International Journal of Basic Science and Technology
April, Volume 10, Number 1, Pages 62 – 70 http://www.ijbst.fuotuoke.edu.ng/ 62
https://doi.org/10.5555/SMRZ3343 **ISSN 2488-8648**

Analysis of Quality of Service (QOS) of MTN and GLO in some Selected Areas in Umuahia Abia State

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Article Information

Article # 10009
Received: 11th Jan. 2024
1st Revision:16h Feb. 2024
2nd Revision:28th Feb. 2024
Acceptance:4th April 2024
Available online:
4th April 2024.

Key Words
Indicators, Channels, Networks communication, Global System for Mobile Quality of service, Key Performance

Abstract

This research is on the analysis of the Quality of service (QoS) of Mobile Telecommunication of Nigeria (MTN) and Global Communication (GLO) in Umuahia, Abia State, Nigeria. Umuahia environment was used as a test-bed for the drive test of this study. The investigation was conducted form June to November 2023. The Global System for Mobile communication (GSM) networks studied were MTN and Glo. The study was conducted using the Astronomical Communication (ASCOM) infrastructure of the Nigerian Communication Commission (NCC). The primary data obtained from this investigation was later compared with secondary data from the NCC reference QoS dataset which gave the same result. Consequently, NCC Key Performance Indicators (KPI) data was leveraged in making the deductions. The result from the investigation shows that the bad quality of service used by these operators was not entirely a result of the traffic channel that is readily accessible but from other influences that include the congestion of the channels. Conclusively, the outcomes demonstrate that the call QoS outcomes in this research are still a far cry from the expectations of customers, and recommend that more concentration ought to be focused on enhancing the quality of service for greater effectiveness.

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Introduction

The socio-economic setting of Nigeria has been positively changed afterward the rollout of wireless moveable offerings across Nigeria (Idigo *et al.*, 2020). Evenly, the citizenries are not additionally forsaken regarding profit from the offerings of Wireless Telecommunication, not as a method of passing facts thousands of individuals had additionally benefited regarding job opportunities in Nigeria (Juwah, 2019). Nonetheless, the network provided by these providers has continued to observe a series of complaints from the members regarding the inadequacy of offerings (QoS) given in the state. The lamentable component of these circumstances is the fact that all the moveable members are continually impacted. On account of this issue, a few of the members are undecided on which mobile Provider to sign to and consequently making the members to emigrate from one moveable contacts Provider to the other in look for of a greater offering (Kuboye, *et al.*, 2021)

The essential drive of this study is that the members also in Umuahia but additionally everywhere like to observe quick and dependable telecommunication business activities and get data for their finances (Odii and Onuoha 2018). This survey was undertaken as said by the inadequacy of articulate and information encountered in Umuahia. to have an idea of the reason for unreliable articulate and information and furnish several functional references.

QoS in GSM networks

The Quality of service may differ from situation to situation and from person to person. Quality consults to the classic of something when in comparison with other things like it, whereas, intends application, or facilities, or any mixture of these offerings, that is given remarkably for communications between contacts (Okonedo, 2018). Quality of service is the description or measurement of the general effectiveness of a network, for an example a telephony or device contacts or cloud services, in particular the effectiveness seen by the users of the links. To quantitatively degree quality of service, various narrated facets of the connections are repeatedly considered (Olatokun and Nwonne, 2018). The definition of Quality of service only differs in verbiage but after all, entails determining in case perceived delivery meets, exceeds or fails to meet member goals. It's the level of assurance to a user.

Meanwhile, Opele *et al.* (2020) defined QoS from the perspective of users as the level and trend of disagreement amongst the mobile user perceptions and

https://doi.org/10.5555/SMRZ3343 ISSN 2488-8648

prospect or the scope to which a service meets or exceeds possibility. Hence, Quality of service is the difference between member's expectations and perceptions of service given by a provider (Aliyu *et al.*, 2018)

Fundamentally, Quality of Service (QoS) includes the absence of intrusion and tones on the circuit, excellent quality speech, appropriate loudness point, elevated sign brawn, minimum call obstructing, minimum call dropping, highest handoff and excellent information rates for multi-media applications (Suhail *et al*., 2107). Meanwhile, all these influences have not been accomplished perfectly in the Telecommunication industry. Making an accomplished call without interruption is the main dream of all mobile subscribers. This, but sometimes, had not been conceivable because of inadequacy encountered by the e-users (Suhail *et al.*, 2017)

Agubor *et al.* (2016) utilized a guide test procedure to assess the quality of service of mobile network operators in Lagos state in which three major towns Ikoyi, Abule-Egba and Agege were covered. Call Drop Rate (CDR), among the effectiveness indicators, was measured in this work. It was complied with that Etisalat had the fewest worth of 0.6% of all the calls started whilst the test. The weaknesses of this work were that one performance indicators were assessed as against this work where Eight performance indicators were measured.

