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Voice Traffic Pattern Modelling In Communication Network In Globacom, Akure Ondo State Nigeria.

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ABSTRACT:*In accessing the network performance and evaluating the quality of service of Global System for Mobile Communication operators from the end-user point of view, Key Performance Indicators such as call setup success rate, Handover success rate, Traffic Channel availability , Standalone dedicated control channel, Call success rate and Call drop rate are very germane. This research analyse voice traffic and the performance of Glomobile Network in Akure metropolis using some of the above mentioned key performance indicators. Data were collected using Glomobile network in three local government areas for a period of two and a half years. The analysis and correlation of the Key performance indicators for the Local Governments was carried out to determine the predominant indicators on network performance. Pearson Correlation technique was used with a significant level of 5%. Linear Regression models describing network performance in terms of the indicators were developed for the Local Governments. All the analysis and model were performed with the aid of MATLAB R2012b and SPSS tools. The result showed that the stand alone dedicated control channel has been fully optimized within the three local governments as any further improvement would have no effect on the success of a call. Other indicators needs improvement for a better performance of Glomobile Network in Akure. Call success Rate in Ifedore Local Governmentis 99.13% as against the 99.99% by Nigeria Communications Commission. Call Setup Success Rate in the other two Local governments have lowervalues of 97.56% and 96.21% which should also be improved with Handover Failure Rate and Traffic channel availability for all the Local Governments.*

KEYWORDS*-Modelling, Traffic, Key performance Indicator, Corellation*

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I. INTRODUCTION

The study on voice traffic blocking in a modeled cellular network was represented by the results obtained from a statistical analysis of a cellular network, having tested system samples with different cell configurations with 2 transceivers, 4 transceivers, and 14 transceiver units which served a de-limited region of several square kilometers (Oliver and Mohammad, 2007). The Erlang B, Erlang C and Poisson models were considered for the study. The experimental work showed that Erlang C model provided the closest match for the studied environment. The real-life traffic measurement was obtained from BSS performance management system majorly for voice traffic. With Erlang C, cells with more than 14 channels have a good behavior and activation of GSM enhanced feature, such as GSM half-rate speech codec which helps the network to reduce blocking probabilities. Its shortcoming is that as wireless technology advances with increased number of subscribers, Erlang B and Erlang C would be inaccurate for proper cell or trunk dimensioning for system capacity, this work relates only to fixed network. The causes and effects of congestion as it relates to QoS provided by operators were presented which was on the optimization model of minimizing congestion in GSM in Nigeria (Kuboye,2010). The paper listed factors that led to congestion and an overview of the congestion and where it occurs on the GSM network. Some optimization models for minimizing congestion problem on the GSM network in Nigeria were also presented in the paper. These models are government and corporate organizations in partnership with GSM operators, use of dynamic half rate decoder, national roaming agreement, regionalization and merging GSM networks. The shortcoming of the work is that as wireless technology increases with increased number of subscribers, appropriate and accurate models would be required for proper cell dimensioning to ease congestion. The high demand of GSM services (voice, data, and multimedia) and limited capacity were attributed to be the causes of congestion in a mobile network (Igbekele and Orakwe, 2010). In a congested cell, there will be no more available voice channel for use by additional mobile host in the cell. They looked into six (6) Northern States: Taraba, Adamawa, Gombe, Bauchi, Yobe and Bornu. The BSS captured three (3) BScs and real traffic data from OMC-R using RNP Opnet software was used as a statistical tool. The traffic intensity in these locations was taken over 24hrs for 48weeks. The mean hour of the traffic in Erlangs was recorded and plotted. They developed a multiservice traffic model using Enhanced Knapsack traffic model. Also, the average rate of blocked calls against the generated Erlangs was used to find the lost traffic to enable the formulated offered traffic for accurate cell dimensioning. The shortcoming of this work is that in an age where the use of voice and data services in real time is evident, accurate cell dimensioning is important due to increased number of subscribers. Voice traffic model is a mathematical expression or approximation or algorithms that represent real voice traffic characteristics (Zukerman, 2010).It shows the relationship between channel resource, traffic load in erlang and blocking probabilities. The relationship between traffic loads and services state, shows that as the offered traffic load increases, service rendered to subscribers decline in a constant channel capacity (Houda et al, 2002). Among the various types of traffic models which exist, only some are commonly employed in real life environment by operators based on arrival rate within the network. The models help operators to know about the blockings faced by users within their networks (Freeman, 2004; Smith et al, 1999).

