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Evaluation of Broadband Network Performance in Nigeria

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Abstract

Broadband provides high speed data transmission to Internet and 4G networks were developed to transform broadband technology with higher data rate and enhanced quality of service. The performance of broadband network in Nigeria in terms of type, purpose and speed was evaluated in this work. Some quarters at Ilesa and Oba-Ile in Akure were chosen as rural areas, while Abuja and Lagos represented the urban areas of the study. Questionnaires were administered among users in these areas randomly. Thereafter, data were analyzed and research questions answered from the analyzed results. The results showed that the majority of the respondents operated on wireless broadband technologies. The download speed is generally above 100 mbps in urban areas and below in rural areas, with MTN having the highest number of subscribers. In addition, most of the Internet surfers download files. With these characteristics, it was discovered that the network operators were deploying 3G systems as broadband instead of 4G systems.

Keywords

Performance, Evaluation, Broadband, Network, Subscribers

1. Introduction

A great number of people across the globe have adopted mobile cellular network as their primary means of accessing Internet, voice communication, entertainment services and text messages, therefore, the demand for mobile network services increases every day. As reported by [1], mobile penetration rate of the country has steadily grown over the last ten years to 103.91%, with a total active subscriber base of 145.5 million. Due to the success of data connection on the cellular network, there has been a great demand for data services that have led to the introduction of several generations of wireless systems and paved way to in-

troduction of broadband technology. Active mobile Internet subscriptions in Nigeria using Global System for Mobile Communications has steadily grown from 63 million in February 2014 to 87 million in April, 2015 [1]. One of the objectives of broadband networks is to let users access the Internet at a speed of at least 1 Mbps and throughput of 300 mbps. As a result of the success of data connection on mobile cellular network, subscribers can use their mobile phones for a wide range of activities, including surfing the Internet, purchasing goods and services online, streaming video or music and conducting financial transactions when connected to the Internet through broadband network [2] [3].

The introduction of Code Division Multiple Access Evolution-Data Optimized (CDMA-EVDO), High Speed Packet Access (HSPA) networks, Worldwide Interoperability for Microwave Access (WiMAX) and Long Term Evolution (LTE) has widened broadband access. Mobile broadband has created momentum in the broadband market. Mobile broadband subscribers now account for over half of all high speed Internet service users [4]. According to [5], mobile broadband subscriptions reached over 1.4 billion in 2012 and it is projected to reach 6.5 billion by 2018. Despite its promising services, broadband are still not readily available in Nigeria [6].

Broadband networks comprises Digital Subscriber Line (DSL) that transmits data over traditional copper telephone line to home and businesses, fiber optics technology that converts electrical signals carrying data to light and has the capacity to transmit data at speeds surpassing any other broadband technology [7]. Furthermore, wireless cellular networks such as Long Term Evolution (LTE), mobile WiMAX, CDMA2000 (EVDO), and UMTS (HSPA) also are part of broadband. Wireless broadband connects a home or business to the Internet using a radio link between the customer's location and the service provider's facility. Wireless broadband can be mobile or fixed cellular network. Satellite broadband is another form of wireless broadband and it is useful for serving remote or sparsely populated areas. Broadband over Power lines (BPL) technology provides broadband by using power lines connected to a consumer's residence. Consumers have to use special modem provided by the power company to access this type of broadband Internet services.

Prior to the advent of broadband, wireless technology generations have been delivering functionalities like voice, short message service (SMS), video calls and data file transfers. The first generation wireless technology (1G) was successful in establishing the fundamental mobile voice communication, while the second generation (2G) introduced higher capacity and coverage than the 1G. Thereafter, 2.5G was introduced to pave way for the data connection on cellular network, thus, revolutionizing the adoption of data connection on the cellular network till date [8]. The third generation (3G) brought the quest for data at higher speeds to open the gates for mobile broadband experience. Moreover, due to the low transmission rate and high service costs, the third generation (3G) technology has been unsuccessful in delivering ubiquitous and high-speed mobile

broadband [9]. To address the mobile broadband requirements, the 3GPP introduced the new radio access technology Long Term Evolution (LTE) which paved way for the fourth generation (4G) wireless systems that have access to wide range of telecommunication services while 3GPP2 introduced Evolution Data Optimized (EVDO) Rev 0 scale up to Rev C that have similar specification with LTE [10] [11]. In the same vein, Worldwide Interoperability for Microwave Access (WiMAX) was developed by IEEE as IEEE 802.16 standard. It was aimed at providing wireless data over long distances in a variety of ways from point-to-point links to full mobile cellular type access.

