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An Assessment of Quality of Service (QoS) In Voice Communications over Four GSM Networks in Lagos and Oyo States of Nigeria

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ABSTRACT

This study investigated the performances of four operators of mobile telecommunications services in voice communications in Lagos and Oyo States in South Western Nigeria for the first five years of operation. Using the International Telecommunications Union (ITU) standard of measuring customer experience of voice telephony service through the voice quality scores known as the Mean Opinion Score (MOS), the study identified the quality of service in voice call between the year 2001 and 2006. The data used for the statistical analysis were obtained randomly from the subscribers of GSM services in the states. The research established that the voice quality for the first five years of operation on all the networks considered were below the ITU specified conversational voice quality of > 3.0 on the MOS scale.

Keywords: *Telecommunications, Conversational Voice Quality, Mean Opinion Score (MOS), GSM Network, Cell*

1. INTRODUCTION

Telecommunications network in Nigeria has experienced tremendous growth in recent time. Efficiency, reliability and affordability are three main criteria usually considered in a telecommunications network system [1, 2, 3,4]. This study assess the quality of service in voice call over four major GSM networks; MTN, GLO, MTEL and CELTEL, in Lagos and Oyo states of Nigeria.

In GSM, the voice waveform is digitally encoded before transmission. As the system is based on Time Division Multiple Access (TDMA), individual users are given access to the radio channel for a limited period and transmit a burst of binary information [5, 6]. Frequency planning is a major issue in the design of a cellular system. The base stations communicate simultaneously with all mobiles within their area of coverage (or cell) and are connected to mobile switching centres (MSCs). A mobile switching centre controls a number of cells, arranges base stations and channels for the mobiles and handles connections with the fixed public switched telephone network (PSTN) [5, 7, 8, 9].

In order to ensure universality and interoperability across the globe in telecommunications services, the ITU has set specific standards and regulations in various aspects of information and communications technologies. The ITU has provided bench marks for equipments and services.

The Nigerian Communications Commission (NCC) has adopted the ITU standard so that the country can be totally integrated into the entire globe. Conversational Voice Quality is a means of measuring customer experience of voice telephony service through the voice quality scores known as Mean Opinion Score (MOS) standardized on a scale of 1 to 5 by ITU. The Quality Scores are 5 – Excellent, 4 – Good, 3 – Fair, 2 – Poor, 1 – Bad.

2. RESEARCH METHODOLOGY

The study was carried out in coverage areas of MTN, CELTEL, GLOBACOM and M - TEL. signals in Lagos and Oyo States. Five percent (5 %) of the subscribers on each of the operator's network as at December 2006 were randomly selected. The respondents are academicians, students, industrialists, bureaucrats, technocrats, vendors of GSM services, and the general public. The main instrument used for the study was structured questionnaire (Appendix). The question is strictly on voice quality, and is structured to elicit responses through which the mean opinion scale can be calculated.

3. RESULTS AND DISCUSSIONS

Table 1 depicts the number of subscribers on the network of the four services providers in Lagos and Oyo States between 2001 and 2006. Table 2(a), 3(a), 4(a) and 5(a) depict the available telecommunications facilities over the same period while table 2(b), 3(b), 4(b) and 5(b) shows the annual increment in facilities and subscribers. The subscriber responses are as tabulated in table 6.

From Table 4.5.1, it is clear that in both states, the Mean Opinion Score (MOS) for Voice Quality on all the Networks considered in this study are far below the ITU specifications. Celtel and Mtel with the best performance in conversational voice quality in Oyo and Lagos States during the period under consideration have 39.2 % and 51.1% of their respective subscribers agreeing to the excellence of voice quality over the networks. Technically, the implication is that the Mean Opinion Score (MOS) for the conversational voice quality is 1.96 and 2.55. This is below the ITU standard of Conversational voice quality of > 3.0 on the MOS scale.