This research work looked into all these shortcomings by analysing data collected for three local governments, thereby identifying the predominant KPI's for successful call set up and handover of call with a prediction to satisfy subscribers and also to evaluate system performance with a view for system expansion.

II. MATERIALS AND METHODS

This research work is in three stages as shown in the diagram in Figure 2.1. The stages include Data Collection, Data Analysis and Model Development.

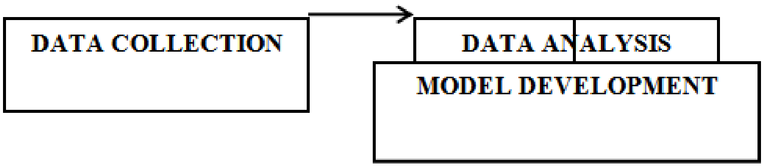

Fig.2.1: Block Diagram showing stages of Research Methodology

2.1 Brief Description Of Akure

Akuredouble up as a city and state capital of Ondo State, in the south western part of Nigeria. It is located on Latitude 7.25°N and Longitude 5.19°E; it is situated at an elevation of 353 meters above sea level. Akure has a population of 420,594 making it the largest city in Ondo State. Akure is a semi urban city in terms of development. This city is important in terms of economy and the commercial profile of the state. Akure connects to other certain cities in Nigeria such as Ibadan, Lagos, Benin and Port Harcourt. Figure 2.2 shows the location of Akure within Ondo State.

Fig 2.2: Map of Nigeria showing Akure, Ondo state

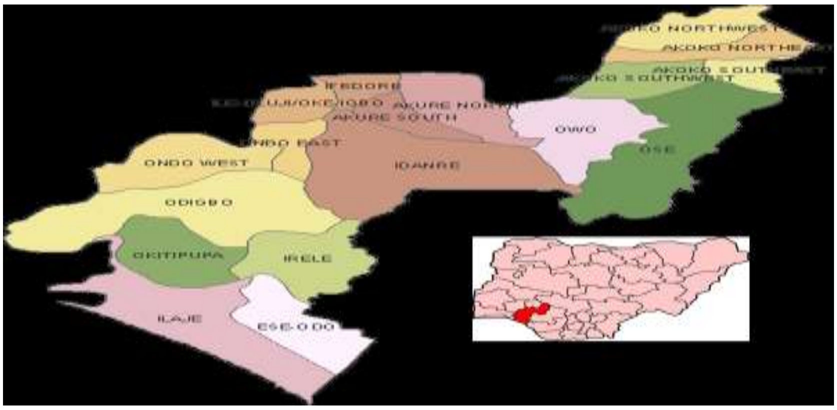

Fig. 2.3: Map of Ondo State showing Ifedore, Akure North and Akure South LGA

2.2 Data Collectionand Analysis

Data for top level Key Performance Indicators (KPI’s) which describes the successes/failure rates of the most important events such as total call request, total successful call request, total handover request, total successful handover request, total stand alone dedicated control channel (SDCCH) request, total successful stand-alone dedicated control channel (SDCCH) and Traffic Channel (TCH) at the Base Transceiver Station (BTS) level for Glomobile Network in Akure was obtained at the Network Management Center (NMC) Lagos, using Alcatel Lucent Network Server Statistics. The collected data spread over two and a half years between September 2012 and February 2015 for the base transceiver stations within Akure Network. Data for 38 base transceiver stations were obtained as well as their number of antenna sectors. For data analysis, the Glomobile Network in Akure was divided into three Local Government Areas (Ifedore, Akure North and Akure South) as shown in figure 2.3. Ifedore local Government has 10 Base Transceiver Stations, Akure North local Government has 8 Base Transceiver Stations and Akure South Local Government has 20 Base Transceiver Stations respectively. The predominant key performance indicator (KPI’s) was identified from the data obtained using Pearson correlation techniques according to equation (2.20).

$$r = \frac{\sum XY - \frac{\left(\sum X\right)\left(\sum Y\right)}{n}}{\sqrt{\left(\sum X^2 - \frac{\left(\sum X\right)^2}{n}\right)\left(\sum Y^2 - \frac{\left(\sum Y\right)^2}{n}\right)}} \qquad (2.1)$$

where r is the Pearson correlation coefficient, X and Y are the sets of data to be correlated.
For each Local Government, the KPI’s were correlated with each other and this shows which KPI was predominant in the success of a call.