A comparison of 3G and 4G wireless network was done by [12]. The research focused on their architecture, speed, supporting technology, bandwidth and quality of service. They gave full description of LTE and 3G architecture stating that LTE architecture is flat IP based architecture and made it a better choice than 3G. Studies on Broadband Wireless Access Deployment Approach to Rural Communities were carried out by [13]. The work was aimed at implementing wireless broadband access with WiMAX and Wi-Fi. Their impetus was based on the fact that, in rural inaccessible areas, wired networks are not cost effective. People in rural areas want to communicate with both people in the rural and urban areas for many reasons because communication is a vital part of their daily social, political, and economic activities. As a result of this, there is a high demand for high speed Internet access.

Dahunsi [7] investigated Broadband infrastructure using Fiber Optic and the state of development of broadband in a developing economy. An assessment of fiber optic operator's activities in terms of coverage, capacity and utilization was given. The work also examines the relationship between major stakeholders—core network, distribution network, access network and the customer—using the broadband ecosystem model to analyze the relationships between the different tiers of the system in terms of competitions, information and symbiosis. Furthermore, challenges facing broadband penetration in Nigeria were also investigated and solutions proffered. The research recommended that if Nigeria is to be a key player in the emerging information society, there is the need to address the problems of infrastructure, ICT policy, illiteracy and research.

Agbakwuru [14] examined the level of Internet penetration and diffusion in Orlu Zone of Imo state, Nigeria, its level of access and problems associated with the penetration. The study was based on questionnaires administered to subscribers of Internet. The results showed that some people do browse despite the challenges but most people could not. It was recommended that government should help the rural areas in having access to Internet by finding a way of reducing the cost of Internet access.

Omigie [15] investigated the factors that could stimulate the intention of users to use mobile broadband in Nigeria. The work validates an integrated research model adopted from the unified theory of acceptance and use technology (UTUAT) model by integrating mobile broadband motivation, government

support and perceived price value constructs. Online survey was done and data collected were analyzed and results showed that mobile broadband motivation, government support, perceived price value, social influence and facilitating conditions are very important determinants of intention of subscribers to use mobile broadband in Nigeria.

Tantawy [16] studied cross layer scheduling algorithm. It revealed the fact that LTE emanated from an increasing need of next generation mobile networks to offer high performance, mobile broadband services. The objective of the work was to develop a cross-layer scheduling algorithm in LTE that will offer high performance, mobile broadband services, along with a combination of high bit-rates and system throughput in both uplink and downlink along with low latency. A novel Quality of Service (QoS) guaranteed cross-layer scheduling algorithm for LTE system that allocates resources to the users as resource blocks was proposed.

Prasanna [2] investigated the impact of differentiation and scheduling of resources in the transport network on the end to end performance of voice over LTE network. The study prioritized voice over data traffic and analyzed its performance for different transport network scheduling algorithms. The results showed that proper classification and scheduling of resources in the transport network, will significantly increase voice capacity in LTE. It was also showed that prioritizing voice calls totally will affect the performance of data traffic. As a result, voice and data users were classified into different priority levels and their performance in this scenario was investigated. The results showed that by grouping voice users into different priority levels, there is an increase in capacity when compared to mapping them to a single specific service class. The work was simulated using OPNET.

