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Investigating Internet Access and Bandwidth Management Strategies in University: LAUTECH, Ogbomoso, Nigeria as Case Study.

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ABSTRACT: The shifting patterns of Internet access and usage continue to generate resource and administrative challenges for the University. Besides the limited bandwidth, the improper use of the existing connectivity is also a major challenge. Inappropriate use of existing bandwidth, due to absence of bandwidth management strategies also promotes wastage and unwanted traffic such as music and movie downloads by some of the staff and students also download or transfer of virus and other malwares.

In addition, the largely unrestricted access to the Internet exposes the university Internet connectivity to bandwidth hogging applications such as Peer to Peer (P2P) or media streaming. Video and audio streaming applications found in websites like YouTube has grown in popularity among staff and students on the network. Although the University may increase its bandwidth capacity by purchasing more from its existing service providers or from another service provider, this is still very expensive. Thus, investigation of internet access and bandwidth management strategies is highly essential in university environment.

KEYWORDS: Internet access; bandwidth; management strategies; service provider; network

I. INTRODUCTION

It has been noted that the growth of the Internet and the continuing digitalization of society are much-heralded events in developed countries, however, leaders in developing nations such as Nigeria are still trying to meet up with the rapid changes in this development [32]. The Internet is a connection of computers around the world to share data and information. It started life in America in the 1960s. It was later popularized by the United States National Science Foundation Network (NSFNET), the first nationwide educational network linking universities and academic research establishments. This allows graphics and even video to be moved across telephone lines, bringing about more possibilities to the Internet. The Internet brought about a free flow of information all over the globe. One could possibly get access to any kind of information on almost everything. There are educational services too. Universities are offering courses over the network. The world is now said to be a global village.

Internet connectivity and access to networked information resources are in increasing demand and are very paramount in carrying out meaningful activities and research in any institution of learning, thus its importance to its staff [30]. Internet access is made possible through the allocation of frequency, which is known as bandwidth usually by spectrum regulators [16]. Bandwidth refers to the capacity of communication media to transfer data from one source to a destination [31]. Many Universities in Nigeria do set aside a significant fraction of their budget towards increasing their bandwidth and upgrading their networks, Ladoko Akintola University of Technology is not an exception.



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Comparing the bandwidth and mode of connectivity to the Internet some years back and its current status, it is obvious that the University has invested quite an amount of money in network and bandwidth upgrade.

Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria came into being in 1990 as the 32nd university then in Nigeria. The University of Technology is a state owned university, jointly owned by Oyo and Osun state governments. It holds a paramount position in the Nigeria tertiary education system and is recognized both at the local and international levels for her academic performance. This has made it under the obligation to provide all its human resources with reliable Internet access because Internet connectivity is increasingly becoming a strategic resource tool for University education at the global level. Having a robust university network with good Internet connectivity is no longer seen as a luxury to the University but as a basic necessity. This is because Internet connectivity is now critical for any university to effectively participate in the global society especially the educational sector.

In addition, bandwidth is also often used by low priority, bandwidth hungry users who usually consume it for non-educational purposes [9]. However, as the usage and need of having heavy bandwidth consuming applications grows and the number of network users increases dramatically, the need for a more coordinated and concerted effort to monitor the bandwidth utilization and implementation of effective bandwidth management strategies is important and needs to be put in place, in order to ensure excellent service provision. The main purpose of this study is to provide results that would be helpful to the University and the ICT management unit to know the level of bandwidth utilization, level of accessibility, availability and service quality of the Internet facilities provided and its management strategies.

II. RELATED WORK

A Information and Communication Technology in Nigeria Universities

Various studies have provided the existence of ICT most especially the internet use in the Nigerian Universities, however, [32] in their study, have affirmed that the use of ICT such as the internet in the educational sector in Nigeria is still in its infant stage as compared to developed countries. In addition [2], in a descriptive study investigated information and Communication Technology in Universities in Nigeria: Challenges for Teaching and Learning, studied 240 university teachers. His findings revealed that Information and Communication Technology (ICT) has grown tremendously around the globe and that there is a wide disparity in its use between the developed nations of the world and the developing nations including African nations such as Nigeria as the growth of ICT in developing nation is lower and slower.