Table 2.1: Akure South BTS sites with Antenna sectors

S/N	Site Code	Site Name	No of Antenna Sectors
1	AKR029	Ipinsa	S6
2	AKR022	OritaObele	S6
3	AKR014	Adejuyigbe	S3
4	ILS802	Local govt	S3
5	AKR009	Alewi	S6
6	AKR001	Iroko, Akure	S6
7	AKR002	Adesida 1	S6
8	AKR003	Conoil	S6
9	AKR005	Adesida 2	S6
10	AKR006	Ijoka	S6
11	AKR007	Ijapo	S6
12	AKR008	Bolajoko	S6
13	AKR016	Oluwatedo	S3
14	AKR017	Adebowale	S3
15	AKR019	Davoc Area	S6
16	AKR020	Afubiowo Estate	S6
17	AKR021	Awule	S4
18	AKR028	Oda Road	S6
19	AKR030	School of Health.	S6
20	AKR025	State Secretariat	S3

Network performance model(s) of Voice traffic was established for each local government areas using Linear Regression through the origin with a 5% significant level. Three Different Models were established in this research work, each for a local government. Call Success Rate (CSR) being the dependent variable, Call Set up Success Rate (CSSR), Handover Success Rate (HSR) and Traffic Channel (TCH) are the independent variables. They are expressed by the regression model in equation (2.2).

$$y = ax_1 + bx_2 + cx_3 + ... \quad (2.2)$$

where y is the dependent variable (overall network voice performance (CSR)), x_1, x_2, x_3……. are the independent variables (other KPI's) and a, b, c…..are the coefficients of the respective KPI's. Data Analysis and Model development were carried out using Matlab and SPSS tools.

III. RESULTS AND DISCUSSION

Traffic channel is the Channel allocated to a subscriber for the duration of call after the successful seizure of SDCCH channel. Figures 3.1 to34.3 show the Traffic Channel for Ifedore, Akure North and Akure South Local Government respectively.

Figure 3.1 shows the traffic channel for Ifedore LGA with AKR010 (FUTA), IIN001 (Igbaraoke) and IJA001 (Ijare) are seen to have high number of traffic channels being a road coverage site for travellers, the only base station in Igbaraoke and Ijare town respectively while the site with the lowest traffic channel is seen to be IMK001 (IlaraMokin) as a result of its sparsely populated density. Traffic Channel is configured or upgraded based on the increase in number of subscribers on the particular Base station in order to ease channel congestion and to improve call set up success rate.

Figure 3.2 shows Akure North local government traffic channel with AKR026 (Oba Ile road) seen to have the highest traffic channel as a result of its location along Oba ile /Alagbaka environs because of the number of subscribers, while AKR013 (Oba Ile) and USO001 (Uso town) is observed to have the lowest TCH due to its sparsely populated density. It can be inferred that traffic channel is allotted with respect to the number of subscribers.

Figure 3.3 shows the traffic channel of Akure South LGA where a larger part of the sites are clustered. AKR017 (Adebowale) is observed to have to have the lowest TCH of 0.43 being a road coverage base station site with less number of users while AKR005 (Adesida 2) has the highest traffic channel of 3.63 because it is located in the heart of the town where we have commercial activities takes place with larger percentage of subscribers.

