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Comparative Assessment of GSM Call Quality in a Semi-Urban Nigerian Town: Evidence from MTN and Glo Networks in Ozoro, Delta State

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Abstract- ***Semi-urban populations continue to be underrepresented in empirical Quality of Service (QoS) research, despite the significant expansion of mobile telecommunications in Nigeria. This study compares the GSM call quality of Glo Mobile and MTN Nigeria in Ozoro, Delta State, a semi-urban settlement in the Niger Delta. Three zonal categories, they are the town center (high-density), residential regions (moderate-density), and the periphery (low-coverage) and they were used to gather data utilizing an organized drive-test approach. Five essential QoS metrics were evaluated: Call Drop Rate (CDR), Call Setup Success Rate (CSSR), Subjective speech quality, call completion rate (CCR) and received signal strength indicator (RSSI). The findings show that MTN consistently performed better than Glo in every indication that was measured: MTN reported a mean signal strength of -75 dBm over Glo's -86 dBm, a CSSR of 98.5% versus Glo's 96.2%, and a CDR of 0.8% versus Glo's 1.5%. During periods of high traffic, both networks' performance deteriorated, but Glo was more vulnerable in low-coverage areas. These results highlight the necessity of the Nigerian Communications Commission (NCC) enforcing QoS regulations more strictly and making targeted network investments in peri-urban regions.***

Keywords: Call Quality, Quality of Service, Signal Strength, MTN, Glo

I. INTRODUCTION

Since its commercial introduction in August 2001, the Global System for Mobile Communication (GSM) has radically changed Nigeria's telecom environment. The teledensity ratio tripled within a year of GSM deployment, marking the start of a mobile revolution that would attract millions of Nigerians to the digital economy (Oladimeji & Akinwole, 2018). Nigeria has developed into one of Africa's largest mobile marketplaces, with several operators servicing tens of millions of active users, from a pitiful 18,724 functioning telephone lines at independence in 1960, serving a population of about 45 million (Ndukwe, 2008).

However, the impressive growth of GSM infrastructure hasn't always resulted in dependable customer service. In the early 2000s, networks started to experience pressure due to the fast growth of customer bases. Particularly outside of large cities, dropped calls, unsuccessful call settings, poor signals, and diminished voice clarity were frequent complaints (Agbesi & Louis, 2022). In response, the Nigerian Communications Commission (NCC) has set minimum QoS thresholds, such as requiring Call Setup Success Rates to be at least 98% and Call Drop Rates to be under 2% (Abdulkareem et al). It has also hired independent auditors to evaluate operator performance (Ozovehe & Usman, 2015).

However, rather than using direct field measurements, a large portion of the empirical literature on Nigerian GSM performance has focused on major cities like Lagos (Adegoke, et al, 2022) (Akinola & Allison, 2015), Abuja (Lawal et al., 2016), and Port Harcourt, or it has relied on aggregated national datasets from the NCC (Popoola et al., 2018; Oritsetimeyin, Abayomi & Akpabio, 2023). This collection of research noticeably lacks semi-urban populations, which comprise a significant section of Nigeria's population. Network performance in mid-tier towns might differ significantly from what national statistics show, especially in locations with poor base station coverage and heavy network congestion (Agoda et al, 2026). This geographic bias in QoS research creates a considerable information vacuum.

In order to close this gap, a direct field assessment of GSM call quality was carried out in Ozoro, a semi-urban town in Delta State's Isoko North Local Government Area. Using five recognized QoS metrics, the study compares MTN Nigeria and Glo Mobile, the two biggest independent providers in Nigeria, bilaterally. This study's specific goals are to: (i) assess and compare the two networks' Call Setup Success Rates (CSSR); (ii) measure and compare Call Drop Rates (CDR); (iii) assess and compare signal strength (RSSI) across various zones; (iv) determine Call Completion Rates (CCR); and (v) perform a subjective evaluation of speech quality in real-world settings.

