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A Systematic Review on the Quality of Service of the Nigerian Communication System.

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ABSTRACT
There have been controversies from different standpoints about the quality of service delivered to consumers by mobile network operators inNigeria. This has led to divers' approach of investigating these services. This study found out that with the consumer's perspective of the quality of service is not reflected in the data collected by the telecommunication governing body in Nigeria, Nigerian Communication Commission (NCC). But several individuals have done privately sponsored and government sponsored research to reveal the true state of the services delivered by Mobile Network Operators (MNOs). The governing body NCC has revealed from data collected and posted their website that there have been improvement in the quality of telecommunication service delivered to it's consumers but individual research has proven that that is not the case. Furthermore, the tools by which these evaluations are carried was found to be the reason for the difference in results. The NCC approach of evaluation was not fully objective, such that it allowed interference of human while individual researches have used several improved technology like using machines for data collection, and using Artificial Intelligence (AI) based approach for data analytics.

Keywords: NCC, MNOs, QoS (quality of service), Artificial Intelligence.

I. INTRODUCTION

Global system for mobile communication (GSM) is the most widely used mobile standard globally because it improves voice quality by using digital modulation. Both customers and network operators benefit from the universality of the GSM standard. In August 2001, Nigeria's GSM communication revolution began, ushering in a significant shift in the face of information and communication technology (ICT) (Fatimah andLasisi Hammed, 2018). GSM services include calls and data services starting from the first generation (1G) wireless communication network, which was analog and only supported voice communications. The second-generation (2G) digital technology allows users to send and receive text messages. Third-generation (3G) mobile technology allows for faster data transmission, more capacity, and multimedia capability. The fourth-generation (4G) combines 3G with fixed internet to provide wireless mobile internet, advancing mobile technology that overcomes 3G's restrictions (Barretoet al., 2016; Batista andBarreto, 2018).

GSM service is brought to us by Mobile Network Operators. In Nigeria, there are examples such as MTN, Glo, Airtel, etc., under the Nigerian Communication Commission (NCC). This NCC is a regulatory body that ensures that the aforementioned mobile network operators are working under the GSM spectrum standards and regulating the quality of service delivered to the consumers by providing means for Key Performance Indicators and ensuring that these standards are met. These key performance indicators include call setup success rate (CSSR), call drop rate (CDR), hand-over success rate (HOSR), traffic channel congestion rate (TCH cong.), standalone dedicated channel congestion (SDCH cong.) for voice. At the same time, for data services, the KPIs are download and upload speed, jitter, DNS look-up, packet loss, latency.(A and B, 2019; Haryadi, 2018; Imoize et al., 2020; Ponnle andTijani, 2019)

Over time, assessment of the quality of service of mobile network operations has been carried out by private individuals, sometimes they are also done by the equipment manufacturers, and

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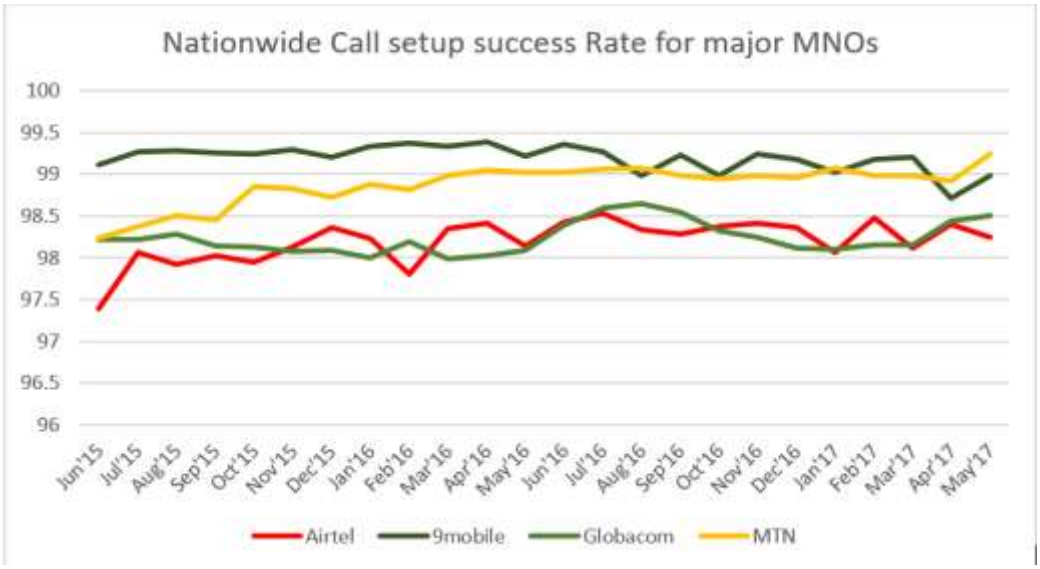
individuals carry out this assessment for research purposes. The evaluation carried out by theequipment manufacturers only considers the coverage of each base station. Also, previous research by both NCC and private individuals (for research purposes) has proved ineffective due to factors that include the fast development in infrastructure and some other sociodemographic factors that have led to an increase in the population in different areas through immigration. An increment in the number of people who use these services in particular areas is skyrocketing, making the existing infrastructure unable to accommodate these new users and causing traffic regularly. Increment in bandwidth-intensive applications also tends to reduce the number of people that can use a particular service at a specific time. Due to these varying and uncontrollable factors, a predictive method of analysis would be best in providing good quality of service recommendation, which will reduce the unexpected failures and, in turn, prevent early maintenance. This paper therefore looks into the different approaches used in monitoring and evaluating the quality of service of mobile network.