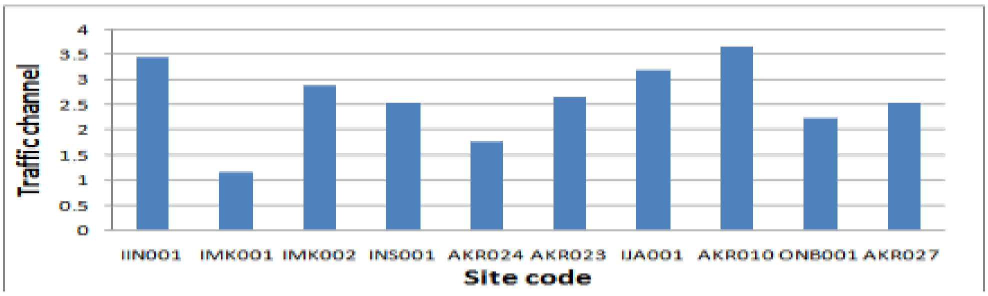

Figure 3.1: Traffic Channel: Ifedore LGA

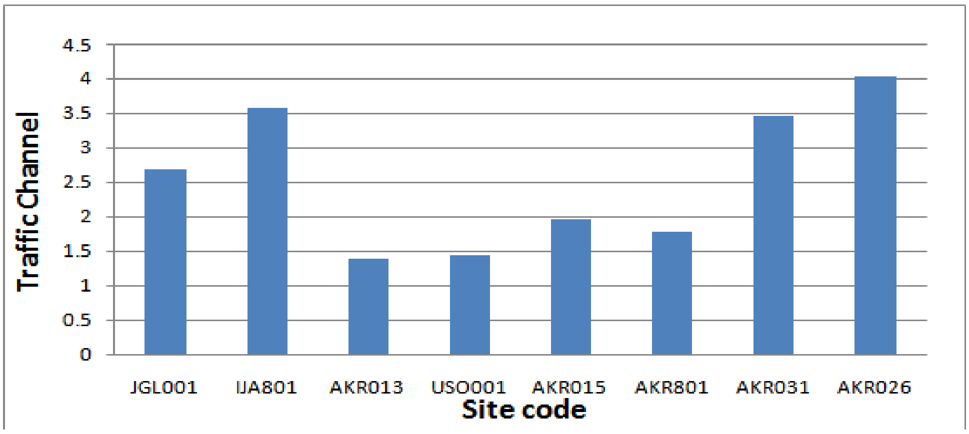

Figure 3.2: Traffic Channel: Akure North LGA

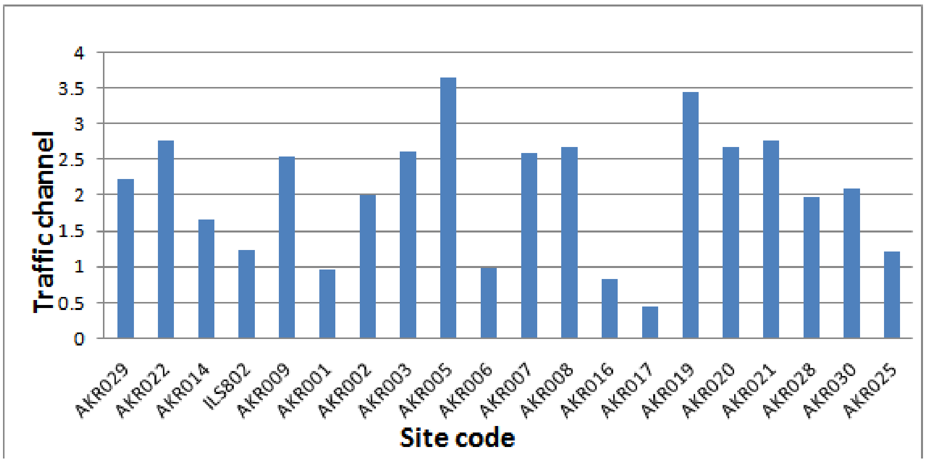

Figure 3.3: Traffic Channel: Akure South LGA

3.1 Call Drop

A dropped call is a call that is prematurely terminated during the conversation when either party is yet to terminate the call. Figures 3.4 to 3.6 show the Dropped calls in Ifedore, Akure North and Akure South local government respectively.From Figure 3.4, the site with the highest Call Drop is observed to be AKR023 (Ibule town) which is partly due to undefined handover parameters having a total call drop of 785 while IMK001 (IlaraMokin) has the lowest total call drop with total call drop of 174 which may be due to well defined handover parameters on the cells and with few subscribers. Call drop is a KPI that measures the Quality of the Network for the length of time the user engages a traffic channel when either party hasn't terminated the call. Figure 3.5 shows AKR026 (Oba Ile Road), IJA801 (Igoba) and JGL001 (Ilado) having the highest number of dropped calls which is likely due to the hilly topography, undefined handover parameters on the neighboring cells, insufficient channels to handle the handover calls. AKR013 (Oba Ile) is seen to have the lowest number of dropped calls. Figure 3.6 shows Akure South local government dropped calls with AKR021 (Awule) having the highest total number of dropped calls which is likely due to the sloppy topography and unavailable channel for handover with AKR022 (OritaObele) almost having the same call drop pattern, AKR017 (Adebowale) has the lowest dropped call with a total of 62 being a road site coverage with available TCH for handover. The lesser the dropped calls, the better the CSR.

