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Customer-centric mobile broadband performance of MTN 3G cellular network in Trans-Amadi Area of Port Harcourt, Nigeria

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Abstract
With massive rise in broadband penetration in Nigeria, customer-centric mobile broadband performance analysis is very crucial. There is need to bridge the information gap among the customers as to what the quality of service (QoS) delivered by the mobile operators is. This paper presents an ISP-perf web-based application package analysis of MTN 3G wireless cellular Network. Analysis was carried out on the QoS metric parameters which include, download speed, upload speed and latency. This research was carried out in Trans-Amadi area of Port Harcourt and real time assessment of the network performance during the different hours of the day such as in the morning, afternoon and evening was obtained and analysed. The result shows that the download speed was highest in the evening hours with a speed of 6.345567 Mbps, followed by the morning hours with a speed of 3.416579 Mbps. Thus, it can be deduced from the research that download speed is usually highest and fastest in the evening hours due to the fact that many institutions like banks, schools, hospitals, etc. use less of the services during the evening hours hence making the available channel ample for other service users.
Keywords: *Isp-perf, 3G wirelesses cellular network, Upload speed, Download speed, Latency*

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1. Introduction

Internet access has become a vital tool in development and social progress since the inception of the 21st century. It is recognized as a basic utility similar to telephones, water, and electricity. However, the customer-centric mobile broadband performance of mobile network operator's (MNOs) in Nigeria is still unknown. Customer-centric is an approach to doing business that focuses on providing a positive customer experience in order to drive profit and gain competitive advantage. There are information gap between mobile customers and mobile network operators on the service performance (Dahunsi1 and Akinlabi, 2019).An understanding of where internet broadband exists and where it does not exist is still emerging, and the predominant measure of broadband availability has been the download and upload speed measured in megabits per second (Mbps), and the time delay for a response over the network, or "latency" (Junaid, 2015).

Data collection is done in broadband mapping to know the state of the network from the user end thereby knowing the served, underserved and unserved areas. This way, decisions can be made based on the data collected to improve the service (NCC, 2018). One of the software used to know areas with or without availability of broadband service is the U2000 adopted in Denmark. However, U2000 has limitations in that it is available only to some specific telecommunication subject matters, experts and therefore not available to network users. In United Kingdom, Meter.Net is adopted. While in United State of America, since the initial deployment of broadband in the late 1990s, two federal agencies (the National Telecommunications and Information Administration and Federal Communications Commission) have implemented broadband availability data collection and mapping initiatives. A large amount of money has been spent to develop and maintain a comprehensive nationwide inventory map of existing broadband service capability and availability in the United States (Congregational Research Service, 2019). However, in Nigeria the MNOs have their individual software for checking their broadband

mapping. There is no single means used by Nigerian communication commission (NCC) in monitoring the broadband available to the customers to checkmate the activities of the MNOs.

In 2005, Ajala suggested the use of a geographical information system (GIS) as a standard network monitoring tool to produce different types of dynamic maps to show various aspect of the network. Predicted coverage arrays comprises of geo-referenced polygon in space that represent radial distance of the signal strength away from each cell based on the signal interaction with some factors of the environment to enhance the monitoring of network providers. Dahunsi1 and Akinlabi (2019) developed a mobile broadband performance measurement application using Java and Extensible Mark-up Language to monitor the quality of service and tested it in some part of Nigeria. According to their findings, 3G users are not getting the industry set speeds. They got about 10% below the lower limit of the benchmark. Also, network performance is highly unpredictable and variable during the day but greatly improves at the early hours of the morning. In this work, a mobile performance application called an Isp-perf web-based application package was applied to measure the quality of service (QOS) metrics such as download speed, upload speed and latency in an area of Port Harcourt Nigeria called Trans–Amadi. Analysing the result gave an insight on the performance of the mobile network operators as perceived by the consumers. The approach used and the result gotten from the study could serve as a template that could be adopted for other regions or Nigeria as a whole.

2. Materials and methods

In order to carry out the mobile broadband performance measurement in Trans-Amadi, Port Harcourt, a geographical survey was first of all carried out on the study area to mark out points where the measurement would be carried out using TEMS alongside the ISP-perf, a web-based application package. After carrying out a comprehensive survey, a driving test was carried out using web-based application Isp-Perf. The test was carried out in the morning, afternoon and evening hours for a period of one week. Upload speed, download speed and latency were the data collected from the measurement. After the completion of the test, the result gotten was computed and the graph plotted in Microsoft excel environment. The map showing Trans-Amadi industrial layout is shown if Fig. 1, and the red arrow in the map shows the measurement spot, and related road links where the test was carried out.