QoS perceived by the mobile users

This expresses the mobile user's insight of the quality levels that are obtained or encountered, which are generally denoted by the amount of approval and not in the technical terms. Hence, the levels of QoS as perceived by the mobile users must be interpreted into QoS influences to match the rest of the perspectives. Call Setup Time (CST), Call Drop Rate (CDR), Call Setup Success Rate (CSSR), and Call Setup Failure Rate (CSFR) are some of the KPI parameters used in evaluating and estimating the QoS alleged by the mobile user for a mobile service provider as it seriously affects the users experience and expectation, (Gopal and Kuppusamy, 2015)

Materials and Methods

The following materials were used:

i. Ascom equipment, a leading provider of Mission-Critical Communications Network Testing division

ii.Trace mobile: A mobile supporting GSM and GPRS equipped with special software.

iii. Global Positioning System (GPS): It is a satellite system that provides users with location of the measurement point

iv. Personal Computer (PC): It is a computer equipped with interface carte RS 232 to link the serial output of the MS and the serial port of the PC.

Umuahia environment was used as a test-bed for the drive test of this study. The investigation was conducted from June to November 2022. The GSM networks studied are MTN and Glo. The study was conducted using ASCOM infrastructure of NCC. The primary data obtained from this investigation was later compared with secondary data from NCC reference QoS dataset which gave the same result (NCC, 2017). Consequently, NCC KPI data was leveraged in making the deductions.

a **Call set up success rate**

This is the ratio of the number of successful seizures of Standalone Dedicated Congestion Channel (SDCCH) to the total number of requests for seizure. Call setup success rate is given as shown in equation (1).

$$CSSR = \frac{N_{sz}}{N_{RZ}} \quad (1)$$

Where C_{sr} is the Call set up success rate, N_{sz} is the number of successful seizures of SDCCH, N_{RZ} is the total number of requests from seizure.

b. **Call drop rate**

This metrics determines the rate of calls that were not completed. It is given as shown in equation (2).

$$\text{CDR} = \frac{TCH_a}{TCH_b} \quad (2)$$

Where CDR is the Call Drop Rate, TCH_a is the channel drop rate after assignment, and TCH_b is the channel drop rate before the assignment.

c. **Rate of successful handover (H_{sr})**

This metric defines the rate of successful handover calls. It is given as shown in equation (3).

$$H_{sr} = \frac{N_{sr}}{T_{hr}} \quad (3)$$

https://doi.org/10.5555/SMRZ3343 ISSN 2488-8648

WhereH_{sr}, is the rate of successful handover, $N_{sr} = intracell + intercell\ hand\ over$ and T_{hr} is the total number of handover requests.

d. **Call completion rate**
This defines the rate of successful completion of incoming and outgoing calls. This index is calculated as shown in equation (4).

$$\text{CCR} = \frac{C_s}{C_r} \qquad (4)$$

Where CCR, is the Call Completion Rate, C_s is the incoming calls, C_r is the outgoing calls.
e. Call quality factor$(\boldsymbol{C_{qf}})$

This index gives the call quality ratio. It is given as shown in equation (5).

$$C_{qf} = \frac{N_{ra}}{N_c} \qquad (5)$$

Where $\boldsymbol{C_{qf}}$ is the Call Quality Factor,N_{ra} is the total number of abandonment rate, N_c is the total number of calls.
h. Call arrival rate $(\mathbf{C_R})$
This is the total number of calls a contact center receives within a specific period. The time frame can be expressed by day, hour, or minute. This metric is given as shown in equation (6).

$$C_r = \frac{N_c}{T_t} \qquad (6)$$

Where C_R is the Call Arrival Rate,N_c is the total number of calls, T_t is total time.

Table 1: Average QoS KPI's data set for the various network operators in Umuahia, Abia State, Nigeria in June 2023.