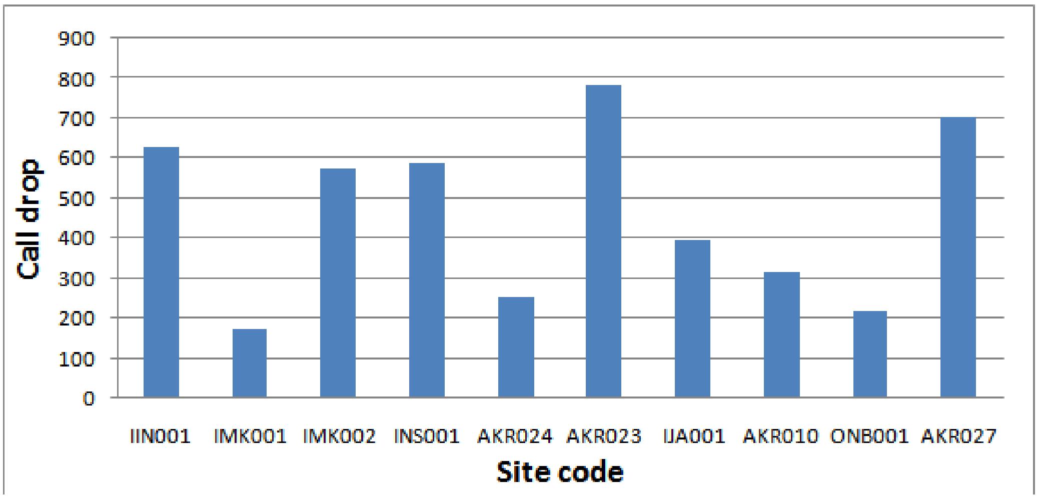

Figure 3.4: Call Drop: Ifedore LGA

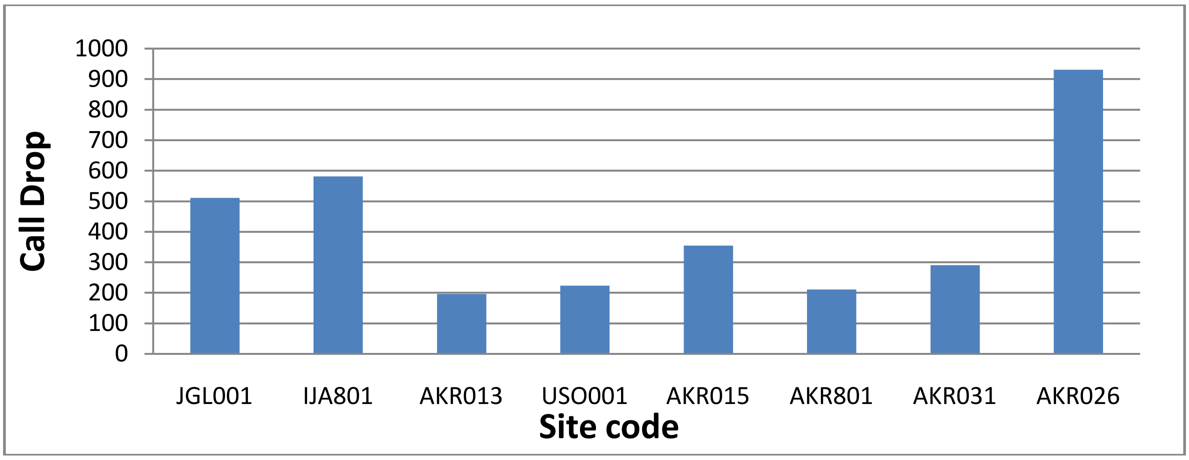

Figure 3.5: Call Drop: Akure North LGA

Figure 3.6: Call Drop: Akure South LGA

3.2 Antenna Sectors

The sites in Ifedore Local Government Area are all six-sectored antennas, while four of the base station sites in Akure North Local Government Area have six (6) antenna sectors, two has four (4) antenna sectors, and two has three (3) antenna sectors. In Akure South local Government Area, fourteen base stations have six (6) sector antennas; five has three (3) sectors while we have a site with only four (4) sector antennas. The higher the number of sectors, the better the signal reception and the better the voice call quality. In wireless technology, GSM (900 MHz) has a coverage distance of 35km or more depending on the terrain and antenna orientation while DCS (1800 MHz) which is being used for capacity covers a maximum distance of 5km (Gohsh, 2007).