Furthermore,[3] affirmed that the ICT is now been used in all sector of the Nigerian economy such as the educational sector because it has opened a new visage to globalization in education and the deployment and integration of ICT facilities into university for internet access and a web portal implementation enable the university to carry out most of its activities ubiquitously on the internet. In Nigeria quite a large number of universities have either developed their portal or have had one deployed for the purpose of ICT-related activities. This development has added tremendous impact on university management, teaching and learning. This reveals that there is a dire need for the use of ICT especially the Internet for educational activities in Nigeria because of its impact on teaching and research related activities among staff and students.

B Internet Penetration in Nigerian Universities

Studies by [1],[25],[19],[35] authors have provided detailed report on internet penetration in developing countries, bandwidth divide: obstacles to efficient broadband adoption in rural Sub-Saharan Africa. In [35] authors stated that internet penetration in developing countries such as Nigeria has staggeringly increased however, basic connectivity is lacking in many developing regions. Global statistics showed that in 2011, developed countries had Internet penetration higher than 73% stated by International Telecommunication Union, (2011). However, in the developing world during the same year, only 26% of individuals were connected to the Internet [35]. In [1] and [25] authors found that the importance of Internet connectivity in developing regions is immense however there are evidences of divide in these developing regions. Furthermore, internet penetration in the developing countries such as Nigeria lags behind than that of the developed countries for many reasons such as: lack of supporting infrastructure (roads and electricity), outdated regulatory frameworks, and high connectivity cost, to mention few[6].



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C Bandwidth Utilization

Studies have revealed the trend in bandwidth utilization among Universities especially in developing countries such as Nigeria. In [9] an empirical study titled, bandwidth management in universities in Zimbabwe: Towards a responsible user base through effective policy implementation stated that despite considerable investment in bandwidth, many universities are still finding themselves not having reliable, usable Internet access for their students and staff. The demand for bandwidth within universities is constantly rising and the overall bandwidth usage continues in its upward trend. This demand is caused by: increased student enrolment, the increased use of electronic resources for teaching and learning, and the spread of software applications that uses larger quantity of bandwidth for their downloads. A definite trend is continuing towards multimedia websites, which contain bandwidth-hungry images, video, animations, and interactive content. Bandwidth is often consumed by low priority, bandwidth hungry uses for non-educational purposes.

Furthermore, [9] found that Bandwidth utilization among staff of universities starts immediately during office hour from 8:00 am to 10:00pm and was almost 100%, even though its availability was fairly good. It has been stated that the cost to ensure the provision of internet for human resource of any higher institution is high. In a study by The International Network for the Availability of Scientific Publications (INASP), on Optimizing Internet Bandwidth in Developing Country Higher Education, it was affirmed that bandwidth in developing countries is expensive: Makerere University pays about \$22,000/month for 1.5Mbps/768Kbps (in/out), Eduardo Mondlane pays \$10,000/month for 1Mbps/384Kbps, while the University of Ghana pays \$10,000/month for 1Mbps/512Kbps. These figures indicate that African universities are paying over \$55,000/month for 4Mbps inbound and 2Mbps outbound. These figures are about 100 times more expensive than equivalent prices in North America or Europe [18].

D Bandwidth Management

Managing bandwidth improves the performance of Internet connection by removing unnecessary traffic [9]. Improving bandwidth management is probably the easiest way for universities to improve the quantity and quality of their bandwidth for educational purposes [4]. Bandwidth management involves the creation and enforcement of network policies to ensure fair and satisfactory network performance. It becomes the tool used to ensure that enough bandwidth is available to meet the traffic needs of those mission-critical and time-sensitive applications and prevents competition between these applications and lower priority traffic for the limited network resources [9]. It also has the goal to ensure the availability of Internet bandwidth to everyone.