Many telecommunication companies in Nigeria have laid claim on the deployment of broadband services in Nigeria. Also, Nigeria Communication Commission (NCC) has tried to license some companies to give broadband services and most GSM operators in Nigeria (GLO, MTN, Etisalat and Airtel) are advertising that they deploy LTE as a broadband service to their customers [6]. Therefore, this work is to investigate the claims and see how far they have penetrated the telecommunication markets, in terms of the technologies adopted, and download speed.

In view of this, the research questions examined in this work are as follows:

R1: Is the download per click or capacity of the Internet in Nigeria above or below 100 mbps?

R2: What is the type of broadband technology in use in Nigeria?

R3: What is the purpose of broadband usage in Nigeria?

R4: Which Network Operator is mostly used by Nigerians?

2. Research Methodology

Global System for Mobile communications (GSM), Code Division Multiple

Access (CDMA) and evolution of wireless networks to broadband from 1G to 4G were studied. Furthermore, related works on wireless networks and broadband networks were studied. In the bid to access the performance of broadband network in Nigeria, data on broadband performance were collected using survey research method by administering questionnaires to the subscribers of the wireless networks in four location areas. The four locations consist of two rural areas which are Ilesa and Oba-Ile and two urban areas which are Lagos and Abuja with 30 respondents from each of the chosen locations. The participated broadband subscribers comprised of civil servants, lecturers, politicians, unemployed graduates, traders, doctors, engineers and students. The sample comprised of 160 respondents randomly selected from the four locations mentioned and 120 respondents returned theirs. The questionnaire was structured into two major sections; the bio-data of the respondents and the personal assessment of the quality of service (QoS) of the broadband service providers in Nigeria which include items such as service providers, subscribers, type of subscription used, how fast is the downloading, level of download, connectivity level, broadband type, tariff plan type used, how easy is access broadband network, purpose of using broadband, types of applications used on it, and reasons for running away from using broadband. Then, the data from the questionnaire were analyzed and thereafter, Statistical Package for Social Sciences (SPSS) was used as the statistical tool.

3. Results and Discussion

3.1. General Overview of All the Variables and Observed Frequencies

Tables 1-3 present the demographic data of the respondents. This shows that most of the respondents were male civil servants, who fall within the age range 26 - 35.

Table 1. Sex of respondents.

Variables	Rural count (Ilesha/Oba-Ile)	Urban count (Abuja/Lagos)	Total	Percentage (%)	Cumulative percentage (%)
Male	36	38	74	61.67	61.67
Female	24	22	46	38.33	100
Total	60	60	120	100	

Table 2. Respondents' occupation.

Variables	Rural count (Ilesha/Oba-Ile)	Urban count (Abuja/Lagos)	Total	Percentage (%)	Cumulative percentage (%)
Civil Servants	48	39	87	72.5	72.5
Students	8	11	19	15.8	88.3
Others	4	10	14	11.7	100
Total	60	60	120	100	

Table 3. Respondents' age.

Variables	Rural count (Ilesha/Oba-Ile)	Urban count (Abuja/Lagos)	Total	Percentage	Cumulative percentage (%)
15 - 20	2	3	5	4.17	4.17
21 - 25	8	12	20	16.67	20.84
26 - 30	20	18	38	31.67	52.51
31 - 35	19	18	37	30.83	83.34
36 - 40	9	4	13	10.83	94.17
41 - 50	2	5	7	5.83	100
50 - 100	0	0	0	0.00	100
Total	60	60	120	100	

Table 4 answers the first research question revealing that the download per click in Nigeria is relative to location. In the urban areas, it is generally above 100 mbps, while it relatively below in the rural areas. Table 5 answers the second research question showing that the type of broadband used in Nigeria is Wireless. Other technologies like Satellite, Digital Subscriber Line (DSL) and Fiber are not as prominent. The third research question is answered by Table 6 showing the purpose of using broadband usage in Nigeria. Most of the Internet users surfing Internet download files. Only a few do video streaming and carry out other online transactions. Table 7 answers the last research question revealing that MTN is the mostly used broadband network service provider.