KPI	NCC	MTN NIG	GLO NIG
CSSR	0.9	0.89	0.86
HSR	0.9	0.8	0.9
CDR	0.02	0.04	0.05
AUR	1	0.9	0.81
AWT	0.5	0.65	0.68
CQF	0.98	0.90	0.75

Table 2 shows the average QoS KPIs data set for the various network operators in Umuahia, Abia State, Nigeria in July 2023. The average QoS KPI's data set for the various network operators in Umuahia, Abia State, Nigeria in July, 2023.

KPI	NCC	MTN NIG	GLO NIG
CSSR	0.9	0.88	0.90
HSR	0.9	0.79	0.91
CDR	0.02	0.036	0.057
AUR	1	0.93	0.85
AWT	0.5	0.51	0.321
CQF	0.98	0.93	0.891

Table 3 shows the average QoS KPIs data set for the various network operators in Umuahia, Abia State, Nigeria in August 2023. The average QoS KPI's data set for the various network operators in Umuahia, Abia State, Nigeria in August 2023

https://doi.org/10.5555/SMRZ3343 ISSN 2488-8648

KPI	NCC	MTN NIG	GLO NIG
CSSR	0.9	0.92	0.90
HSR	0.9	0.78	0.89
CDR	0.02	0.03	0.033
AUR	1	0.94	0.83
AWT	0.5	0.54	0.61
CQF	0.98	0.89	0.91

Table 4 shows the average QoS KPIs data set for the various network operators in Umuahia, Abia State, Nigeria in September 2023. The average QoS KPI's data set for the various network operators in Umuahia, Abia State, Nigeria in September 2023

KPI	NCC	MTN NIG	GLO NIG
CSSR	0.9	0.95	0.90
HSR	0.9	0.85	0.93
CDR	0.02	0.05	0.01
AUR	1	0.92	0.83
AWT	0.5	0.5	0.3
CQF	0.98	0.91	0.91

Table 5 shows the average QoS KPIs data set for the various network operators in Nigeria in October 2023.
Table 5: Average QoS KPI's data set for the various network operators in Umuahia, Abia State, Nigeria in October 2023

KPI	NCC	MTN NIG	GLO NIG
CSSR	0.9	0.9	0.874
HSR	0.9	0.891	0.91
CDR	0.02	0.033	0.03
AUR	1	0.9	0.88
AWT	0.5	0.25	0.40
CQF	0.98	0.98	0.83

Table 6 shows the average QoS KPIs data set for the various network operators in Umuahia, Abia State, Nigeria in November 2023.
Table 6: Average QoS KPI's data set for the various network operators in Umuahia, Abia State, Nigeria in November 2023.

KPI	NCC	MTN NIG	GLO NIG
CSSR	0.9	0.93	0.91
HSR	0.9	0.80	0.9
CDR	0.02	0.013	0.033
AUR	1	0.91	0.83

AWT	0.5	0.373	0.264
CQF	0.98	0.94	0.92

Results and Discussion

Figure 1 shows the plot of the various network operators' KPI data set in Umuahia, Abia State, Nigeria in June 2023.

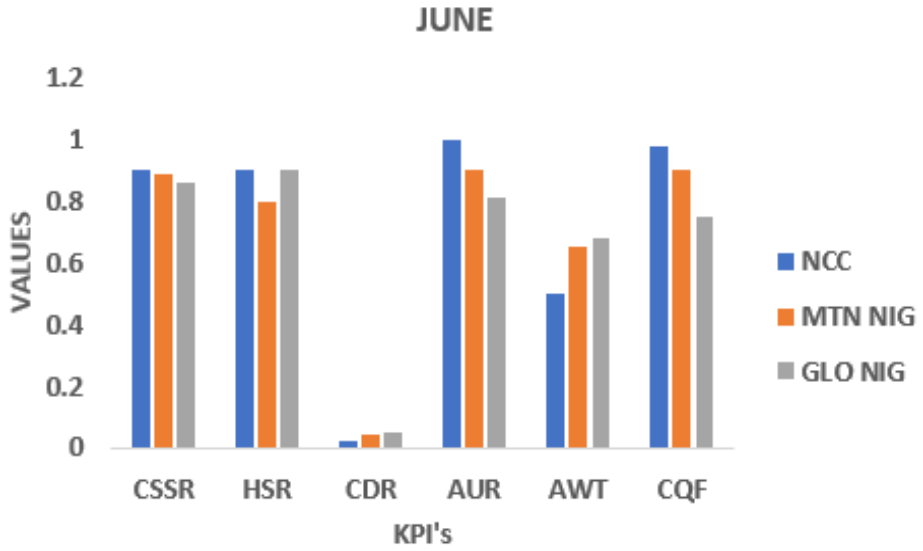


Figure 1: KIP data set in Umuahia, Abia State, Nigeria in the Month of June, 2023.