II. RELATED WORK

1) Although there is still little coverage of semi-urban regions, a significant amount of material has looked at QoS in Nigerian GSM networks. One of the most thorough studies of this sort was carried out by Akinola and Allison (2015), who evaluated four anonymous GSM providers in Ikorodu and Badagry over the course of six months using a benchmarking drive-test approach. Call blocking rates were evaluated using Erlang and Poisson probability distribution models. While the majority of operators achieved NCC objectives on a number of KPIs, performance below threshold was noted in others. However, the study's anonymization of operator identities limited the applicability of its comparison findings.
2) Nwabueze and Oyubu (2016) specifically examined GSM performance in Oleh, Delta State which is a community geographically adjacent to Ozoro using Netmonitor software installed on an Android handset to log RSSI and Cell ID across 30 days of intra- and inter-network calls. Their results showed that MTN provided the strongest signal quality in Oleh, followed by Airtel, Glo, and Etisalat. Crucially, they observed that the town centre exhibited superior coverage to peripheral areas, a spatial pattern that is consistent with infrastructure deployment trends in Delta State.
3) Popoola et al. (2018) collected and statistically examined NCC-sourced KPI data for all four main operators like Airtel, Etisalat, Glo, and MTN across four quarterly reporting periods at the national level. Significant quarterly differences in CSSR, DCR, SDCCH congestion, and TCH congestion were found using ANOVA and Tukey's Post Hoc testing. The localized network circumstances that individual subscribers in locations like Ozoro really encounter are not captured by this macro-level dataset, despite the fact that it is useful for regulatory monitoring.
4) A two-year longitudinal study by Oritsetimeyin et al. (2023) covering the period June 2020 to May 2022 further confirmed MTN's consistent leadership across Nigerian GSM networks, recording the highest CSSR of 99.73% and the lowest CDR of 0.28% among the four major operators. Globacom (Glo) recorded a CSSR of 99.06% and a CDR of 0.32%, suggesting reasonable national-level performance though, as the authors noted, these averages mask significant location-specific variability. Ekah and Emeruwa (2022) reached a related conclusion in their Calabar study of UMTS versus GSM performance, finding that no consistent QoS improvement was evident in the transition between network generations, and that poor planning and inadequate optimization were likely contributors to substandard service delivery.
5) Research conducted outside of Nigeria offers helpful methodological standards. Using the Nelson Mandela African Institute of Science and Technology as a case study, Lukonge, Kaaya, and Kisangiri (2014) showed how focused network optimization with KPIs as guiding metrics may significantly increase coverage and service quality. In a similar vein, Regmi and Shrestha (2020) shown that physical GSM optimization, which includes neighbor-cell reconfiguration, azimuth modification, and antenna tilt, may result in quality increases of up to 14%. These results support the claim that supply-side optimization deficiencies, rather than just demand-side issues, are the cause of underperformance in networks such as Glo in Ozoro.

Taken together, the reviewed literature reveals three persistent gaps: the near-absence of GSM QoS research in semi-urban Delta State communities other

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than Oleh; the lack of a focused bilateral MTN-versus-Glo comparison using primary field data; and the exclusion of subjective speech quality ratings from most Nigerian studies. This paper addresses all three gaps.

III. MATERIALS AND METHODS

A. Research Design and Study Area

A field measurement and comparison analysis design was used in this study. Instead of using surveys or secondary databases, data was gathered through direct drive-test calls and contemporaneous signal strength assessments, guaranteeing that the results represent genuine subscriber-side experience rather than operator-reported statistics. Ozoro, which is situated in Delta State, Nigeria's Isoko North Local Government Area, served as the research area. Ozoro is a semi-urban area that acts as the administrative, economic, and educational hub for the nearby communities. To quantify performance heterogeneity across varying network demand levels, three spatial zones were established:

Zone A - Town Centre: High population density, active commercial activity, and significant network load during business hours, particularly mid-morning and early afternoon.

Zone B - Residential Areas: Moderate-density neighbourhoods with mixed land use and average network demand throughout the day.

Zone C - Outskirts: Peri-urban fringe areas characterized by sparse infrastructure and lower base station coverage density, where signal weakness was anticipated.