Bandwidth management is essential for any institutional network. Universities understand that if they had a much smaller capacity connection and managed it correctly, the Internet would still be accessible. However, if the connection was increased with no or low management, useful access to the Internet would decrease immediately and soon become insufficient. The main challenges relating to bandwidth management can be categorized as increasing awareness, improving skills and providing appropriate tools for management [34]. In [34] authors stated that in the Sub Sahara region, which Nigeria is inclusive, there is lack of basic infrastructures to manage bandwidth or rather these infrastructures are obsolete. These infrastructures are telecommunication and computing structure which range from basic power supply, poor connectivity, Internet devices, modems, Internet connections.

Studies in [27], [10], [36] and [23] revealed that bandwidth availability can be managed through the use of artificial intelligence techniques or by making public policies that seek to influence the use of the network. Public policy techniques include: bandwidth prioritization schemes which are often trailed by heavy debates relating to privacy issues and network neutrality, use of economic measures e.g. network traffic being metered and users pay for the bandwidth they use [12],[7], promotion of local content, peering and interconnection caching [5]. On the other hand, artificial intelligence techniques include: traffic shaping, scheduling algorithms [8], bandwidth reservation algorithms and protocols [21] and congestion avoidance schemes [7]. Not having an efficient bandwidth management in the University may leave the university's network at the risk of being locked down, to the point that legitimate users are denied access to valuable global learning resources. Even in situations where high amount of bandwidth are made available, the importance and necessity of controls, monitoring and optimization cannot be over emphasized because users will always find ways to use up the amount of available bandwidth. Moreover, with the ongoing plan of the University management to also provide students with Internet access for mobile learning, it is important to consider the fact that students use the Internet for other purposes rather than learning and quite different from how staff uses it



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Since bandwidth is seen as a strategic resource, its efficient usage and management should as well be seen as a top priority in the University. Without bandwidth management, the primary purpose of ensuring access of Internet facilities to staff of the University would be aborted, thus providing inefficient access and inefficient bandwidth provision. This may also leads to the disruption of services and activities that may possibly impact the operational activities of the University, and users who need the resource for critical operations will be left frustrated. To cushion this effect, it is mandatory that the institution know the level of utilization of bandwidth among staff, the problems they face, accessibility and availability to this Internet facility, peak periods when this Internet facilities are available and accessed and also put in place necessary management techniques that would ensure the University achieve its purpose for providing such service to the Institution.

E Bandwidth Management Strategies

Bandwidth management is a process of allocating bandwidth resources to critical applications on a network [9], it aims to improve performance of an Internet connection by removing unnecessary traffic. The goal of managing network capacity is to have the right amount of bandwidth in the right place at the right time for the right set of users and applications [39]. By efficient use, mean both the minimization of unnecessary bandwidth consumption and the delivery of the best possible levels of service to users. According to [9], no bandwidth size can ever be enough to meet the ever increasing user demands in the absence of an effective bandwidth management strategy. Bandwidth management could also involve the creation and enforcement of network policies to ensure fair and satisfactory network performance which becomes the tool used to ensure enough bandwidth is available to meet the traffic needs of those mission-critical and time-sensitive applications and prevents competition between these applications and lower priority traffic for the limited network.

According to [4], managing bandwidth improves the performance of an Internet connection by removing unnecessary traffic and it is essential for any institutional network. Bandwidth is like a pipe and it doesn't matter how big the pipe is, if the traffic in the pipe is not managed it will clog up with unwanted traffic and be hijacked by peer-to-peer traffic, viruses and other malware. Improving bandwidth management is probably the easiest way for universities to improve the quantity and quality of their bandwidth for educational purposes African Tertiary Institutions Connectivity Survey.

In the most part of Nigerian institution, budgets for managing connections are often far greater than the cost of the connection itself and Universities understand that if they had a much smaller capacity connection and managed it correctly, the Internet would still be accessible. However, if the connection is increased and the management removed useful access to the Internet would decrease immediately and soon become impossible [4].