II. THEORETICAL ANALYSIS

i. Mobile Networks Operators Performance based on NCC Data

The NCC website features graphs showing the nationwide Call set-up success rate and dropped call rate for the four largest MNOs in Nigeria (MTN, Airtel, 9mobile, and Glo) for the previous seven years (2015–2021). In Nigeria, telecommunications are governed by the National Communication Commission (NCC). They provide mechanisms for Key Performance Indicators and oversee the quality of service offered to customers, making sure that the MNOs adhere to the GSM spectrum regulations (Fatimah andLasisi Hammed, 2018). Customer voice quality enhancement discussions will be informed by data downloaded from the NCC website (NCC, 2022) and visualized in Microsoft Excel. To begin, the NOCs of the largest MNOs in the country were the source of the information we gathered. The information was gathered from the BSC at peak times and then examined with monthly weighted averages to see how well each operator performed (NCC, 2022; S. Popoola et al., 2017). The performance of the mobile network was measured over time by looking at the call setup success rate (CSSR) and the dropped call rate (DCR).



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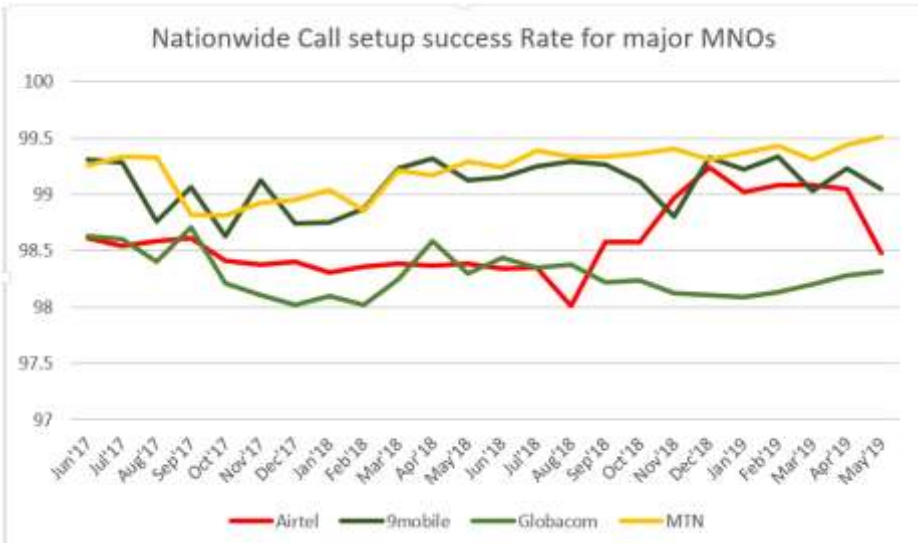

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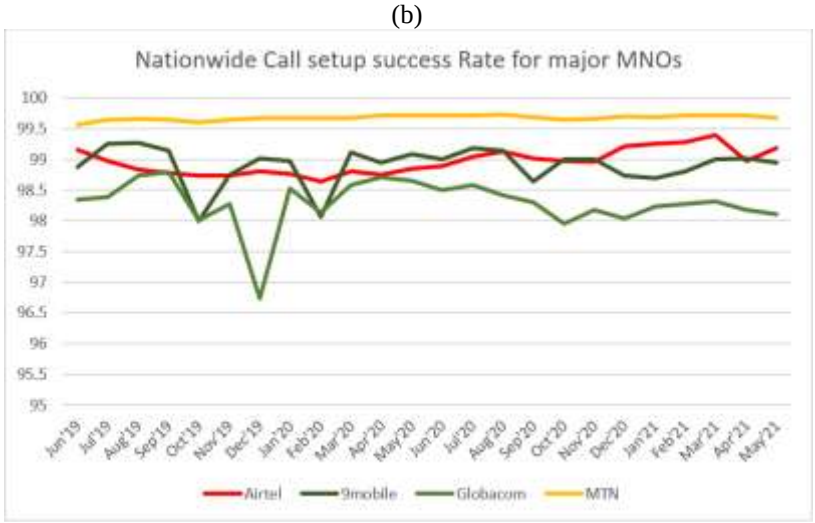

