9	1	0	1
Week 10	0	1	4
Week 11	0	4	7

Week 12	1	1	9
Week 13	0	1	10
Week 14	1	2	6
Week 15	0	3	8

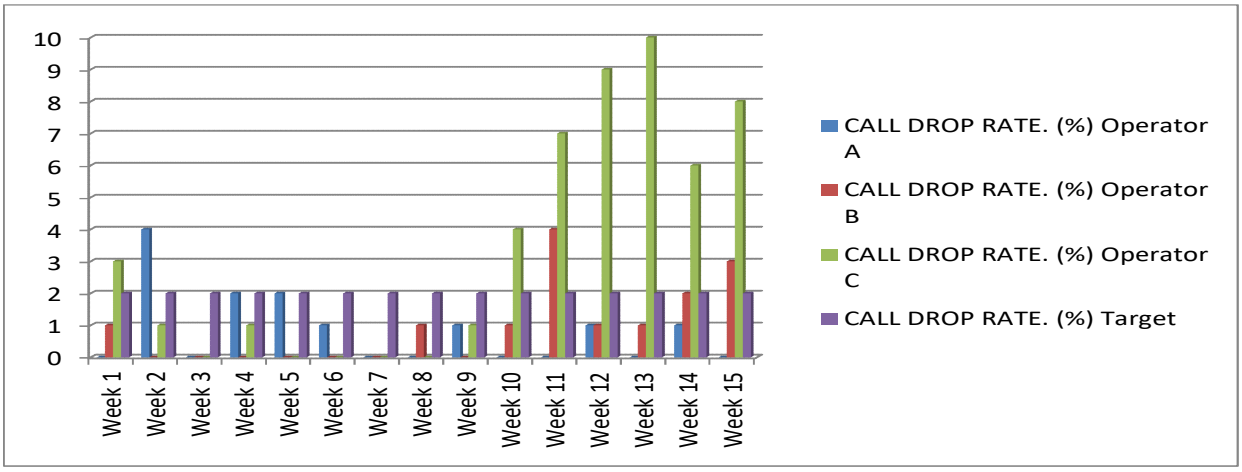

Figure 1: Plot for call drop rate.

NCC Regulation and Standard. ≤ 2%

Network Operator A satisfied the standard and slightly had a lower percentage call drop of 0.12% compare to the commission target, from week3 to week 15. Network Operator B result shows a relatively fair performance, except for week 11 and week 15were it was above the bench mark. While on the contrary, Network Operator C had a very high call drop rate of ≥0.5% from the period of week 10 to week 15. In overall result, Operator A shows a better performance.

Table 2: Data for Call success Rate.

CALL SUCCESS RATE. (%)			
WEEKS	**Operator A**	**Operator B**	**Operator C**
Week 1	99.39	99.31	98.98
Week 2	99.51	99.86	99.1
Week 3	99.94	99.4	98.92
Week 4	99.63	99.91	99.6
Week 5	99.41	99.61	100
Week 6	98.42	99.72	100
Week 7	99.42	99.77	98.11

Week 8	100	99.83	100
Week 9	100	99.88	95.46
Week 10	100	99.94	100
Week 11	100	99.42	100
Week 12	100	99.49	98.44
Week 13	100	98.63	98.29
Week 14	100	99.56	96.92
Week 15	99.76	98.97	98.18

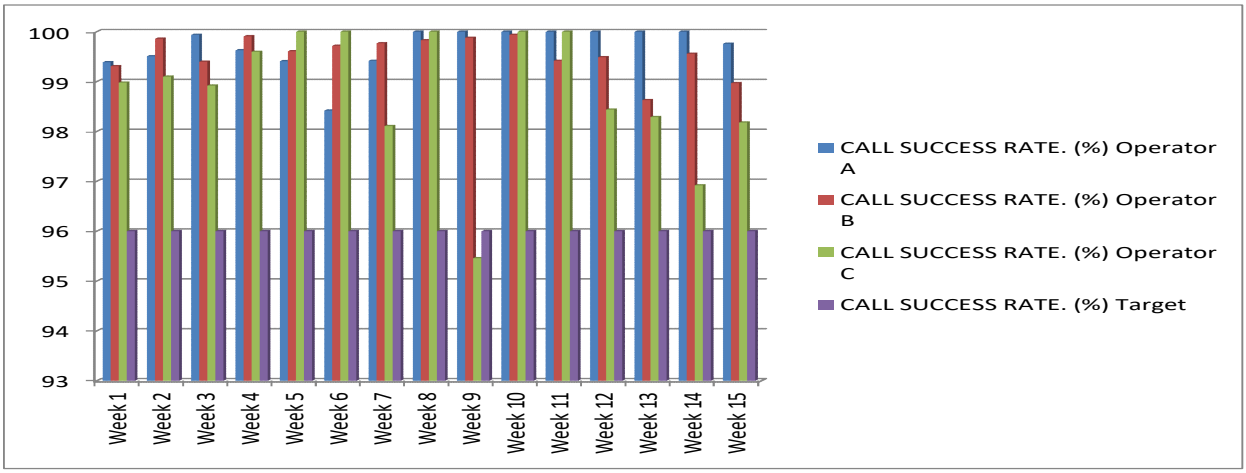

Figure 2: Plot for Call success Rate.