F Challenges Militating against the provision and use of Bandwidth in Nigeria Universities

The main challenges relating to bandwidth management can be categorized as; increasing awareness, improving skills and providing appropriate tools [4].

1. Increasing Awareness

Although there are technical issues relating to bandwidth management, the biggest challenge is to raise awareness of the importance of managing bandwidth. Bandwidth is a limited resource that needs to be shared. Bandwidth has a cost and policy that govern its use. Just as with a phone line, use of bandwidth should be monitored and managed.

2. Improving Skills

Capacity building and skills development are fundamental to improving bandwidth management practice within developing world institutions. Institutions have put forward a strong demand for bandwidth management training, even amongst those institutions some have organized some sort of training in the time past. The challenge is to provide comprehensive training on policy and the purpose of bandwidth management for managers, integrated with hands-on technical training for network administrators.

3. Providing Appropriate Tools

In many institutions the necessary tools are not yet present, and if they are present they may not have been used to their full capacity. Working with the above partner institutions, amongst others, Aptivate believes that further investigation would answer the remaining questions like:

- Why are tools not being used at many institutions?
- are the tools appropriate for the audience?

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- are there significant gaps in the functionality of existing tools?
- How can the most appropriate tools be integrated into a wider programme of bandwidth management and training?
- Can any existing tools be leveraged for use by small or overstretched IT teams?

G The Policy Based Bandwidth Management Strategies

This policy is a statement of opinions, intentions, actions and procedures that guide the overall use of the network to meet the organization's goals and objectives which in this context is LAUTECH. Policy-based bandwidth management involves the allocation of network-based resources and services in accordance with the mission and management policies of an organization. According to [14], bandwidth management is being viewed as a set of tools that need to be installed, rather than a fundamental change in attitude that needs to be imparted to all stakeholders in the network. In [9] the author divided the components of bandwidth management into three broad categories which are:

- **Techniques and technologies** – these are number of tools and techniques that help network administrators to ensure that bandwidth is managed and that policy is enforced;
- **Organizational access and management policies** – known as policy-based bandwidth management;
- **Monitoring**- employs both technical and physical check means, to help in the definition and enforcement of policy, faults/errors diagnosis and accurate troubleshooting on the network and amending the detected errors. This connection is provided in Fig.1