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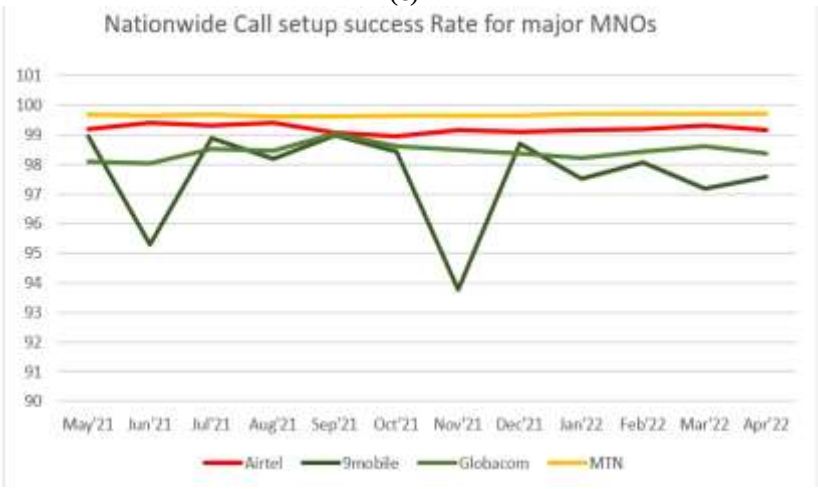

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Figure 1: Nationwide CSSR

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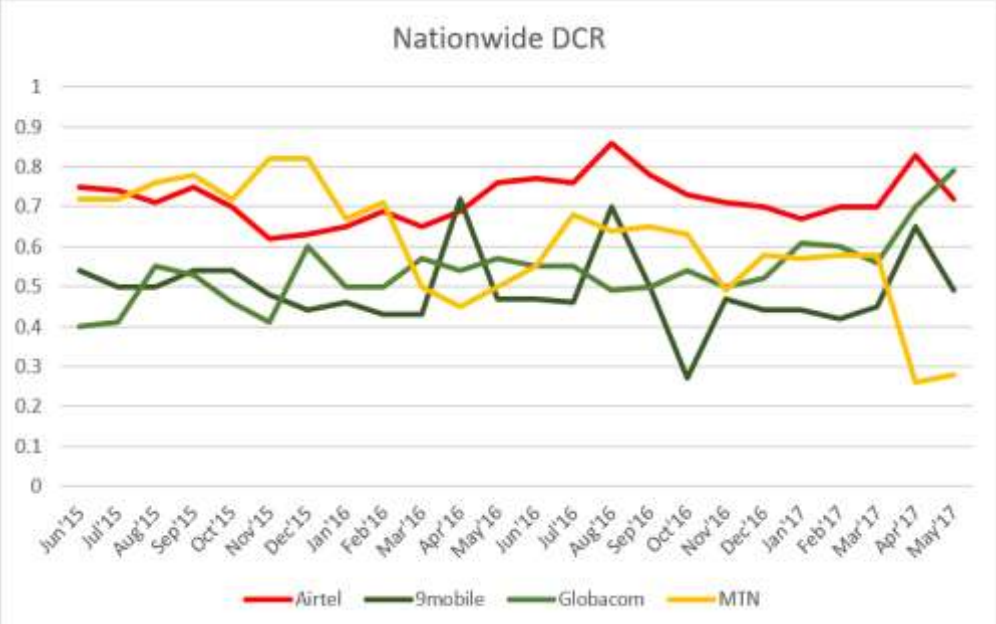
Figures 1 and 2 show that the data gathered by MTN and Airtel are remarkably consistent and seldom deviate from the expected range. Yet, closer inspection of the data reveals variations. Yet, there has been an improvement over time, whereas Globacom has seen little to no change and 9mobile's network has worsened and is continuing to degrade; if this trend continues, 9mobile will fall below the regulatory board's 98% criterion. An examination of the numbers reveals that Airtel's call setup success rate was below the threshold in 2015, at 97.6%, but has progressively climbed since then, reaching 99.25% by 2021. Comparable trends were seen for MTN, with the exception that MTN began below the cut-off value of 98% and continued to improve until it reached 99.6% in 2021. Initially, 9mobile had the highest CSSR of any mobile network, but its value has been steadily declining ever since. Yet, Globacom began with a 98% average in 2015 and kept it throughout the seven years.

Table 1: Average yearly CSSR

	2015	2016	2017	2018	2019	2020	2021
Airtel	97.61167	98.30583	98.40417	98.49083	98.89333	98.92083	99.25167
9Mobile	99.19417	99.2425	99.00333	99.12583	99.01417	98.9075	98.295
Globacom	98.2625	98.26417	98.33667	98.26	98.19333	98.38083	98.18667
MTN	98.4725	98.9825	99.0525	99.24667	99.54167	99.69417	99.69333



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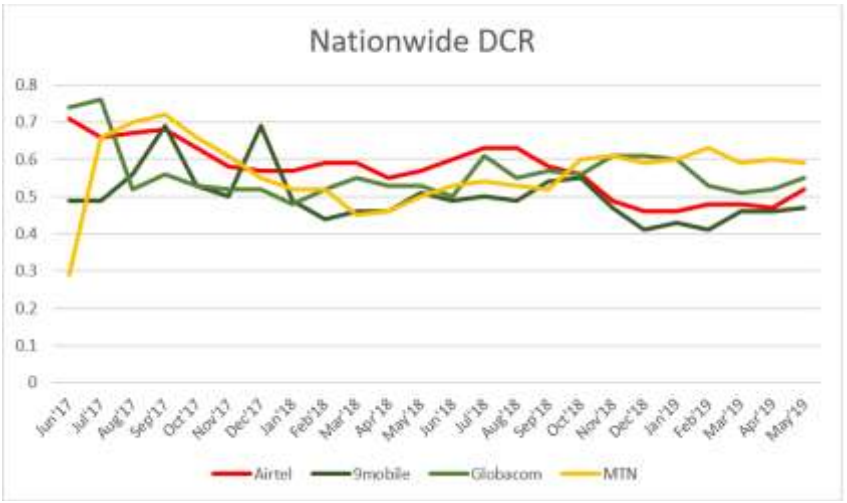