3.2. Discussion

The scenario in Table 1 where percentage of male subscriber of Internet broadband both in the rural and urban are more conforms to the findings that most females are mostly preoccupied with household activities than devoting most of their time on ICT [17]. Most of them are satisfied with making calls and receiving SMS messages. Civil servants responded well according to the Table 2 due to the cost of broadband services [6] [14]. Civil servant being a working class will be able to afford it than the students that depend on their parents or sponsors for survival. The optimum activity range on broadband are between age of 21 to 49 years in Table 3 shows the fact that this is the most productive life of human being and in the era we are now, most life activities ranges from downloading of videos, documents, to use of ATM to transact business electronically all depend on Internet. The range of downloading per click means for every of your clicking for downloading, will you be able to download up to 100 mb before it will disconnect. The results on range of download shown in Table 4 agree with the assertion of NCC that their broad band are still 3G Mobile cellular based, that is, the networks are on transition to 4G network [1]. The wireless mobile cellular networks account for the highest percentage of broadband usage in Nigeria due to the upgrade of already established GSM networks to the 3G services [7]. The

Table 4. Range of download.

Variables	Rural count (Ilesa/Oba-Ile)	Urban count (Abuja/Lagos)	Total	Percentage	Cumulative percentage (%)
Above 100 MB per click	22	47	69	57.5	57.5
Below 100 MB click	38	13	51	42.5	100
Total	60	60	120	100	

Table 5. Type of broadband.

Variables	Rural count (Ilesha/Oba-Ile)	Urban count (Abuja/Lagos)	Total	Percentage	Cumulative percentage (%)
Cable modem	19	3	22	18.33	18.33
Wireless	31	43	74	61.67	80.00
Satellite	0	1	1	0.83	80.83
DSL	0	3	3	2.50	83.33
Fiber	0	2	2	1.67	85
Other	10	8	18	15	100
Total	60	60	120	100	

Table 6. Purpose of broadband usage.

Variables	Rural count (Ilesha/Oba-Ile)	Urban count (Abuja/Lagos)	Total	Percentage (%)	Cumulative percentage (%)
Surfing the Internet	21	32	53	35.10	35.10
Streaming videos	8	19	27	17.88	52.98
Downloading files	23	14	37	24.50	77.48
Performing transaction online	8	9	17	11.26	88.74
Others	12	5	17	11.26	100
Total	72	79	151	100	

Table 7. Network service providers.

Variables	Rural count (Ilesha/Oba-Ile)	Urban count (Abuja/Lagos)	Total	Percentage (%)	Cumulative percentage (%)
MTN	28	33	61	50.83	50.83
AIRTEL	15	7	22	18.33	69.16
GLO	9	5	14	11.67	80.83
ETISALAT	5	14	19	15.83	96.66
Others	3	1	4	3.33	100
Total	60	60	120	100	

outcome of Table 5 shows most people connected to broadband network using Mobile cellular network, while Table 6 showed that the surfing is what subscribers mostly do with the broadband while streaming of videos which is one of

the core purpose of broadband has lesser percentage; this attests to the fact that the broadband is still costly and slow because fiber optic cable laying is still ongoing [1] [18]. These are some of the challenges facing the broadband in Nigeria. In the area of provider that has the highest deliverables of broadband in Nigeria, according to Table 7, MTN emerges as the highest broadband network service provider this agrees with the assertion of Fielding-Smith [19] that it has the highest coverage in Nigeria and thereby making it easier to upgrade their networks to 3G networks easily.

The results of the study showed the reality that 3G systems are the networks on ground in Nigeria and all the network providers are still battling with the installation of fiber optic cables that will support their broadband network to be able to have an optimum speed when rolled out [1] [7]. According to ITU LTE configuration, the capacity of LTE radio network can provide a peak cell throughput of around 300 Mbps in the downlink in the 4×4 MIMO configuration, since LTE is a major broadband Network, the Mobile cellular operators in Nigeria and Government should collaborate in order to quicken the roll out of LTE and WIMAX networks.