From Figure 1, the NCC benchmark for CSSR in June was 0.9. MTN CSSR was 0.89, and Glo was 0.86. MTN was very close to the NCC benchmark. The Glo's CSSR of 0.86 was less than the NCC benchmark of 0.9. Therefore, in June, MTN results for CSSR were the best for the selected networks. The NCC benchmark for HSR in June was 0.9. MTN has a HSR of 0.8 and Glo was 0.9. The results show that Glo has a better HSR as compared to MTN. The NCC benchmark for CDR in June was 0.02. MTN has a CDR of 0.04 and Glo was 0.05. The results show that the Glo has the worst CDR in the month under review. The NCC benchmark for AUR for June was 1. MTN AUR was 0.9, while Glo has AUR result of 0.81. The result shows that MTN result was the best for the month of June. The NCC benchmark for AWT in the month of June was 0.5. MTN and Glo AWT results were 0.65 and 0.68 respectively for the month under review. This implies that none of the networks was able to attain a benchmark close to NCC stipulation in June. The CQF specified by NCC in June was 0.98. MTN has a CQF of 0.90, GLO result for CQF was 0.75. This implies that Glo network has the worst CQF, while MTN has a better CQF in June.

From the results of the KIP above, it was seen that none of the networks was able to reach or exceed the KIP standard set by NCC in June, except GLO which reached the NCC HSR of 0.9 in June.

Figure 2 shows the plot of the various network operators' KPI data set in Umuahia, Abia State, Nigeria in July 2023.

https://doi.org/10.5555/SMRZ3343 ISSN 2488-8648

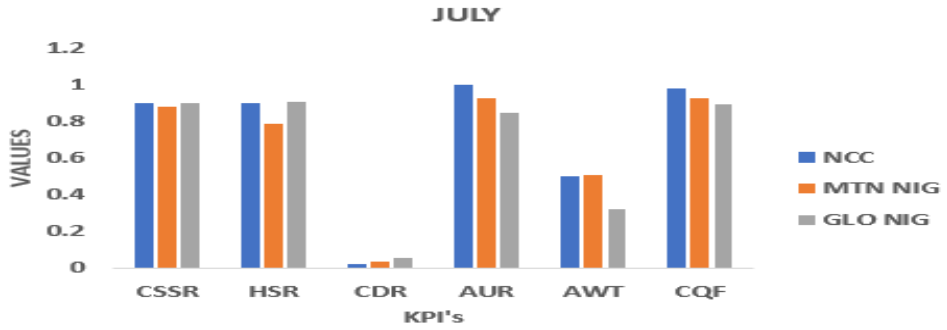


Figure 2: KPI data set in Umuahia, Abia State, Nigeria in July 2023.

From Figure 2, the benchmark of the NCC set for CSSR in July was 0.9. MTN has a CSSR of 0.88 and Glo 0.9. This implies that the Glo network is better in terms of the CSSR. The HSR specified by NCC for July was 0.9. MTN has HSR of 0.79 and Glo 0.91. This implies that in the month under review, Glo has a better HSR than other networks, while MTN has the worst HSR in the same month. The NCC benchmark for CDR for July was 0.02. MTN has a CDR of 0.036 and Glo was 0.057. From the result, it could be seen that the Glo network had the worst CDR in July. Also, the benchmark set by NCC for AUR in July was 1. MTN and Glo results of AUR were 0.93 and 0.85 respectively. From the result, it could be seen that MTN has the best AUR, while Glo has the worst AUR in July. The NCC AWT for July was 0.5. MTN and Glo result for AWT for the same month was 0.51 and 0.321 respectively. The result shows that Glo has the best AWT in July. The NCC CQF result for July was 0.98. MTN and Glo results for CQF in July were 0.93 and 0.891 respectively. The result shows that Glo has a better CQF as compared to MTN in July. The entire results of the comparison in July shows that most of the networks considered failed to reach or exceed the recommended NCC benchmark for the various KPIs in July. Glo CSSR and HSR reached the NCC benchmark of 0.9 and 0.91 respectively. Also, the AWT of Glo was 0.321, which was better than that of NCC with AWT of 0.5.