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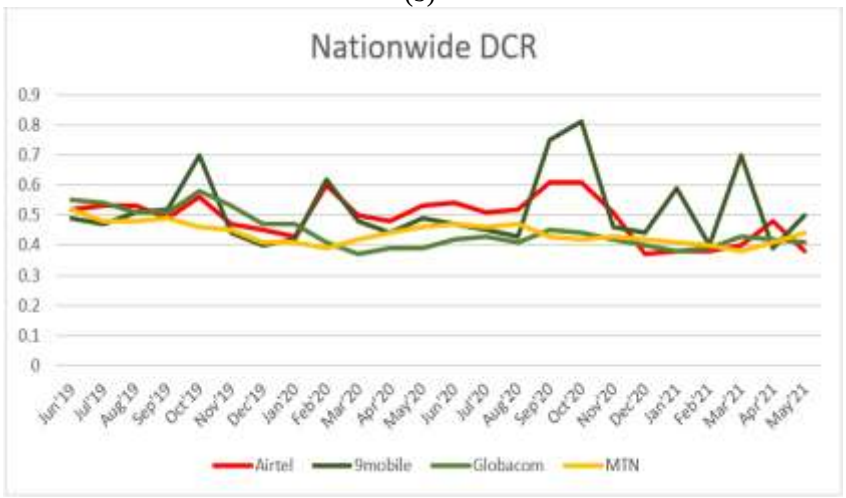

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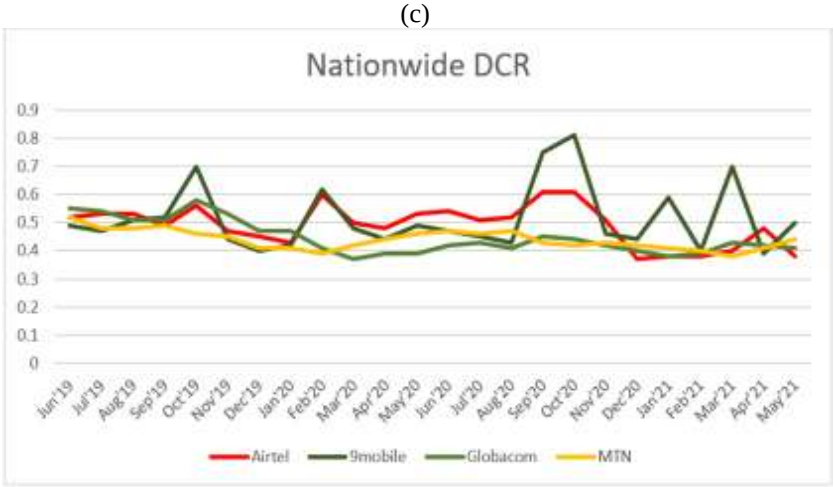

(d)

Figure 2: Nationwide DCR

Figure 2 shows that, much like in figure 1, by 2021, 9mobile's dropped call rate will have doubled from its original value of about 0.5. The quality of 9mobile's network is deteriorating, as seen in Figures 1 and 2. In addition, the DCR for the Globacom network was initially quite low but

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increases by 2021. The DCR for MTN and AIRTEL's mobile communication networks have improved significantly recently.

Table 2: Average yearly DCR

	2015	2016	2017	2018	2019	2020	2021
Airtel	0.730000	0.729167	0.676667	0.568333	0.496667	0.517500	0.411667
9Mobile	0.513333	0.485000	0.533333	0.484167	0.480000	0.521667	0.568333
Globacom	0.516667	0.527500	0.617500	0.551667	0.533333	0.416667	0.411667
MTN	0.795000	0.587500	0.538333	0.530833	0.525000	0.435000	0.408333

In conclusion, whereas MTN, GLOBACOM, and AIRTEL have all seen improvements in their voice performance over the previous seven years, 9MOBILE's network has continuously worsened over that time. These KPIs are presented as percentages or ranges to better illustrate their significance. One definition of dispersion is the variation in values or characteristics between different types of items (Rayat, 2018). With 195,128,265 subscribers to voice service from one of the four mobile network providers in December 2021, the average call establishment success rate was 98%. (NCC, 2021). Over 4 million people are affected by the inability to initiate a call. If we want to reduce the number of individuals who are negatively impacted by network operator failures, we need to either account for the number of subscribers when selecting threshold levels, or we need to restrict the values themselves.

ii. Independent Evaluations of Mobile Network Performance

The performance of the network providers is presented in section 2 from the perspective of the regulatory authority of the nation. Nonetheless, different findings have been drawn concerning the quality of service provided by these mobile network carriers in the study that has been conducted. Despite frequent reviews and improvements in service quality, MNOs have consistently failed to meet the requirements set by regulatory agencies, according to previous research (Oseniet al., 2014). Abeokuta, Nigeria, was analyzed by (Oseniet al., 2014) utilizing a driving test methodology and the MapInfo software for statistical analysis. Poor network coverage and deteriorating quality of service were noted in different parts of the cities. Because of obstacles in the propagation environment caused by the terrain of the land. It was suggested that more base stations be placed in the afflicted districts of Abeokuta city since a synchronization error with the Base Station Controller (BSC) was the root cause of Handover (HO) failures.