4. Conclusion

The implication of the results of the various analyses carried out in this study is that broadband networks in Nigeria are still developing and need a lot of improvements. Therefore, the government and the service providers must work hand-in-hand to fast track the full operation of broadband network services in Nigeria; failure to do this will continue to delay the gains of Information Technology to the economic growth of Nigeria.

References

[1] Dambatta, U.G. (2015) Providing Seamless Connectivity in E-commerce.

[2] Prasanna, G.R. (2012) Voice over LTE. Master's Thesis, Delft University of Technology, Netherlands.

[3] Iliev, T. and Mihaylov, G. (2012) 3GPP LTE system model Analysis and Simulation of Video Transmission. *Proceedings of Advanced Research in Scientific Areas*, Lublin, 3-7 December 2012, 2016-2021.

[4] Dahlman, E., Parkvall, S. and Beming, P. (2011) 4G LTE/LTE-Advanced for Mobile Broadband. Elsevier Ltd., Cambridge, 132-358.

[5] Mojtahed, M. and Xirasagar, S. (2013) Quality of Service over LTE Networks. White Paper.

[6] Sesan, G. (2015) Reality Check: Status of Internet Freedom in Nigeria. Paradigm Initiative Nigeria. https://pinigeria.org

[7] Dahunsi, F.M. (2015) Broadband Infrastructure Using Fiber Optic: The State of things in a Developing Economy. *African Journal of Computing and ICT*, **8**, 77-88.

[8] Sharma, P. (2013) Evolution of Mobile Wireless Communication. *International Journal of Computer Science and Mobile Computing*, **2**, 47-53.

[9] Tsang, T. (2013) Performance Analysis for QoS-Aware Two-Layer Scheduling in

LTE Networks. *International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)*, **2**, 79-84.

[10] Ozovehe, A. and Usman, A.U. (2015) Performance Analysis Of GSM Networks in Minna Metropolis Of Nigeria. *Nigerian Journal of Technology*, **34**, 359-367. https://doi.org/10.4314/njt.v34i2.21

[11] Zakhia, A., Chang, J.M. and Chau-Yun, H. (2010) Wimax vs LTE, Who Will Lead the Broadband Mobile Internet. IT Professional, IEEE Computer Society, 26-36.

[12] Kumar and Suman (2011) Comparison of 3G Wireless Networks and 4G. *International Journal of Electronics and Communication Engineering*, **6**, 1-8.

[13] Ibikunle, F., Orunta, J. and Dike, I. (2013) Broadband Wireless Access Deployment Approach to Rural Communities. *Journal of Computer Networks*, **1**, 38-45.

[14] Agbakwuru, O.A., Elochukwu, A.U. and Sylvanus, I. (2011) Internet Penetration and Diffusion in Orlu Zone of Imo State, Nigeria. *Asian Journal of Information Technology*, **10**, 149-153.

[15] Omigie, N.O., Zo, H. and Rho, J.J. (2015) User Acceptance of Mobile Broadband in Nigeria. *Information and Knowledge Management*, **5**, 62-78.

[16] Tantawy, M.M., Adly, S.T.E. and Rokaia, M.Z. (2011) Cross Layer Scheduling Algorithm for Long Term Evolution. *Canadian Journal on Multimedia and Wireless Networks*, **2**, 57-62.

[17] Ojokoh, B.A., Adeola, O.S., Isinkaye, F.O. and Abraham, C. (2014) Career Choices in Information and Communication Technology among South Western Nigerian Women. *Journal of Global Information Management*, **22**, 48-77.

[18] Umezuruike, C., Oludele, A., Kuyoro, S.O. and Izang, A.A. (2015) Broadband Internet Penetration in Nigeria: A Review. *International Journal of Research Studies in Computer Science and Engineering*, **2**, 1-7.

[19] Fielding-Smith, A. (2014) Poor Infrastructure Holds Back Nigeria's Broadband Revolution. http://www.ft.com/intl/topics/organisations/MTN_Group_Ltd