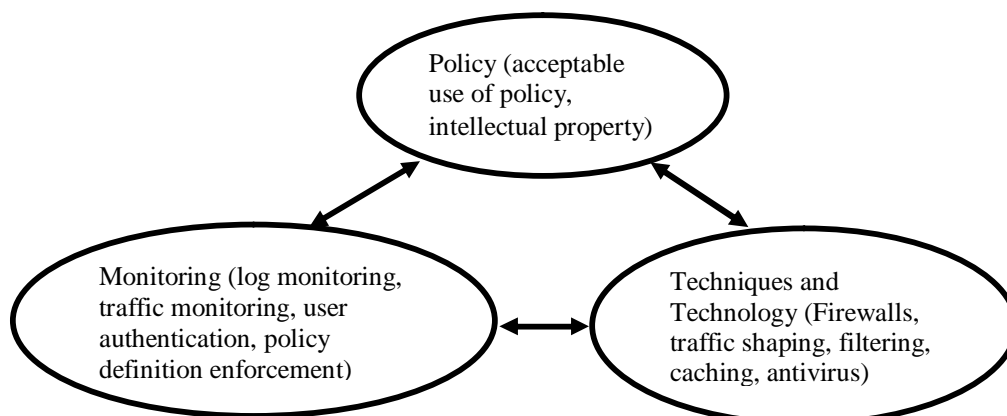


Fig. 1. Policy Based Bandwidth Management Components

H. Information System Model

The study also adapted the information system model of; in a particular information system which could be the use of internet or a bandwidth system quality and information quality are two important constructs. In fig.2, the system quality and the information quality have a casual impact on other two construct of the model which are perceived usefulness and user satisfaction [38]. Furthermore, [38] stated that perceived usefulness and user satisfaction also have influence on the net benefit of the system use, also perceived usefulness influences user satisfaction. The net benefits are expected to have a direct casual connection with usefulness and satisfaction. The work of [11] added to that of [38] as an extension of the work or model of Seddon. To Delone and McLean, the quality of any service is another major component of the information system model. This implies that there are three main components: service quality, system quality and information quality. Other constructs in the model are perceived usefulness, users satisfaction, and net benefits.

In this present study, three constructs are important, system quality, service quality, and users satisfaction. System quality is the degree how a system transfers the symbols of communication. It is however formed through a continuous

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interaction with the system such as the internet, in completing a specific task such as those that occur among teaching staff of the University [26].

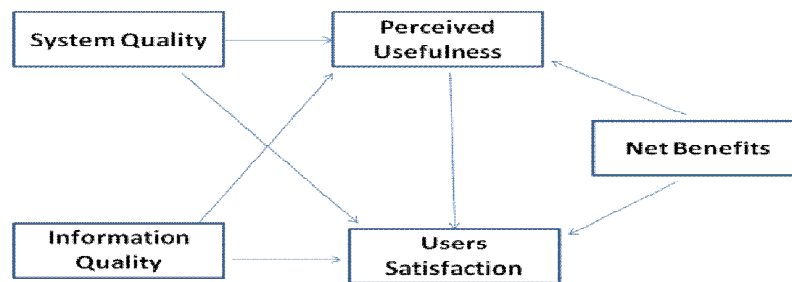


Fig. 2. Information System Model (Source: [38])

Major variables used to measure this construct are characteristics of the system, independency of the knowledge/information it contains, flexibility of the system, stability, reliability, usefulness of specific functions, user – friendly interface, ease of use and acceptable response time [11], [13]. Service quality is support delivered by the service provider [11],[13]. Users’ satisfaction is the sum of one’s feelings and attitudes towards variety of factors affecting a particular situation, as shown in fig. 3. According to [38] author stated that, it is a subjective assessment of the various consequences, evaluated on a pleasant and unpleasant continuum.

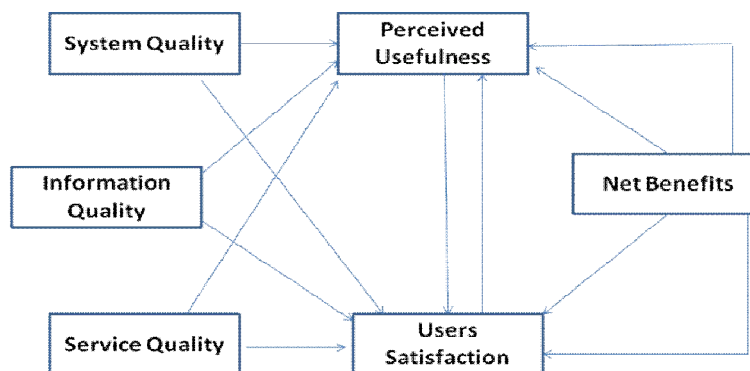


Fig. 3. Updated Information System Model (Source, [11])

III. STUDY APPROACH

A study on Internet access and bandwidth management strategies in Ladoke Akintola University of Technology, would only major on the staff and the ICT unit of the institution. Also, variables of interest to this study are divided into two: users side and the providers or suppliers side. The users side include the staff of the university which are teaching, non-teaching staff and technologist while the providers side is the ICT management. Variables from the user side are level of accessibility, service quality, challenges faced by users in utilization of internet. Variables from the providers side which are the ICT unit and the management strategies deployed to ensure efficient utilization among staff, problems encountered in ensuring efficient management of bandwidth by ICT units.