Similar findings were reported by (Obiyemiet al., 2015) after they conducted a driving test on a rail journey between Lagos and Osogbo. The data indicated that the train was not continuously covered by a single mobile network service provider for the whole 6-hour trip. It was also suggested that as demand grows, the government step in to help boost the capacity of mobile network providers. Penalties for falling short of the target level of service offered to customers were discussed in detail by (Ogunlewe andShoewu, 2016). MTN, Etisalat, Airtel, and Globacom were fined a total of 1.7 billion Naira by the Nigerian Communication Commission (NCC). The KPIs were put through a speed test and found to be lacking in comparison to the criteria in 2012. The 2016 researchers did the same thing and discovered that the four major network providers had gotten better over the previous four years (2012). The various mobile networks were evaluated using the KPIs in this benchmarking methodology. While Etisalat had the highest signal-to-noise ratio, the best CSSR was found to be provided by Globacom. By taking the HOSR into account, Airtel came out on top.

(Ponnle andTijani, 2019) looked at the key performance indicators for the Globacom network in Ifedore, Akure-north, and Akure-south LGA in the Ondo state capital of Akure. Key performance indicators (KPIs) including CSSR, HOSR, TCH, SDCCH-SR, CDR, and CSR were used to probe customer satisfaction with service. SDCCH was found to be almost maximized throughout all three jurisdictions, despite average values falling short of the NCC's 98% criterion. Even if its success rate doubles, the network will only perform somewhat better. There was a mixed picture painted by the other KPIs across the three LGAs. CSR, CSSR, and HOSR all showed strong coherence across all LGAs. The Key Performance Indicators were also identified as needing to be enhanced in order to boost the functionality of the Globacom mobile

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network in Akure. CSSR was determined to be 97.26%, 97.16%, and 97.27% in the local government areas of Ifedore, Akure North, and Akure South, respectively; hence, improvements are required. According to NCC, CSSR should not be less than 98 percent, and CSR should not be less than 97 percent. The average CSR numbers in the Ifedore, Akure North, and Akure South LGAs were 97.08, 96.97, and 96.99 percent, respectively; these percentages are all lower than the 1% allowed by the NCC. There needs to be more traffic lanes made available in these jurisdictions. In 2019, Ponnle and Tijani published a paper arguing that.

Similar study to that provided by (Fatimah andLasisi Hammed, 2018) for the same service provider but in a different city was provided by (Ponnle andTijani, 2019). The city of Osogbo was the subject of their research (Fatimah &Lasisi Hammed, 2018). Both (Ponnle andTijani, 2019) and (Olayinkaet al., 2019) conducted their research in the Akure south and Akure north local government area of Ondo state in 2019, and both found that Globacom was the only mobile network provider that did not fulfilled the benchmark established by the regulating body (NCC).

Table 3 compares the values obtained for Globacom mobile network operator between the two years.

Table 3: Comparison between Globacomperformances.

	(PonnleandTijani, 2019), **(performed in 2018)**	(Olayinkaet al., 2019) **(performed in 2019)**
Akure South Local Government		
Call Setup Success Rate	97.27%	91.71%
Call Drop Rate	0.28%	2.25%
Handover Success Rate	97.20%	88.27%
Akure North Local Government		
Call Setup Success Rate	97.15%	78.11%
Call Drop Rate	0.18%	15.83%
Handover Success Rate	97.00%	100%

There has been a noticeable decline in Globacom network quality, most likely due to the country's rapidly expanding population (Eke et al., 2017; Olayinkaet al., 2019). Akure north local government has the highest rates of visible degradation, with call drops rising from 0.18% to 15.83% and hand-over rates improving from 97.0% to 100%; these numbers suggest that poor weather conditions and signal obstruction from obstacles like tall mountains and buildings are to blame for the region's dismal performance.

According to research (Chukwudebeet al., 2020), We used a driving test methodology to examine the performance and Quality of Service offered by the various network providers active in Owerri City. This study's findings suggested that all mobile network providers improve service delivery in certain city neighborhoods by implementing service upgrades. The low radio coverage and deterioration in service quality seen in the affected areas of the city were associated with resource use, code management, and other physical factors such as topology and physical barriers in the propagation environment. Moreover, poor coverage in the region contributed to subpar data collection, as no information is gathered in areas with poor to no radio reception. Figure 3 displays the results of his study.