4. CONCLUSIONS & RECOMMENDATIONS

In both states, the Mean Opinion Score (MOS) for Voice Quality on all the Networks considered in this study are below the ITU specifications of Conversational voice quality of > 3.0 on the MOS scale. There is the need for services providers to strengthen their Mobility Management Operations. The number of available Base Station Transceivers, Base Station Switching Centres, Mobile Service Switching Centres, and Gateway Mobile Service Switching Centres are not commensurate with the increment in number of subscribers during the period. Where operators are unable to establish a macro cell base station because of cost, there is the need to utilize the advantage of micro, pico and umbrella cells. The dependence of operators on macro cells during the period may be partly responsible for poor voice quality.

Table 1: Number of Subscribers (in Millions) on the Network of Service Providers in Lagos and Oyo State (2001 – 2006)

		MTN	MTN	GLO	GLO	CELTEL	CELTEL	MTEL	MTEL
		Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo
2001	1	0.5	0.35			0.302	0.25	0.04	0.032
2002	2	1.2	0.7			1.3	0.8	0.069	0.053
2003	3	2.7	2.4	2.5	1.9	1.6	1.1	0.15	0.092
2004	4	3.244	3	3	2.23	1.8	1.5	0.221	0.153
2005	5	5.432	4.902	5.2	4.83	2.9	2.1	0.45	0.342
2006	6	6.932	5.54	6.7	5.4	3.321	2.661	0.545	0.411

Table 2 (a): Telecommunications Facilities available for MTN Services

S/N	FACILITY	2001		2002		2003		2004		2005		2006	
		Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo
1	BTS	20	14	26	30	38	46	46	60	56	66	66	72
2	BSC/BSSC	4	2	7	4	9	4	14	6	17	6	24	8
3	BS-GPRS	-	-	-	-	4	-	4	3	6	6	10	8
4	MSC	4	2	4	2	4	3	6	4	6	5	6	6
5	GMSC	2	1	2	1	2	1	2	1	3	2	3	2
6	DTI	1	1	1	1	1	1	1	1	1	1	1	1
7	AUC	2	1	2	1	2	1	2	1	2	1	3	2
8	HLR	2	2	2	2	2	2	2	2	2	2	2	2
9	SMS-GMSC	-	-	3	3	5	3	5	4	5	4	7	7
10	SMS-IWMSC	-	-	-	-	-	-	1	1	2	2	2	2

Table 2 (b): Increment in MTN Facilities and Subscribers (2001 – 2006)

FACILITY	LAGOS STATE	OYO STATE
BTS	46	58
BSSC	20	6
MSC	2	4
GMSC	1	1
SUBSCRIBERS	**6,432,000**	**5,190,000**

Table 3 (a): Telecommunications Facilities Available for GLO Services

S/N		2001		2002		2003		2004		2005		2006	
		Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo
1	BTS	-	-	15	10	22	18	30	29	40	37	47	48
2	BSC/BSSC	-	-	3	2	5	2	7	5	9	7	14	7
3	BS-GPRS	-	-	-	-	2	3	6	4	7	7	9	7
4	MSC	2	2	2	2	3	2	3	2	3	3	4	3
5	GMSC	2	1	2	1	2	2	2	2	3	2	3	2

6	DTI	1	1	1	1	1	1	1	1	1	1	1	1
7	AUC	2	2	2	2	2	2	2	2	3	3	4	4
8	HLR	3	3	3	3	3	3	3	3	3	3	3	3
9	SMS-GMSC	-	-	5	4	5	4	7	6	7	6	7	7
10	SMS-IWMSC	-	-	-	-	-	-	1	1	1	1	3	3

Table 3(b): Increment in GLOBACOM Facilities and Subscribers (2003 – 2006)