However this work will provide the challenges faced by users (staff) in the use of Internet facilities in the institution. This would assist in correlating and/or discovering if there is a gap to be filled between the providers and users. A questionnaire was design using Delphi study.



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A. Delphi Method of Survey

Delphi study was used to survey and collect the opinions of LAUTECH staff. The steps involved in the study are as follow:

1. Gathering and Formulation of Major Information

The method used is quantitative survey, where data collection were done through the questionnaire and oral interview. The survey was designed to identify accurate and relevant information needed for the study. The questionnaire was used to obtain information from users, while the oral interview conducted was used to obtain information from the ICT management unit.

2. Design of the Delphi Questionnaire

The questionnaire designed for the users has five sections with sub-sections. First section captured demographic specifications of a statistical sample: gender and status. Second section captured questions related to the level of accessibility of Internet facilities among users. Five-point likert scale type of questions were employed, it ranges from Strongly disagreed, Disagree, Neutral, Agreed and Strongly agreed. Third section includes questions related to the satisfaction of the quality of Internet service and major construct used to capture this include the service quality of Internet, and its uses five-point likert scale. Fourth section determined the use of Internet facility and the period of its availability. The questionnaire based on three-point likert scale, ranges from morning, afternoon and evening. Fifth section captured questions related to the problems encountered in the use of Internet facility. This was provided in form of open ended questions where respondents were free to write their subjective opinions and experience based on their use of Internet.

B. Procedure for Data Collection

This research in its approach is a pure research based on descriptive design. The survey method was utilized for data collection from the field study. The rationale behind this approach derived from fact that one of the characteristics of a good quality research depends on its ability to produce evidence that could be generalized from the empirical result of the sample study. The study population includes 150 staff of teaching, non-teaching and technologist from five faculties in the university. A total of 99 questionnaires were returned and used for analysis with response rate of 66 percent.

C. Data Analysis

The first step of data analysis is data coding. The data was coded into a format with alphanumerical code using the Statistical Package for Social Sciences (SPSS). Furthermore, a content analysis of the respondents from the interview schedule and responses during the interview process from the ICT management unit was done. The data were analyzed using descriptive Statistics in Statistical Package for Social Science.

IV. RESULTS AND DISCUSSION

A. Summary Statistics of Demographic Characteristics of the Respondents

The first section of the questionnaire included questions about demographic characteristics of the respondents as shown in Table1. A total of 99 (66%) staff fully participated in this study. The number of females staff involved in the study was more than males (female, 58 (58.6%) males, 41 (41.4%)). Staff status showed that teaching staff has the largest of 52 (52.5%), followed by non-teaching with 32 (32.3%)while the technologists is the least with 15 (15.2%).

Table1: Frequency Distribution of Demographic Characteristics of Respondents

S/N	Demographic characteristics	Frequency	Valid (%)
1	Category of staff		
	Teaching	52	52.5%
	Non-teaching	32	32.3%
	Technologist	15	15.2%
2	Sex		
	Male	41	41.4%
	Female	58	58.6%

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B. Answers to Research Questions

Research Question 1: What is the level of use of Internet facility among staff of Ladoke Akintola University of Technology?

The Table2 gives a breakdown of the level of Internet facility being used in Ladoke Akintola University of Technology by the teaching, non-teaching staff and technologist. The use of Internet facility as shown in the table was examined based on the use of Internet facility among the staff against the category of staff using cross tabulation. Table2, is the use of Internet facilities among the teaching, non-teaching and technologist staff in Ladoke Akintola University of Technology. It was discovered that In the case of (teaching staff, 5.0%, non-teaching staff 2.0% and technologist 0.0%) use the Internet facility at anytime that they want, in the same vein, (22.2% of teaching staff, 11.1% of non-teaching staff and 5.6% of technologist) do not use Ladoke Akintola University of Technology Internet facilities. The study showed that teaching staff, non-teaching staff and technologist have other Internet facilities they subscribed to apart from Ladoke Akintola University of Technology Internet facilities (44.4%, 27.8% and 5.6%) respectively.

