STRATEGIES FOR IMPROVING QUALITY OF SERVICE (QoS) OF GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM) IN NIGERIA

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Abstract

With the increase in growing technology, it becomes imperative to review quality of service (QoS) parameters for global system for mobile *communication (GSM).This paper develops a model of service quality and a set of dimension for comparative evaluation which could provide useful direction to regulators and service providers. This paper concludes with recommendation on how to improve both the QoS in the country in order to enhance the mass-connectivity.*

Keywords: Quality of Service (QoS), Key Performance Indicator (KPI), GSM frequency, Synchronization, Network, Geographic Information Service (GIS).

Introduction

The need for information and communication has been there since the beginning of human existence on this planet. In Nigeria, we had our traditional means of communication which involves the use of locally made instrument such as gong, gun, trumpet, town crier etc. This continued until the colonial masters came with a new method of communication which was telephony. This brought changes in the way information dissemination is done in our country and later the company became our NITEL. In those early times of its introduction, the usage of telephone was luxury meant for the privileged few. The 'teledensity' of Nigeria was very low compared to other countries of the world and also compared to the population it was meant to service. Note: Teledensity refers to the ratio of number of people to the available number of telephone lines. Hence, quality of service (QoS) was not considered as a serious issue since there was no competition, and very small number of customers on the network.

In the year 2001, the first GSM call was made in Nigeria. This brought about a new era in the communication industry. Ten years after the launching of GSM, the industry has witnessed a lot of changes. Other communication companies have moved into the market. The industry is looked at as one of the fastest growing market in Africa and indeed the world. During the first years of its launch, the entire Nigerian populace experienced the euphoria of owning a GSM phone set. With the euphoria settled the focus is shifting to very important key areas of service delivery. The demand for good quality of service (QoS) has become an issue in the country. This agitation has become a national issue which had been brought before the House of Representative on July 18, 2007 and the Nigerian Communication Commission (NCC). In finding the lasting solution to the problem, the NCC, a body responsible for the regulation of GSM in Nigeria on 6th July 2007 issued out the threshold levels on the key performance indicators (KPIs) for measuring QoS of all GSM operators in the country.

Methodology

Let us first understand what Quality of Service is. Quality of Service (QoS) refers to the state of nature of services rendered by the GSM operator, which can either be good or bad quality. For the service to be considered as good, it has to satisfy the demand expectation of the customers. Technically speaking, QoS was defined in the ITU standard X.902 as "A set of quality requirements on the collected behaviour of one or more objects". Quality of service comprises requirements on all the aspects of a connection, such as service response time, loss, signal-to-noise ratio, cross-talk, echo, interrupts, frequency response, loudness level, etc. QoS is defined by a set of parameters, metrics, key performance indicator (KPI's), measures and determinants. QoS is judged by the customers so it is very important to carry out evaluation from their point of view. There are four fundamental aspect of quality of service: network accessibility, connection quality, network retainability, billing and accuracy.

Network Accessibility: This has to do with hooking up to the network and the availability of the desired network. Here the signal strength is measured within coverage area to get to the size of the cell.

Connection Quality: For the duration of the successful call, how good was the user experience while making of the desired service.

Network Retainability: While using the desired network service, does it fail intermittently or is the user able to have a full conversation and download file through a GPRS session. This is what network is all about.

Charging Accuracy: The user network has to be billed accurately. Note: the quality of service QoS should be Important to users, Measurable, Comparable between GSM operators.

The Relevant Key Performance Indicators

The relevant Key Performance Indicators (KPI) on which GSM network are tested are: call set-up success rates (CSSR), call drop rate (CDR), call completion success rates (CCSR), handover success rate (HSR), and traffic channel congestion rate (TCHCR).

Call Set-up Success Rate (CSSR): This measures the ease in which calls are established or set up. The high the value of CSSR, the easier it is to set up a call. For instance if a CSSR of 80% means that out of every 100 calls made 80 are successful while the 20 are unsuccessful. CSSR is defined as the ratio of number of unblocked call attempts to total number of call attempts.

Call Drop Rate (CDR): This indicator measures the network ability to retain call conversion when it ha been established. What a CDR of 10% means is that out of every 100 calls established, 10 will drop before any of the calling parties voluntarily terminates the call. CDR is defined as the ratio of number of dropped call to total number of call attempts [i.e.(1-call complete probability)*100].

Call Completion Success Rate (CCSR): This is the ratio of total number of completed calls to the total number of call attempts. It can serve as a good parameter for evaluating the network accessibility and retainability.

Handover Success Rate (HSR): The indicator measures the success of handover. Actually, this value is expected to be minimal; as it's minimal improves CDR.

Traffic Channel Congestion Rate (TCHC): This is congestion by the users and it measures the relative ease by which the user seizes a traffic channel to set up a call after a signalling seizure has been successful. The higher this value the more difficult it becomes to make a call.