3.1.7 Summary Of Findings

The summary of the findings of this study are highlighted below:

1. The site with the highest weekly call request is AKR005 (40A, Obanla St. Beside Wema Bank, Akure) because it is located in the heart of the city.
2. The highest handover request per week was recorded in AKR010, (FUTA, Ilesa- Akure Road) being a road coverage site.
3. The highest weekly SDCCH request was observed in AKR009, (Alewi Str., Off Oyemekun Road, Akure) due to large number of subscribers using data services.
4. The lowest Call request, Handover request and SDCCH request was observed at AKR001 (29, Gbangbalogun St. Akure) being a six sectored base station.
5. The site with the highest TCH and call drop value is in AKR026 (Inside Celestial Church, Gboliki; Oba Ile Road, Akure) due to the sloppy topography of the base station.
6. Call traffic of over ten percent was recorded in AKR005, (40A, Oba nla St. BesideWema Bank, Akure), AKR009, (AlewiStr, Off Oyemekun Road, Akure) and AKR023, (Ibule Town, Akure) due to the large number of subscribers.
7. All the sites that experienced congestion of over 10 percent in the call and handover success rate have six sectors each, while the sites with the minimal congestion rate have three sectors each.

8. The only six sector site with less congestion rate is AKR001, and this is because it was observed to have the lowest call, handover and SDCCH request.
9. The sites with the highest TCH and call drop value have six sectors each; while the site with the lowest TCH and call drop values have three sectors each.

From the above, it can be inferred that there is more call traffic on site with six (6) sectors than those with three (3) sectors.

3.2 Model Development

Model(s) were developed for the three Local Governments owing to various activities taking place on the network. For the Linear Regression Model Development, Call Success Rate (CSR) is the Dependent Variable while Call Set up Success Rate (CSSR), Handover Success Rate (HSR) and Traffic Channel (TCH) are the Independent Variables. The SDCCH-SR of each LGA's is observed to be almost 100% for most of the sites in each LGA. Owing to this, further improvement of SDCCH-SR in Glomobile Network, Akure would have no effect on its overall network performance and therefore was not included among the independent variables.

3.2.1Model Equation For Ifedore Local Government:

CSR= 0.9913*CSSR + 0.0070*HSR + 0.0066 *TCH (3.1)

The developed regression equation (3.1) shows the relationship between the dependent variable (CSR) and independent variables (CSSR, HSR and TCH). A 99.13% unit increase in CSSR, with 0.7% unit increase in HSR and 0.66% unit increase per channel in TCH would bring a corresponding increase of 1 unit in CSR.

Table 3.1 : Correlations of the KPI's for Ifedore LGA

		CSR	CSSR	Handover	TCH
CSR	Pearson Correlation	1.000	.997**	.888**	-.361
	Sig. (1-tailed)		.000	.000	.153
	N	10	10	10	10
CSSR	Pearson Correlation	.997**	1.000	.890**	-.372
	Sig. (1-tailed)	.000		.000	.145
	N	10	10	10	10
Handover	Pearson Correlation	.888**	.890**	1.000	-.193
	Sig. (1-tailed)	.000	.000		.297
	N	10	10	10	10
TCH	Pearson Correlation	-.361	-.372	-.193	1.000
	Sig. (1-tailed)	.153	.145	.297	
	N	10	10	10	10

**. Correlation is significant at the 0.05 level

3.2.2 Model Equation For Ifedore Local Government:

CSR= 0.9913*CSSR + 0.0070*HSR + 0.0066 *TCH (3.1)

The developed regression equation (3.1) shows the relationship between the dependent variable (CSR) and independent variables (CSSR, HSR and TCH). A 99.13% unit increase in CSSR, with 0.7% unit increase in HSR and 0.66% unit increase per channel in TCH would bring a corresponding increase of 1 unit in CSR.

3.2.3 Model Equation For Akure North Local Government:

CSR= 0.9756*CSSR + 0.2350*HSR - 0.0350 *TCH (3.2)

The developed regression equation (3.2) shows the relationship between the dependent variable (CSR) and independent variables (CSSR, HSR and TCH). A 97.56% unit increase in CSSR, with 23.50% unit increase in HSR and 3.50% unit decrease per channel in TCH would bring a corresponding increase of 1 unit in CSR.

IV. CONCLUSION

This research work on Modeling of Voice traffic analysis in Glomobile Network, Akure has been able to determine predominant KPI's and develop suitable models for three Local Government Areas. SDCCH was the only KPI that met Nigerian Communications Commission (NCC) requirements. Other KPIs need to be improved for a better performance of Glomobile Network in Akure.

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