NCC Target ≥96%

The results for the entire network Operators shows an outstanding performance for call success rate. All the networks met the standard and slightly superseceded the NCC standard of ≥96%.

Table 3: Data for Traffic Channel Availability

TRAFFIC CHANNEL AVALIBILITY (%)			
WEEKS	**Operator A**	**Operator B**	**Operator C**
Week 1	80.99	75.52	68.54
Week 2	88.74	54.68	51.85
Week 3	99.45	83.09	70.84
Week 4	89.9	93.42	57.08
Week 5	98.84	83.12	72.15
Week 6	71.28	65.65	64.16

Week 7	90.17	79.54	66.25
Week 8	82.41	73.42	33.89
Week 9	74.45	77.58	46.74
Week 10	95.7	75.23	45.75
Week 11	76.6	88.67	51.85
Week 12	95.45	78.92	40.84
Week 13	76.24	85.15	37.08
Week 14	75.02	88.34	32.15
Week 15	91.4	67.29	34.16

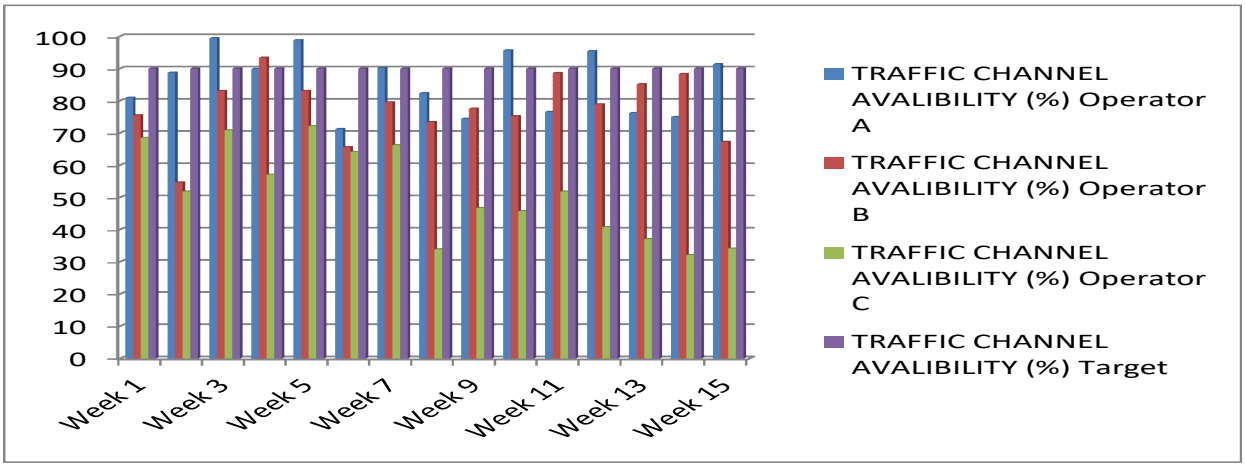

Figure 3: Plot for Traffic Channel Availability

NCC Target ≥ 90%

The result shows network Operator A met the targeted standard and even exceeded it with outstanding performance on week (3,5,10,12).

Network B was fair, while network C was very low from week (8-15).

In the overall, Network A still has the best performance.

Table 4: Data for Traffic Channel congestion

TRAFFIC CHANNEL CONGESTION. (%)			
WEEKS	**Operator A**	**Operator B**	**Operator C**
Week 1	18.72	2.24	5.54
Week 2	12.44	0.98	16.76
Week 3	11.05	0.46	27.2
Week 4	8.58	0.6	31.65
Week 5	6.26	0.39	30.84

Week 6	4.66	0.29	33.23
Week 7	2.12	0.08	32.09
Week 8	0.67	0.22	31.28
Week 9	0.33	1.72	28.2
Week 10	0.5	1.89	19.43
Week 11	0.51	4.02	11.04
Week12	1.13	3.47	9.58
Week 13	0.45	5.26	8.19
Week 14	0.32	4.42	8.5
Week 15	0.58	8.03	5.42