Figure 3 shows the plot of the various network operators' KPI data set in Umuahia, Abia State, Nigeria in August 2023.

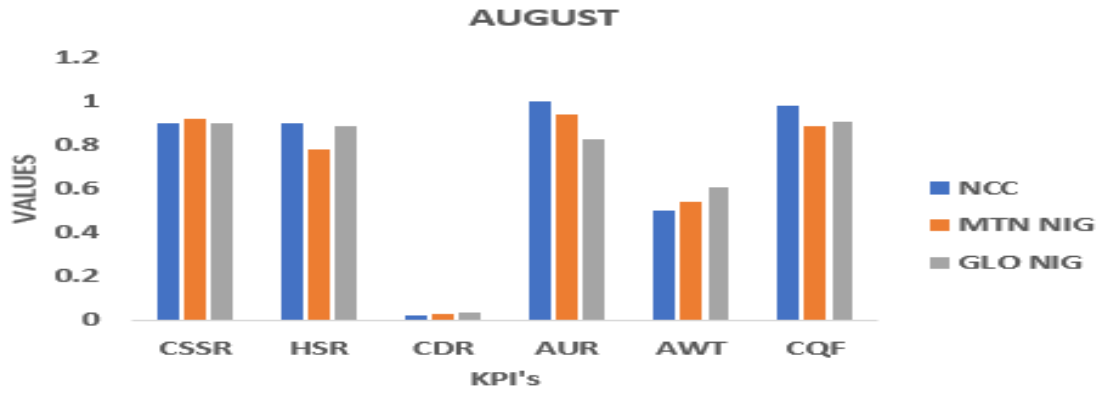


Figure 3: KPI data set in Umuahia, Abia State, Nigeria in August, 2023.

As seen in Figure 3, the NCC CSSR for August was 0.9. MTN has CSSR of 0.92 and Glo was 0.90. The result shows that the MTN CSSR exceeded the NCC benchmark in August. The HSR for NCC in August was 0.9. MTN has HSR of 0.78, and Glo, 0.89. The result implies that none of the networks reached the stipulated NCC benchmark in August. MTN has the worst HSR in the month under review. The NCC benchmark for CDR in August was 0.02. MTN has CDR of 0.03 and Glo 0.033. This shows that none of the network operators was able to attain the NCC CDR specification in August. The NCC AUR specification for August was 1. MTN AUR was 0.94 and Glo was 0.83. The result shows that MTN has a better AUR than Glo in August. In August 2023, the NCC AWT was set at 0.5, MTN, and Glo was 0.4 and 0.61 respectively. In this month, Glo has the worst AWT in the month under review. The NCC benchmark for

https://doi.org/10.5555/SMRZ3343 ISSN 2488-8648

CQF in August was 0.98. MTN and Glo results were 0.89 and 0.91 respectively. From the result, it was seen that Glo has a better CQF than MTN and the computational results.

From the summary of the results of the KPI data of the selected network in August 2023, it could be seen that MTN has a better CSSR which exceeds that of NCC. In terms of other KPI parameters, none of the network operators was able to reach the standard set by the NCC.

Figure 4 shows the plot of the various network operators' KPI data set in Umuahia, Abia State, Nigeria in September, 2023.