FACILITY	LAGOS STATE	OYO STATE
BTS	24	30
BSSC	9	5
MSC	1	1
GMSC	1	-
SUBSCRIBERS	**4,200,000**	**3,500,000**

Table 4(a): Telecommunications Facilities Available for MTEL Services

S/N		2001		2002		2003		2004		2005		2006	
		Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo
1	BTS	-	-	12	8	18	14	24	23	28	36	33	40
2	BSC/BSSC	-	-	2	2	2	2	2	2	2	2	2	2
3	BS-GPRS	-	-	-	-	-	-	-	-	-	-	-	-
4	MSC	2	2	2	2	2	2	2	2	3	3	4	3
5	GMSC	1	1	1	1	1	1	1	1	2	1	2	2
6	DTI	1	1	1	1	1	1	1	1	1	1	1	1
7	AUC	1	1	1	1	1	1	1	1	1	1	1	1
8	HLR	1	1	1	1	1	1	1	1	1	1	1	1
9	SMS-GMSC	-	-	-	-	-	-	-	-	-	-	2	2
10	SMS-IWMSC	-	-	-	-	-	-	-	-	-	-	1	1

Table 4 (b): Increment in MTEL Facilities and Subscribers (2001 – 2006)

FACILITY	LAGOS STATE	OYO STATE
BTS	21	32
BSSC	-	-
MSC	2	1
GMSC	1	1
SUBSCRIBERS	**476,000**	**358,000**

Table 5(a): Telecommunications Facilities Available for CELTEL Services

S/N		2001		2002		2003		2004		2005		2006	
		Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo	Lagos	Oyo
1	BTS	17	12	22	18	25	27	25	38	30	42	42	58
2	BSC/BSSC	3	2	4	3	6	3	7	4	11	7	13	11
3	BS-GPRS	-	-	4	2	4	4	8	4	11	7	13	
4	MSC	2	1	2	1	2	1	3	3	3	3	4	4
5	GMSC	2	1	2	1	2	1	2	1	2	2	3	2
6	DTI	1	1	1	1	1	1	1	1	1	1	1	1
7	AUC	2	1	2	1	2	1	2	1	2	1	3	2
8	HLR	1	1	1	1	1	1	1	1	2	2	2	2
9	SMS-GMSC	2	2	2	2	4	4	4	4	6	5	6	6
10	SMS-IWMSC	1	1	1	1	1	1	1	1	2	2	3	3

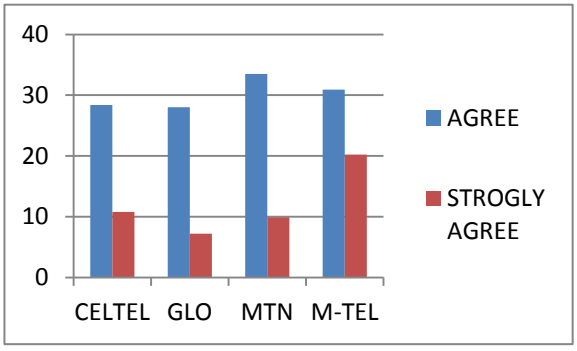
Table 5(b): Increment in CELTEL Facilities and Subscribers (2001 – 2006)

FACILITY	LAGOS STATE	OYO STATE
BTS	25	46
BSSC	10	9
MSC	2	3
GMSC	1	1
SUBSCRIBERS	**3,019,000**	**2,411,000**

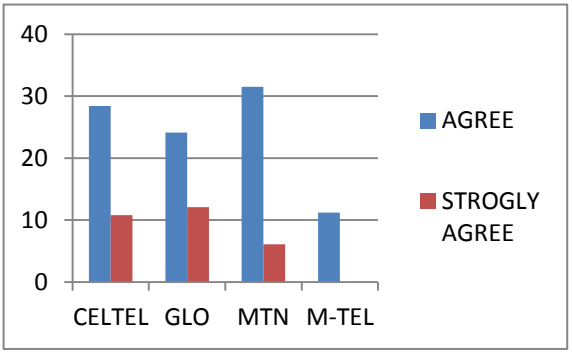
Table 6: Inferences from Responses of Subscribers in Oyo and Lagos States

Question Number	General Interpretation of The Question/ Technical Parameter Under Investigation	Inferences from Cross Tabulations	
		Oyo State Subscribers	Lagos State Subscribers
1.	Conversational voice quality is always excellent i.e. Fading, Noise, Distortion & Interference is extremely minimal or non-existent on the Network. / (Mean Opinion Score, MOS)	**Best Performance:** CELTEL: 28.4% agree, 10.8% agree strongly. MTN: 31.5% agree, 6.1% agree strongly GLOBACOM: 24.1% agree, 12.1% agree strongly **Least Performance:** M-TEL.: 11.2% agree, 0.0% agree strongly.	**Best Performance:** M-TEL: 30.9% agree, 20.2% agree strongly. MTN: 33.5% agree, 9.9% agree strongly CELTEL: 33.8% agree, 18.011% agree strongly **Least Performance:** GLO: 28.0% agree, 7.2% agree strongly.