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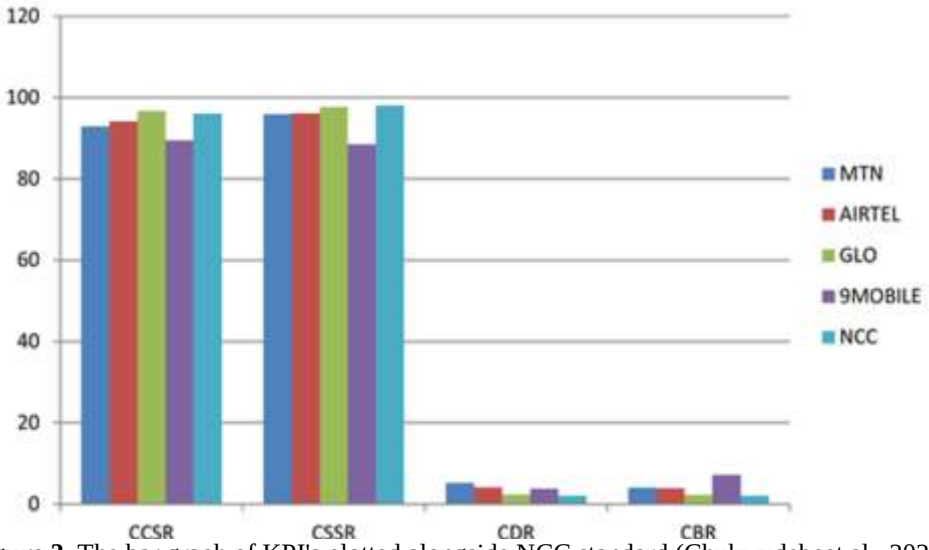

Figure 3. The bar graph of KPI's plotted alongside NCC standard (Chukwudebeet al., 2020).

Figure 3 shows key performance indicators compared to the NCC benchmark. Only Globacom Limited's call completion and setup success retes were within 2% of the benchmark. Neither Globacom nor any other mobile network operator met the NCC criteria of 2% for call dropped or call blocked rates, albeit Globacom was significantly closer than the others. By comparison, MTN's call drop rate is 4.9%, GLO's is 2.2%, and 9mobile's is 7.9%.

The radio access network in the Shiroro region of Niger State was analyzed using a drive test technique (Raphealet al., 2020). The author elaborated that Shiroro was selected because of the significant need for mobile services across a variety of sectors, including the public, private, and nonprofit sectors. Shiroro has a relatively low population—about 404,200 people as of 2021—which should mean less mobile network congestion and, perhaps, higher quality service compared to denser urban centers like Lagos and Ibadan. Nevertheless, however, the opposite is true, since only a small subset of network operators achieved NCC status across all categories.

Notwithstanding this, the major network operators in Nigeria (Raphealet al., 2020) were disguised under the aliases network A, network B, network C, and network D. A 94% call setup success rate, 89% call completion rate, 6% call block rate, and 6% call drop rate are all below the NCC criterion, yet the best mobile network operator throughout the five months of the study was network c. NCC established a threshold of 39Megabit/sec for data rate, however network C surpassed that with speeds of approximately 7Megabit/sec, therefore this metric wasn't the only one looked at to gauge network performance.

Network D likewise had a similar experience to that of network C, where the signal strength did not permit sufficient data gathering, as stated by (Raphealet al., 2020) and (Chukwudebeet al., 2020).

Recently, in 2021, researchers (Ajayiet al., 2021) conducted a driving test to analyze the quality of service provided by mobile network providers near the University of Ilorin. All of the university's roads were used for the driving test. The author also avoided mentioning MTN, Airtel, 9mobile, and Glo, the four largest mobile network companies in Nigeria.

A particular operator, aliased operator A, had the best-received signal level, with 80.5% of the collected data falling above the NCC threshold of -85dbm, and operator D had a 100% call set up rate, as discussed by the author, who also discussed the other key performance indicators for the operators. Operator A's call set success rate was 91.67 percent, Operator B's was 86.67 percent, and Operator C's was 93.33 percent, all below the NCC standard of 98 percent. When the author compared the call setup times of the four mobile network providers, he found that operators A and B both had 100% of their data fall inside the 6-second threshold, but operators C and D both fell short by a full second. The call drop rates for both service providers were much over the allowed 2%. The call drop rate was 22.27% for operator A, 15.38% for operator B, 14.29% for operator C, and 16.67% for operator D,lastly, the handover success rates for

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each operator are 90% for operator D and 100% for operators A and B.

Network A and Network B were the subjects of a comparable research conducted a year before to the one described above (Surajudeen-bakindeet al., 2020). None of the networks tested achieved the 2% CDR or 98% CSSR thresholds mandated by the NCC guidelines. This is a clear indication that the GSM networks in the nation have a terrible service retention rate and that network congestion is still a problem. One of the most obvious reasons for this is that GSM operators, in general, have a rising customer base but not enough infrastructure to support it. Based on the data, it was also determined that the network coverage provided by these systems is sometimes inadequate.