GSM Frequency

The GSM is based on the concept of frequency reuse. The propagation environment determines the interference received from the neighbouring co-channel cells which in turn govern the reuse distance, that is the distance allowed between co-channel cells (i.e. cells using the same set of frequency channels). Generally, there are five frequency bands designed by International Telecommunication Union (ITU) for the operation of the GSM mobile phone; GSM-400, GSM-850, GSM-900, GSM-1800, GSM-1900.

GSM Architecture

A GSM architecture is a complex structure. It is made up of many small units working in harmonious way. To better understand GSM architecture, its units are divided in categories as thus:

i. **Mobile Station**: This is actually the mobile phone itself. It works by communicating with the other parts of the base station.

ii. **Base Station:** This is made of two parts; the Base Transceiver Station (BTS)- which is responsible for the wireless communication between mobile and its relevant network. This is possible through a radio interface. This base transceiver station is based on a radio and antenna. The other one is Base Station Controller (BSC). This provides the control. It directs the function and establishes connection between BTS and MSC. The functions like cell configuration, handover, and RF power level controls are processed in base station control. MSC also controls some of BSC functions.

Factors Affecting QoS

i. **Network design:** The engineers of the mobile operators should design their works having good quality of service at the back of their minds. The network should be designed in such a way that it will never fail. That is it should be able to create alternative links to resolve transient changes over the network. Protocols, gateways and backbone for the network should be wisely chosen or decided upon.

ii. **Instability of the Power Supply:** In advanced nations of the world where power supply is constant, quality of service is highly improved compared to third world countries where power remains an insurmountable challenge. Intermittent power affects the quality of service of mobile network adversely being that electronic equipment requires constant power supply.

iii. **Equipment Specification**: As technologies emerge rapidly, mobile operators should be very proactive in the acquisition and deployment of new electronic when they come onboard. For example, the Eriksson equipment based network. The network should be accessible to the largest number of users. The land mass of the country should be taken into serious consideration, Knowing that greater part of the population reside in the rural areas. Regulatory body should be able to calculate where and when network is lacking in the country and come up with modalities on how the GSM operators are to cover those areas. This is actually the inability to access the network when initiating a call. According to an earlier survey carried out by the NCC, all the three major GSM operators (MTN, GLO and Airtel) were found to perform poorly in the area of numbers of times that users had to dial before the proper connection is made. The survey shows that less than half of the subscribers on each of the .networks do get their calls through on the first or second attempt. In other words, the subscribers who dial more than one time before being properly connected were: (MTN-54%, GLO-53%, and Airtel-51%). Recently another survey was conducted and the results of sample opinion in some selected major towns in Nigeria are shown in tables and figures below.

Table 1: Subscriber dialling two or more times before being connected

CITY	MTN%	GLO%	Zain%
Abakaliki	35	29	34
Aba	41	51	44
Abuja	42	54	39
Awka	46	29	38
Bauch	33	41	35
Benin	55	33	44
Calaber	34	48	42
Enugu	40	34	39
Ilorin	33	29	53
Jos	39	45	29
Kaduna	57	35	30
Kano	61	53	27
Katsina	54	31	45
Lagos	46	50	50
Onitsha	49	54	48

Aggregate: MTN = 44.3, GLO = 41.07%, Zain = 39.80%

CITY	MTN%	GLO%	Zain%
Abakaliki	29	14	34
Aba	32	31	28
Abuja	37	35	26
Awka	22	20	38
Bauch	17	42	19
Benin	19	32	25
Calaber	26	27	40
Enugu	19	32	37
Ilorin	32	34	26
Jos	27	18	22
Kaduna	15	21	19

Kano	42	18	16
Katsina	22	45	21
Lagos	53	39	27
Onitsh	48	49	18
Owerri	30	22	25
Port-Harcourt	31	16	39
Umahia	16	17	21
Uyo	21	30	28