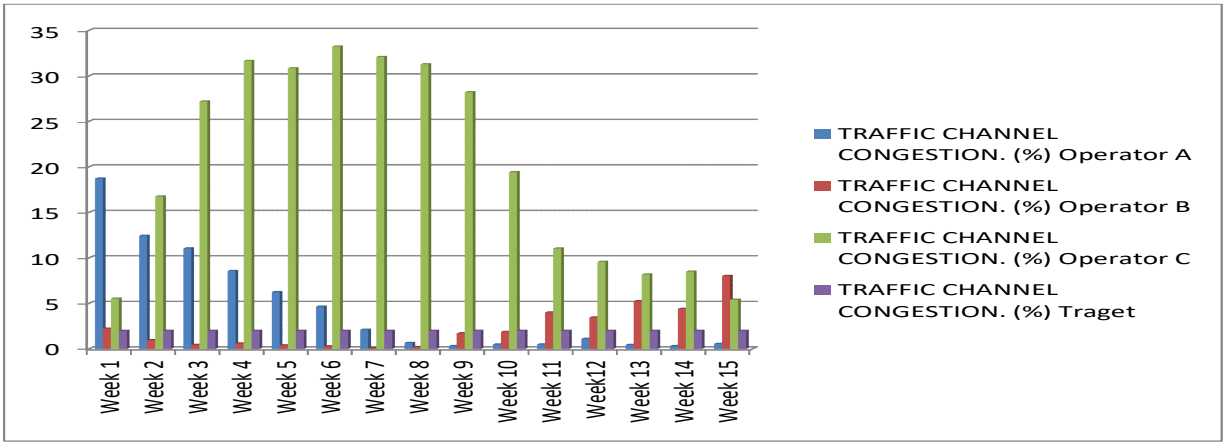

Figure 4: Plot for Traffic Channel congestion

NCC Target ≤ 2%

The result indicates that operator A met the benchmark of ≤ 2% from week of (7-15), network B maintained a fair traffic in the weeks of (1-10), except for week (11-15) were it went slightly up above the bench mark.

Network C was very high most especially in the weeks of (3-10).

The secondary data were obtained from the data base of the regulatory body, Nigeria communication commission (NCC) where the target row is used as the bench mark.

Table 5: NCC Summary of GSM Operators Key Performance Indicators (KPIs). September, 2014**.**

Operators	**CSSR %**	**DCR %**	**TCH_CONG %**

Operator A	96.99	0.84	0.79
Operator B	99.20	0.55	0.27
Operator C	96.85	1.21	0.55
Target	98	1	2

Table 6: NCC Summary of GSM Operators Key Performance Indicators (KPIs) October, 2014.

Operators	**CSSR %**	**DCR %**	**TCH_CONG %**
Operator A	96.46	0.76	1.02
Operator B	98.75	1.48	1.10
Operator C	97.74	1.27	0.92
Target	96.00	1.70	1.50

Table 7: NCC Summary of GSM Operators Key Performance Indicators (KPIs) November, 2014.

Operators	**CSSR %**	**DCR %**	**TCH_CONG %**
Operator A	97.39	0.86	0.54
Operator B	94.38	0.86	1.40
Operator C	97.07	1.33	1.33
Target	98	2	2

Table 8: NCC Summary of GSM Operators Key Performance Indicators (KPIs) December, 2014.

Operators	**CSSR %**	**DCR %**	**TCH_CONG %**
Operator A	97.48	0.92	0.55
Operator B	96.88	1.22	1.95
Operator C	96.42	1.41	0.89
Target	98	1	2

CONCLUSION AND RECOMMENDATIONS

Conclusion

GSM network optimization is a never-ending process, and RF crews should always strive to improve the overall quality of the network by identifying and implementing critical configuration changes that will improve network performance. Therefore, the consequences demonstrate that all network

operators must improve the quality of service they provide to their thronging consumer base.

The best performing network and the worst performing network have been identified. As a result, it can be concluded that network A has the best performance, whereas network C has the worst performance. When looking at the results, it can be seen that every network had some form or another of degradation when it comes to KPI decline. In order to fix the issues discovered on network C in this study, the researchers recommend that physical optimization methods such as switching RF antenna cables, azimuth correction, proper configuration, and the introduction of broadcast control channel (BCCH) frequencies be implemented.

When it comes to measuring quality of service, good network performance is the most significant metric to consider. Poor performance of a telecommunications network would result in consumer complaints, which would then result in customer dissatisfaction with the operator. It is clear from this presentation that the level of service provided by these businesses falls far short of what one would anticipate in this industry. Consequently, network operators must take immediate and realistic steps to improve the overall performance of their networks. Customers would be able to appreciate the highest level of service quality in terms of call establishment success rate, low call drop rate, low traffic congestion, and high traffic availability if this were accomplished.

Recommendations

Based on the findings of this research, the following recommendations were made;

1. There should be swapping of RF antenna cables most especially for network C
2. Network operators should ensure proper azimuth adjustment
3. Network operators should ensure proper network configuration
4. There should be introduction of broadcast channel to network C.
5. Proper frequency adjustment of all networks is highly advised and recommended.
6. NCC as a regulating body should ensure strict penalties are given to erring operators so as to deter others from providing poor service.

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