In response to claims made in reviews by (Ojo et al., 2019), the authors of this study looked into the service quality offered by only Globacom in Ibadan's metropolitan area. (Olayinkaet al., 2019) studied the services provided by MTN, Glo, Airtel, and 9mobile in Akure south Local Government and assessed the extent to which these companies complied with regulations set forth by the Nigerian Communications Commission. The effect of service quality on customers' satisfaction with MNOs was also investigated. Primary data was gathered in the form of a drive test and a questionnaire. Both the drive test technique and a survey questionnaire were used to collect data on the MNOs' Quality of Service and Customer Satisfaction, respectively.

By a large margin, 9mobile had the strongest received signal level in this survey, with 97.09% of its signal strength readings above the -90dbm standard established by NCC; MTN came in second, with 96.96%, and Glo, with 86.34%. Airtel, with 83.96 percent of its measurements exceeding the minimum criteria, placed fourth.

Table 4: The KPI's and NCC threshold (Olayinkaet al., 2019)

KPI ranking	NCC standard	Airtel	MTN	Glo	9mobile
CSSR	≥ 98%	76.26	93.99	91.71	86.0
Drop Call Rate (%)	<2	02.04	01.21	02.25	04.35
Handover Success Rate (%)	≥ 90	99.49	98.92	88.27	89.04

The study's findings are summarized in Table 4 below (Olayinkaet al., 2019). None of the network providers in the table had a call setup success rate that matched the NCC's minimum requirement, but MTN remained in first place, followed by Glo, 9mobile, and Airtel in worst place. In contrast, MTN outperformed the competition and above the NCC criterion for call drop rate, while 9mobile and Glo, which did not achieve the threshold but had figures very near to it, scored extremely well for handover success rate.

According to a discussion of questionnaire data (Olayinkaet al., 2019), it was found that QoS has a very small impact on customers' overall satisfaction. So, customer happiness goes beyond the quality of the service itself and includes aspects of the business that were not measured in this research.

III. RESULTS AND DISCUSSION

In the preceding part, we focused on a few distinct areas in Nigeria's south, north, and west. The vast majority of the works examined demonstrate that mobile network providers in various regions of Nigeria fall well short of the minimum standards established by the Nigerian Communication Commission. Nonetheless, the NCC statistics posted on their website led us to assume that most network providers are enhancing the quality of service they provide over time, despite popular belief to the contrary.

Certain daily publications' front pages throughout the course of several years, such as (AyodeleOluwagbemi, 2017; Samson Akintaro, 2022), agree with what individuals have written by writing about the usually decreased quality of service encountered by consumers. The data obtained suggests that users are enjoying a decent quality of service when the contrary is the case, and Federal University of Technology Akure (FUTA) has encouraged the Nigerian Communication Commission to press for accuracy in the data collected on this topic (The Nation, 2018)

The mechanism utilized by the regulatory authority to obtain the data might be the primary reason of this disparity. Data from the NOCs of the nation's largest mobile network operators forms the basis for the Quality of Service (QoS) Key

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Performance Indicators (KPIs) utilized by NCC (MNO). Base Station Controller (BSC) data is gathered during peak times, and then monthly weighted averages are used to compare the performance of different service providers (NCC, 2021). This is a serious flaw because the regulated networks gather this information. It would be preferable if a separate regulatory entity gathered these statistics without any outside influence, as doing so now might introduce bias.

In addition, several methods for gathering data that the regulatory body might adopt will be compared and contrasted.

Drive test methods, crowdsourcing, and questionnaires are just a few examples of data collecting techniques (J. J. Popoola et al., 2009). As compared to the other approaches, the questionnaire method might be seen as more subjective. The questionnaire method involves asking participants to recall the frequency with which they encountered a set of key performance indicators during a certain time frame (Kuboyeet al., 2009). Questionnaires typically only reveal QoE but not actual service quality (QoS). The whole supply chain is considered in the QoE analysis. Quality of Service (QoS) is also concerned with the radio access network indicators at the access and along with the network (Aroussi, 2014; Cristina, 2017; Rifa, 2011). The main drawback of the questionnaire approach is the limited understanding of the radio access network that it gives. In addition, it has a high potential for inaccuracy because of the involvement of humans in the data gathering process ((J. J. Popoola and Enoch, 2020)).

In order to detect and record a wide range of physical and virtual parameters of mobile cellular service in a given area, the drive test method employs a motor vehicle equipped with air interface measurement equipment for a mobile radio network, such as ASCOM's TEMS investigation, Huawei's GNET Pro, and so on (Oseniet al., 2014) Most driving test configurations offer nearly all attainable data on the radio that accessed the network of choice, hence it has been recognized as one of the most solid platforms for data collecting on signal strength of various network providers.