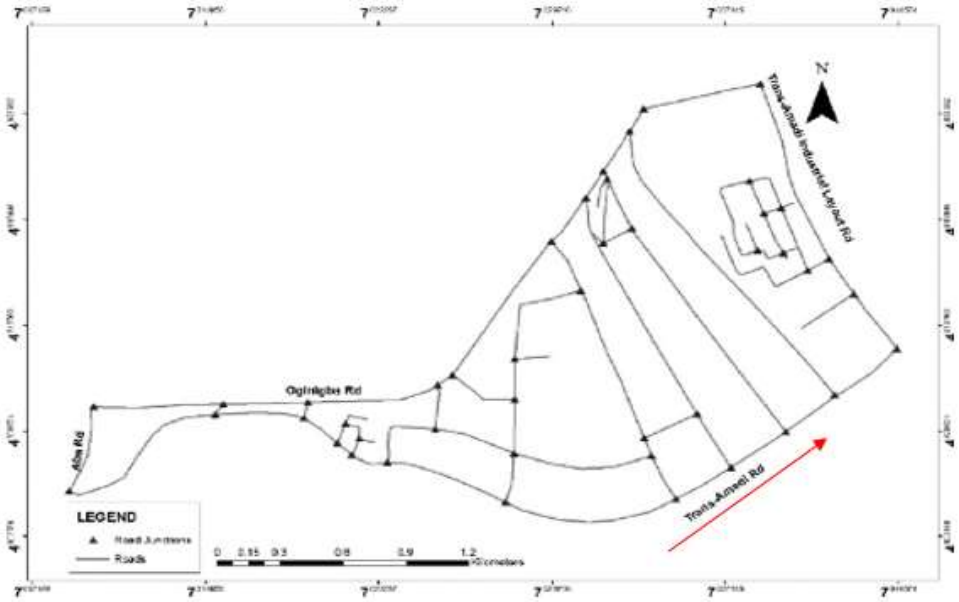

Fig.1: Map of Trans-Amadi industrial layout (Obafemi et al., 2011)

3. Results and discussion

In this section, a graphical comparison of the result gotten from the database of the Isp-perfweb based application package is presented. The average download speed, upload speed and latency were compared with respect to different hours of

the day, which include morning, afternoon and evening. This was done with 3G MTN network. The average values estimated for each quality of service metric were compared with that of the industry standard values.

3.1 Download and upload speed analysis using Isp-Perf

From the result presented in Fig.2, it can be deduced that average download speed in Trans-Amadi area of Port Harcourt was highest and fastest in the evening hours with a speed of 6.345567 Mbps, followed by the speed in the morning (3.416579 Mbps), and the least speed was in the afternoon (2.650526 Mbps). The upload speed for the evening hour was all highest with a speed of 2.365456Mbps, followed by that of morning (1.444211 Mbps), and with the speed of 0.770264 Mbps in the afternoon. The download speed is always higher than the upload speed. Most broadband subscribers do more of download which includes streaming videos online, downloading HD movies, etc. than uploading which include sending an email, sharing files, pictures etc. Trans-Amadi experienced a high download speed in the evening hours due to the fact that the area is a commercial area with more of banks, industries and government offices. The traffic at the base transceiver station is less because most workers have already gone home making the area less congested at the evening time. This will definitely increase the cell capacity, hence given a higher download and upload speed. While the speed in the morning is high, but not as high as the evening period, reason being that workers are yet to come to work or few have already come to their place of work, this make the traffic less congested, thereby increasing the data transfer rate. The least speed is in the afternoon, this is the peak period when workers are in their place of work doing their various businesses. This makes the server congested leading to traffic by subscribers. The implication is reduction in download and upload speed.