Aggregate: MTN = 28.32%, GLO = 28.53%, Zain = 26.79%

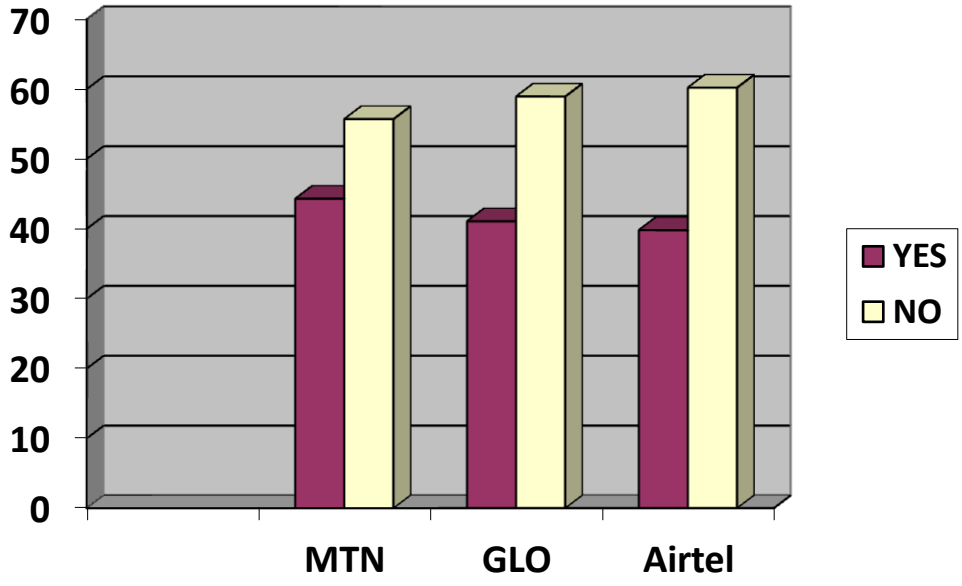

Fig.1: Subscribers dialling two or more times before being connected

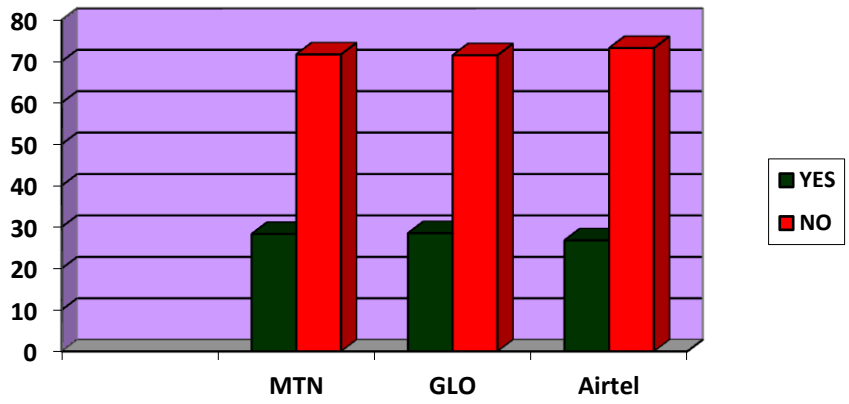

Fig. 2: Subscribers connected to number not dialled

Bandwidth Allocation: When the GSM operator takes more users than it can handle, the resultant effect is congestion on the network. What it means is that there are no available channels to route call through. Regulators should also clamp down on GSM operators and insist that they do not bite more than they can chew. GSM operators must be compelled to purchase enough bandwidth so that their service quality doesn't dwindle when users increase on the network.

Network Frequency Synchronization: This is a new discovery that lack of Base Transceiver Station (BTS) synchronization effects GSM handover performance, leading to some degradation of quality of service. The speech quality of calls between two handsets, undergoing handover between two BTSs synchronized with variable frequency offset, was measured in terms of Mean Opinion Score (MOS) and speech clipping. The result shows that without the network synchronization, there is about 40% performance degradation. The Mean Opinion Score is a measure of listening quality with score ranging from bad; poor; fair; good; excellent according to the scale defined in ITU-T Rec. Speech Clipping is a measure to indicate the loss of speech segment.

Suggested Method of Improving QoS

Operators should upgrade and optimise all existing base stations. If this is done, it will slim call failure rate due to increase in traffic volumes.

Install additional base station across the country. This would create room for the network to handle more traffic.

The use of *Automated Test Calls* and *GIS (geographic information system)- based tool* is highly recommended. Automated Test Calls overcomes all the limitations of *Manual Test Calls* in monitoring quality of service. However, the use of GIS-based

tools becomes imperative as it helps to make informed technical decision in resolving network issues. It shows areas experiencing low quality of service.

The GSM operators should build additional switching centres across the country and increase capacity to handle more traffic.

If a particular base station is to be taken "off-line" (either for schedule maintenance, repairs, upgrades, etc.), all neighbouring base stations should have their communication power levels increased. This will increase the coverage area, thereby reducing congestion and drop calls.

Operators should invest heavily in transmission network development and have proper radio planning. This would ensure increased network silence, improved bandwidth utilization, and alleviation of capacity bottlenecks.

The operators should continue to give back to the society and aim to enhance social security. This is because no amount of security personnel can deter hoodlums from attacking base station sites. Also, if the government can create more jobs for its citizens, poverty levels would be reduced and a lot of boys and girls will be taken off the streets. Hence we would have a secured environment.

Incessant power failures should be addressed by the government. This will put a stop to the over-dependence on generators for power supply. If this is achieved, call tariffs would drastically go down.

Regulatory bodies should make sure that the GSM operators abide by all the rules of engagement.

Conclusion

Our country being the giant of Africa should come up with an ICT master plan for the nation. Having this as a working document will definitely improve the services of the regulatory body, National Communication Commission (NCC). Moreover, the country should have an information super-highway through the laying of fibre optic cables throughout the country. Charting of all our streets, communities, roads, should be accessible through the use of GIS map.

Finally, telecommunication companies should put into consideration accurate radio topologies so as to ensure smooth handovers and call distribution. This is of great importance during site survey and site selection of base stations.

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