Inferences from Responses of Subscribers in Oyo



Inferences from Responses of Subscribers in Lagos



REFERENCES

[1] Chukwudebe, G and Chika, I.E (2005) "Sustainable National Telecommunication Development: An Overview Critical Requirements" Proceedings of the National Engineering Conference of the Nigerian Society of Engineers, Page 269-278.

[2] Olamade, O. O. (2002): "Technological Capability Building in the Telecommunication Industry in Nigeria", An unpublished M.Sc Thesis, Technology Planning and Development Unit, Obafemi Awolowo University, Nigeria.

[3] Ajayi, G. O. (2000): 'General Overview on Information and Networking Technology', Information and Networking Technology Workshop I (INFONET 2000 (I)), Obafemi Awolowo University, Ile-Ife.

[4] Maduka, V.I. (2004): "Telecommunications in NEEDS", Proceedings of COREN 13th Engineering Assembly, Abuja, Page 68-75

[5] Dunlop, J. and Smith, D.G. (1994): Telecommunications Engineering, Stanley

Thornes (Publishers) Ltd., Cheltenham, 3rd Edition.

[6] Scouria, J. (2001): "Overview of the Global System for Mobile Communications", jscouria@www.shoshin.uwaterloo.ca.

[7] Brewster, R.L. (1988): Telecommunications Technology, Hellis Horwood Ltd., New Delhi, India, 2nd Edition.

[8] Elegbede, S. A. (2001): "Global System for Mobile Communication (GSM)", A Paper Presented at the School of Engineering Technology Seminar, The Federal Polytechnic, Ede.

[9] ERICSSON Technologies Company Limited. (2006): Manual on GSM Cell Planning Principles, EN/LZT 123 3314 R4A.

[10] Cell Tower (2006): http://www.privateline.com/index.html.

[11] Celtel (2006): http://www.ng.celtel.com/.

[12] Globacom Nig. Ltd. (2006): http://www.gloworld.com/.

[13] Nigerian Communications Commission, NCC, (2001): "Quality of Service Regulations 2001"

[14] Nigerian Communications Commission, NCC, (2006): "Quality of Service Regulations 2006"

[15] Roaming Service Delivery Platform: http://www.starhome.com/admin/FileServer/8b91c3a6537030e9667d1d8226097e7b.pdf.Intelligate.

[16] Scouria, J. (2001): "Overview of the Global System for Mobile Communications", jscouria@www.shoshin.uwaterloo.ca.

APPENDIX
QUESTIONNAIRE

1. Conversational voice quality is always excellent on the GLOBACOM network.

0	1	2	3	4	5
No Response	Disagree Strongly **(Bad)**	Disagree **(Poor)**	Agree Slightly **(Fair)**	Agree **(Good)**	Agree Strongly **(Excellent)**

2. Conversational voice quality is always excellent on the M-TEL. network.

0	1	2	3	4	5
No Response	Disagree Strongly **(Bad)**	Disagree **(Poor)**	Agree Slightly **(Fair)**	Agree **(Good)**	Agree Strongly **(Excellent)**

3. Conversational voice quality is always excellent on the MTN network.

0	1	2	3	4	5
No Response	Disagree Strongly **(Bad)**	Disagree **(Poor)**	Agree Slightly **(Fair)**	Agree **(Good)**	Agree Strongly **(Excellent)**

4. Conversational voice quality is always excellent on the CELTEL network

0	1	2	3	4	5
No Response	Disagree Strongly **(Bad)**	Disagree **(Poor)**	Agree Slightly **(Fair)**	Agree **(Good)**	Agree Strongly **(Excellent)**