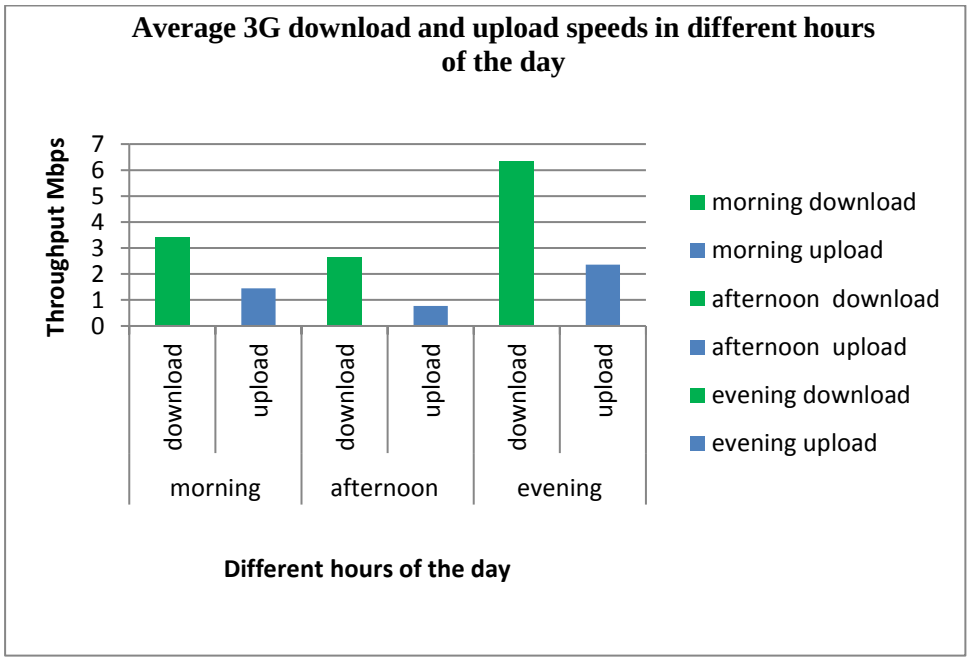

Fig. 2: Average 3G download and upload speeds in the morning (8am- 11 am), afternoon (12noon-4pm) and evening (5pm-9pm) hours by 3G MTN network in Trans Amadi area of Port Harcourt.

3.2 Latency analysis

The comparison of the average latencies for the three periods in the day, which included morning, afternoon and evening is given in the Fig. 3. Latency shows how responsive a network is, that is the time taking for a packet sent from a source to get to the final destination. The major delay was observed in the afternoon hours with a latency speed of 294.5158 ms followed by that gotten in the morning 245.8279 ms. The least responsive was in the evening with 235.6145 ms. This is due to the fact the download speed is highest during the evening hours. More so, the result shows that the latency is inversely proportional to the download speed.

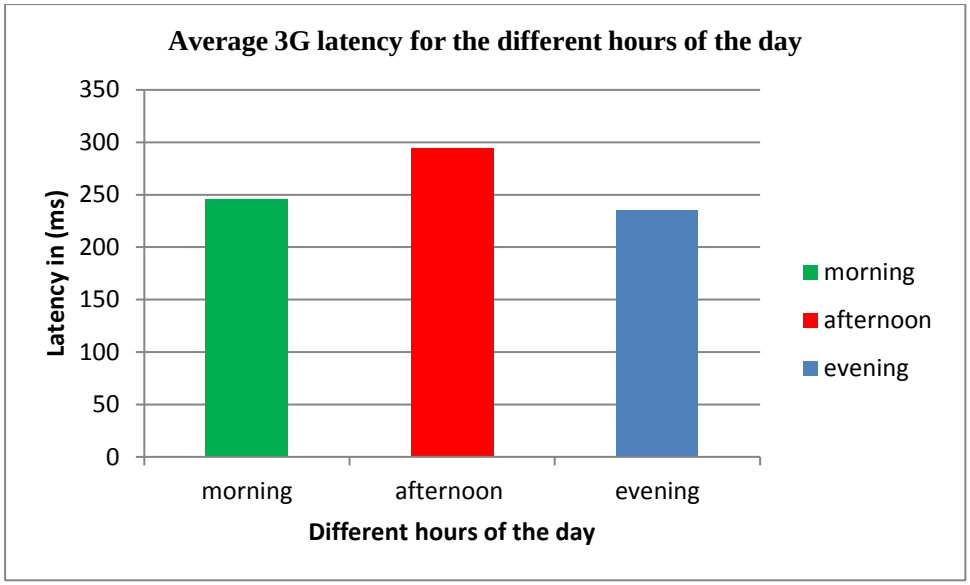

Fig. 3: Average 3G latency for the different hours of the day. Morning hours (8am- 11 am), afternoon hours (12noon-4pm) and evening hours (5pm-9pm) by 3G MTN network in Trans Amadi Area of Port Harcourt.

4. Conclusions

An analysis of a customer-centric mobile broadband performance in Trans-Amadi area of Port Harcourt has been carried out. The test was done using an Isp-perf web-based package. It was observed from the result gotten that the download speed is always higher than the upload speed for morning, afternoon and evening hours. This is because loses tend to be higher in upload than download, thereby reducing the speed in upload when compared to download. It was also observed that the three-performance quality of service metrics which are the download speed, upload speed and latency differs for different hours of the day. Traffic congestion and variation in the hours of the day are the major factors affecting mobile broadband performance. It is recommended that this research be extended to other areas with different mobile network operators. This will enable subscribers to have a better understanding on the quality of service giving to them.

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