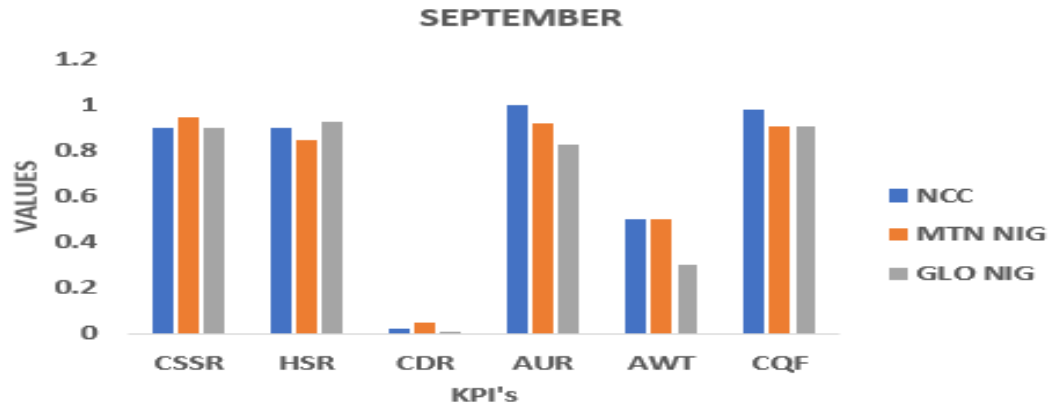
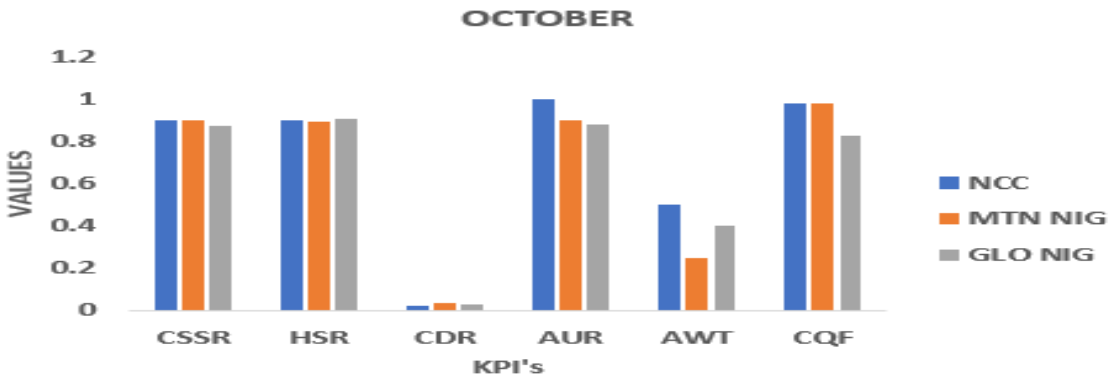


Figure 4: KPI data set in Umuahia, Abia State, Nigeria in September 2023.

Considering the month of September as shown in Figure 4, the NCC CSSR standard was 0.9, MTN 0.95, and GLO was 0.9. From the result, it was seen that MTN outperformed both the NCC benchmark and Glo CSSR of 0.9. The HSR standard set by NCC was 0.9. MTN has HSR of 0.85 and Glo was 0.93. The result shows that GLO network has the best HSR while MTN has the worst HSR in the month under review. The CDR data set of NCC for September was 0.02. MTN has a CDR of 0.05 and Glo was 0.01. The data shows that Glo has the best CDR, while MTN has the worst CDR in September. Considering the data set for AUR, NCC benchmark was 1, MTN 0.92 and Glo was 0.83. From the results, it could be seen that MTN has a better AUR, while Glo has the worst AUR in September. The NCC benchmark of AWT in September was 0.5, MTN 0.5, and Glo 0.3. The results show that the Glo network has the best AWT in September 2023. The NCC benchmark for CQF in the month of September was 0.98, MTN and GLO was 0.91 respectively. The result shows that none of the networks was able to reach the CQF set by NCC in September. From the results of the data set analyzed in September, it could be seen that Glo has the best CDR, while MTN has the best CSSR in the month under review.

Figure 5 shows the plot of the various network operators KPI data set in Umuahia, Abia State, Nigeria in October 2023



https://doi.org/10.5555/SMRZ3343 ISSN 2488-8648

Figure 5: KPI data set in Umuahia, Abia State, Nigeria in October 2023.

From Figure 5, the NCC benchmark for CSSR in October was 0.9. MTN has CSSR of 0.9 and Glo 0.874. The result shows that both the MTN reached the benchmark set by the NCC, while Glo was lagging behind the benchmark. The HSR set by NCC for October was 0.9. MTN has a HSR 0f 0.891, while Glo was 0.91. The result shows that the Glo network has the best HSR, while MTN has the worst HSR in the month under review. The NCC benchmark for CDR in October was 0.02. MTN has a CDR of 0.033 and Glo 0.03. The result shows that the entire network failed to attain the NCC CDR benchmark of 0.02 in October. The NCC benchmark for AUR in October was 1. MTN has AUR of 0.9 and Glo 0.88. The result shows that MTN has a better AUR than the other networks in October 2023. The NCC AWT standard in the month under consideration was 0.5. MTN has an AWT of 0.25 and GLO of 0.40. The result shows that all the considered networks superseded the NCC's AWT of 0.5 recommended in October, with MTN taking the lead. The benchmark set by NCC for CQF in October was 0.98. MTN has a CQF of 0.98, and Glo 0.83. The results show that MTN reached the set target of NCC, while Glo was behind the standard set by NCC in October. From the entire data analysis, it could be seen that the networks performed better in terms of AWT as compared to NCC benchmark. MTN performed very well in CSSR, AUR, AWT, and CQF, while Glo is better in the area of HSR.