The primary drawback of the drive test approach is that it is more expensive than using separate means to collect data. This includes the purchase of separate mobile phones, GPS units, sim cards, dongles, inverters, and software. The driving test method also has the drawback of not being indicative of competence in non-motorized methods or in urban or suburban areas. The benefits of crowdsourcing outweigh the method's drawbacks. KPIs that are reflective of the end-user experience may be obtained by end-users, researchers, and MNOs at a minimal cost and without limiting the end-users' mobility or location (Lauridsenet al., 2016) . Online crowdsourcing occurs when a person, business, or organization makes an open request for help from a large group of individuals who collectively possess a wide range of expertise, diversity, and quantity in order to accomplish a certain task. When people pool their resources—time, money, knowledge, and experience to complete a task of diverse complexity and modularity, everyone benefits. The user's needs, whether they be economic, social, or based on self-esteem and skill development, will be met. The crowdsourcing team will also collect and employ the user's contributions, which can take several forms depending on the nature of the task at hand (Cullinaet al., 2015). A 3GPP project in Release-10 called "Minimizing Drive Test" (MDT) is the genesis of the crowdsourcing method for evaluating networks (Rel-10). As a result of this effort, consumer mobile phones and other UE began collecting radio measurement data (Scaloni, 2016, 2019; Wuri A. Hapsariet al., 2012).

The following are the main characteristics of MDT as described in Rel-10 (Wuri A. Hapsariet al., 2012).

i. The capability of the UE to report its position with radio measurements;
ii. The capability of the UE to record radio measurements when in a dormant state.
iii. Limiting radio measurements utilized to those normally conducted as part of Radio Resource Management (RRM) operations, so that the UE doesn't have to deal with any unnecessary complexity or extra power drain.

Limitations in the amount of Key performance indicators (KPIs) that may be evaluated in a host-based method, in comparison to the drive test technique, would diminish the breadth of potential research. This is a list of attainable KPIs: (Scaloni, 2016).

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Table 5: Comparison of Network monitoring techniques.

	Questionnaire	**Drive Test**	**Crowdsourcing**
Cost	Cheap	Very expensive	Moderate
KPI	Very Limited	Robust	Limited
Setup	Easy	Difficult	Easy
Error-Prone	High	Low	Low
Time	Not time-consuming	Time-consuming	Not time-consuming
Approach	Subjective	Objective	Objective
Technicality	No technical know-how	High technical know-how	Little technical know-how

All data collecting approaches have the same significant limitation, however, in that the type of UE chipset influences its network perception. The network chipsets used to detect nearby radio access networks vary from UE to UE. There will also be a constantly shifting understanding of radio waves because certain UE cannot access all frequency bands used by GSM. The only way to resolve these contrasting views of networks would be for spectrum regulatory agencies to engage closely with UE manufacturers to develop policy guidelines.

The process of data analytics is also crucial. Data, IT, statistical analysis, quantitative methodologies, and mathematical/computer-based models are all part of this process since they enhance insights and facilitate fact-based decision making. Data analytics methods are crucial because they are used to mitigate the negative consequences of the limitations of different types of data collecting and provide deeper insights into the data obtained. For instance, the questionnaire technique of data collection permits only little analysis, restricting the range of possible observations, conclusions, and suggestions. Moreover, the data analytics method permits the modelling of non-mathematical aspects influencing communication networks.

The two main categories of data analytics are "descriptive" and "predictive." When it comes to finding a long-term solution to the telecommunications problem, descriptive analysis conducted by the National Communication Commission and other regulatory boards, as well as the vast majority of researchers in this field, has been shown to be fallible (J. J. Popoola and Enoch, 2020) and myopic. These descriptive approaches, the details of which will be addressed in greater depth in a subsequent section, have yielded findings and output that have shed light on the existing condition of communication networks and offered suggestions for improvement.

Due to the paucity of studies devoted to the topic, predictive analysis is still in its infancy with regards to telecommunications data. Artificial Neural Networks (ANNs) have been used to anticipate call drops in communication systems (Erunkuluet al., 2019b) . We utilize five major performance indicators from GSM networks to make predictions about when calls will be dropped: received signal strength (RxLev), received quality (RxQual), frame error rate (FER), bit error rate (BER), and timing advance. Also (J. J. Popoola and Enoch, 2020).

Yet, it is important to keep in mind that the elements influencing the quality of service of communication networks are dynamic. For instance, immigration and emigration can create population shifts, climate change has led to unpredictable weather conditions, etc. Thus, a more all-encompassing technique, a real-time predictive approach to communication data, is required.

The absence of performance evaluation on prediction models constructed based on the acquired information is another major shortcoming in the assessment of mobile network operators' quality of service by academics (Mebawondu, 2021). The quality of a prediction model is determined by the information used and the algorithm employed (J. J. Popoola andOlst, 2013). For instance, the data regression model's inferential correlations may not provide optimal precision and accuracy. In linear regression, the correlation coefficient is an important metric of dependability (the most popular measure of well a model fits). State-of-the-art machine learning models, such deep neural networks, are well-known to perform exceptionally well in practice, as noted by (Sameket al., 2017). In their review. He specifically mentioned the VGG-16 classification model as a productive data set for telecommunications.

IV. CONCLUSION

Individual effort to investigate and evaluate the mobile network quality delivered by mobile network operators in Nigeria has exposed easier and accurate methods. The NCC need to partner with these individual entities in form of

grants, aids, support and sponsorship, so that investigation can be carried holistically and on a large scale. Also, Artificial Intelligence (AI) approach has been used to give better insight to the causes of failure in the Nigerian telecommunication system and it should be adopted for the already existing system.

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