B. Instruments and Equipment

Data collection required two smartphones; one configured as an active MTN subscriber and the other as a Glo subscriber. Both were in good working condition and loaded with adequate airtime. A network signal monitoring application was installed on each device to record Received Signal Strength Indicator (RSSI) values in dBm at the beginning and end of each test call. A paper-based field log was maintained at each location, capturing call outcomes (successful setup, completion, or drop), RSSI readings, and speech quality ratings. A stopwatch was used to verify call duration, and GPS coordinates were recorded at each measurement point to enable spatial referencing of the data

C. Sampling and Data Collection

The different locations were selected using a random sampling approach, with between five and ten sites chosen within each of the three zones. At each location, ten test calls were made on each network, with each call sustained for a minimum of 60 seconds where connectivity was established. Data collection was scheduled across both peak hours (7:00 - 9:00 AM and 12:00 - 2:00 PM) and off-peak hours (10:00 - 11:30 AM and 3:00 - 5:00 PM) to allow for performance comparisons under differing traffic loads. Call outcomes, whether each attempt resulted in a successful setup, a completion of the full call duration, or a premature drop, were recorded individually for each trial.

D. QoS Parameters Measured

The following five QoS parameters were assessed:

(i) Call Setup Success Rate (CSSR): the proportion of call attempts that successfully established a connection, calculated as;

$$\text{CSSR} = \frac{\text{Number of successful SDCCH seizures}}{\text{Total number of SDCCH seizure requests}} \times 100\%$$

(ii) Call Drop Rate (CDR): the percentage of established calls that terminated unexpectedly, calculated as;

$$\text{CDR} = \frac{\text{Number of TCH drops after assignment}}{\text{Total TCH assignments}} \times 100\%$$

(iii) Signal Strength (RSSI in dBm): mean received signal strength recorded at each location, averaged across the beginning and end readings for all test calls.

(iv) Call Completion Rate (CCR): the proportion of successfully set-up calls that ran to full duration without interruption.

(v) Speech Quality: a subjective rating assigned per completed call on a scale of 1 (Very Poor) to 5 (Excellent), adapted from ITU Mean Opinion Score conventions.

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E. Data Analysis

Collected data were compiled into comparative tables. Arithmetic means were calculated for RSSI readings and speech quality scores at each location. CSSR, CDR, and CCR values were computed using the formulae described above. Cross-network comparisons were made for each parameter across the three zones, and zone-level differences were examined to identify the spatial distribution of network performance variation

IV. RESULTS

Table 1 summarizes the aggregate QoS measurements for MTN and Glo across all test locations in Ozoro. MTN recorded a CSSR of 98.5%, exceeding Glo's 96.2% by 2.3 percentage points. In terms of call stability, MTN's CDR of 0.8% compared favorably to Glo's 1.5%, indicating that Glo's connections were approximately twice as likely to drop once a call had been established. The signal strength differential was pronounced; MTN averaged -75 dBm against Glo's -86 dBm, that is a difference of 11 dBm and in practical terms, places Glo's signal at the edge of the range typically associated with reliable voice communication in many handset models. Call Completion Rates mirrored these trends: MTN achieved 97.8% versus Glo's 94.5%.

Table 1: Comparative QoS Performance of MTN and Glo in Ozoro, Delta State

Parameter	MTN	Glo
CSSR (%)	98.5	96.2
CDR (%)	0.8	1.5
Signal Strength (dBm)	-75	-86
CCR (%)	97.8	94.5
Speech Quality (1-5 scale)	4.1 (Good)	2.8 (Fair – Poor)

A. Zone-Level Performance Patterns

Both networks performed best in Zone A (Town Center), which is consistent with the commercial hub's increased base station density. While Glo's CSSR somewhat increased in comparison to outlying regions, MTN maintained steady CSSR and CCR levels near its general norms. Both providers performed moderately in Zone B (Residential Areas), with MTN retaining comfortable margins in call drop rates and signal strength. The greatest noticeable difference between the two networks was seen in Zone C (Outskirts). At a number of highway and peri-urban sites, Glo's signal strength declined to levels between -89 and -92 dBm, which are limits at which successful call setup becomes problematic for many devices. Glo was unable to connect any of the 10 test calls that were tried at two particular outskirt measuring spots. While MTN also showing performance decline in Zone C, maintained signal readings in the range of -80 to -82 dBm which is weaker than its town-center performance but sufficient for call establishment in most trials.