Figure 6 shows the plot of the various network operators KPI data set in Umuahia, Abia State, Nigeria in November, 2023

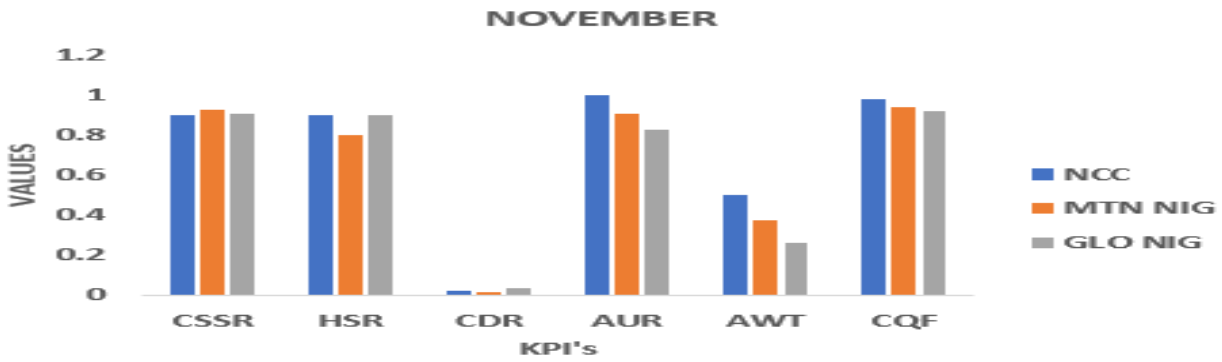


Figure 6: KPI data set in Umuahia, Abia State, Nigeria in November, 2023.

From Figure 6, the NCC CSSR for November was 0.9. MTN has a CSSR of 0.93 and Glo 0.91. From the result, it could be seen that both MTN and Glo outperformed the CSSR standard set by NCC in November. The HSR standard set by NCC in November was 0.9. MTN has HSR of 0.8 and Glo was 0.9. The result shows that Glo network has a better HSR than the other networks in the month under review. In the same month, the CDR standard set by NCC was 0.02. MTN has a CDR of 0.013 and GLO 0.033. The result shows that MTN has the best CDR in the reviewed month. The NCC benchmark for AUR in November was 1. MTN has AUR of 0.91 and Glo 0.83. The result shows that MTN has a better AUR than other networks. It could be seen that none of the networks was able to reach the standard set by NCC for AUR in November. In November 2023, the NCC AWT was set at 0.5. MTN and Glo were 0.373, and 0.264 respectively. The data set shows that the entire network performed better than the NCC benchmark with Glo having the best AWT. The NCC benchmark for CQF in November was 0.98. MTN has a CQF of 0.94 and Glo was 0.92. From the result, it could be seen that none of the networks reached the CQF benchmark set by the NCC in November 2023.

The entire result of November 2023 shows that MTN performed better than other networks in the areas of CSSR, while the AWT of Glo was 0.264 which was better than that of NCC.

Conclusion

It was complied with that these connection operators need to enhance the quality of service provided to their teeming customers. The call drop rate and call set-up rate were elevated for the two contact operators at the time of this survey. It is displayed that the traffic channel was readily accessible during the period of investigation and evaluation and the handover success rate was agreed to accept judging by the NCC standard.

https://doi.org/10.5555/SMRZ3343 **ISSN 2488-8648**

It could be inferred from the investigation that the bad quality of service used by these operators is not therefore the traffic channel that is readily accessible but from other influences that include the congestion of the channels. But sometimes, more concentration ought to be focused to enhancing the quality of service for greater effectiveness. Conclusively, the outcomes demonstrate that the call QoS outcomes in the place of the survey are still a far cry from the expectations of customers.

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