B. Peak-Hour Performance

Both networks showed measurable performance degradation during peak measurement windows. MTN's CDR rose modestly during peak hours while remaining within NCC tolerance levels. Glo's peak-hour CDR climbed more steeply, and its CSSR dropped below 95% at several town-center and residential locations during the morning rush. This pattern is consistent with the congestion dynamics described by Kuboye et al. (2009), where high simultaneous call volumes exhaust available Traffic Channel (TCH) allocations, leading to both blocked call setups and premature call terminations. Off-peak measurements for both networks were generally improved, with MTN recovering to near-peak CSSR values and Glo showing moderate improvement, particularly in residential zones.

V. DISCUSSION

Although they offer significant location-specific subtlety, the study's findings are generally in line with the trends noted in the larger Nigerian GSM QoS research. The results of Nwabueze and Oyubu (2016) in nearby Oleh, Delta State, where MTN also led on signal quality, and the national-scale findings of Oritsetimeyin et al. (2023), who discovered that MTN had the highest CSSR and lowest CDR of all

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Nigerian operators over a two-year observation window, are consistent with MTN's dominance across all five parameters. The current work offers fine-grained geographical evidence of how this performance disparity appears in a particular community and, importantly, where the gap is most detrimental to user experience within that community.

Glo's performance decline in the outskirts of Ozoro is particularly noteworthy. Signal readings approaching -90 dBm at several Zone C locations suggest that existing base station coverage does not adequately serve the town's peripheral areas. This finding echoes the concern raised by Mughele and Olatokun (2012), who argued that congestion and coverage failures affect different zones unevenly and that service providers need location-specific diagnostics to address them effectively. It also aligns with Lukonge et al. (2014), who demonstrated that targeted optimization, including adding new sites, adjusting antenna tilts, and using RF repeaters, can substantially improve coverage in underserved zones.

The subjective speech quality ratings, rarely incorporated in Nigerian GSM studies, provide a useful complement to the objective signal measurements. MTN's mean speech quality score of 4.1 (Good) versus Glo's 2.8 (Fair-to-Poor) suggests that the technical performance gap translates directly into a user-perceived quality gap. This finding has practical implications for subscriber retention: as Mughele et al. (2011) observed, the initial excitement surrounding mobile phone access has given way to subscriber frustration driven largely by poor call quality, and high churn rates threaten operator revenue stability. Glo's considerably lower speech quality scores in this study suggest it faces meaningful subscriber dissatisfaction risk in Ozoro.

Both networks' peak-hour performance declines indicate a capacity management issue that optimization cannot completely resolve. Regardless of antenna calibration, CSSR and CDR are anticipated to deteriorate during times of high demand when subscriber expansion continues to exceed infrastructure investment, a well-documented trend in Nigerian telecommunications history (Kuboye, 2010). To provide enough operator incentives for proactive capacity growth, regulatory intervention may be required. This might include mandated performance monitoring during peak periods and financial penalties for persistent non-compliance.

VI. CONCLUSION

This study presented a field-based comparative evaluation of GSM call quality between MTN Nigeria and Glo Mobile in Ozoro, Delta State. Across all five measured parameters (CSSR, CDR, Signal Strength, CCR, and Speech Quality) MTN demonstrated superior performance, with the gap between the two operators widening considerably in the town's outskirts and during peak traffic hours. Glo's network showed particular vulnerability in low-coverage zones, where signal strength at several locations fell to levels insufficient for reliable call establishment. These findings carry implications for subscribers, operators, and regulators alike: users in Ozoro seeking stable voice connectivity are better served by MTN under current network conditions; Glo requires targeted base station expansion and network optimization in peri-urban areas; and the NCC should strengthen its QoS monitoring to include routine field audits in semi-urban communities, not just national aggregate reporting.

In addition to measuring data throughput and SMS dependability in addition to voice call quality measures, future study should broaden the scope of this bilateral comparison to include Airtel and 9mobile in Ozoro and other villages. The research foundation for Nigeria's semi-urban telecom strategy would be further enhanced by longitudinal studies that monitor seasonal and infrastructure-driven performance variations over time.

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