Table2: Internet Facility Usage

ITEMS	Teaching Staff					Non-Teaching Staff					Technologist				
	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed
I use the internet facility anytime I want	5.0%	10.8%	11.8%	11.8%	35.8%	2.0%	5.3%	3.9%	12.5%	10.5%	%0.0	0.0%	0.0%	0.0%	5.3%
I don't really have a special time I use the internet	5.6%	27.8%	9.7%	4.2%	11.1%	0.0%	22.2%	6.9%	9.6%	0.0%	5.6%	0.0%	0.0%	0.0%	0.0%
I don't use LAUTECH Internet facilities	22.2%	5.6%	9.7%	13.9%	6.9%	5.6%	11.1%	6.9%	8.3%	4.2%	5.6%	0.0%	0.0%	0.0%	0.0%
I use it sometimes	16.7%	13.9%	5.6%	16.7%	5.6%	5.6%	8.3%	11.1%	11.1%	0.0%	5.6%	0.0%	0.0%	0.0%	0.0%
I have other internet facilities/network, or other providers I subscribe to	44.4%	2.8%	5.6%	0.0%	5.6%	27.8%	8.3%	0.0%	0.0%	0.0%	5.6%	0.0%	0.0%	0.0%	0.0%

Research Question 2: Do staff of Ladoke Akintola University of Technology have easy and frequent access to Internet facility?

Table3. gives the breakdown of frequency use of Internet facilities among the three categories considered of Ladoke Akintola University of Technology. The frequency of use and access to the Internet facility in Ladoke Akintola University of Technology, shown in the table was examined based on the days of the week. This was tested using the frequency of access on days of the week against the categories of staff using cross tabulation.

The results as shown in the Table3, revealed the frequency of use of the Internet facility among the teaching, non-teaching staff and technologist in Ladoke Akintola University of Technology during the week days. In the case of teaching staff 18.6%, non-teaching staff 6.6% and technologist 0.8% use the Internet facility on Mondays. This could be as a result of the teaching staff having more time at their disposal to spend online, either with reference to their daily work or on other personal and time consuming things such as conference video.



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Table3: Frequency of use and access to the Internet facilities

ITEMS	Teaching Staff					Non-Teaching Staff					Technologist				
	More Frequent	Frequent	Moderate	Less Frequent	Not at all	More Frequent	Frequent	Moderate	Less Frequent	Not at all	More Frequent	Frequent	Moderate	Less Frequent	Not at all
Monday	8.1%	18.6%	14.1%	8.0%	4.6%	6.6%	2.0%	1.1%	8.1%	26.0%	0.0%	0.0%	0.8%	0.0%	2.0%
Tuesday	20.6%	6.1%	2.0%	1.1%	26.0%	4.6%	0.8%	6.6%	8.0%	14.1%	2.0%	0.0%	0.0%	0.0%	8.1%
Wednesday	0.0%	2.0%	18.6%	8.1%	26.0%	4.6%	0.8%	6.6%	8.0%	14.1%	2.0%	0.0%	0.0%	0.0%	8.1%
Thursday	0.8%	18.6%	14.1%	8.0%	4.6%	6.6%	2.0%	1.1%	8.1%	26.0%	0.0%	0.0%	8.1%	0.0%	2.0%
Friday	18.6%	8.1%	2.0%	1.1%	26.0%	4.6%	0.8%	6.6%	8.0%	14.1%	2.0%	0.0%	0.0%	0.0%	8.1%

The results in Table4 revealed the accessibility of Internet facilities among the teaching, non-teaching staff and technologist in Ladoke Akintola University of Technology. In the case of (teaching staff, 15.8% and non-teaching staff 5.4% and technologist 0.0%) believe that the Internet facility is rarely accessible, in the same vein, (8.2%, 10% and 0.0%) respectively says there is break in the network when trying to access it. And (42.1%, 28.9% and 5.3%) respectively disclose that either the accessibility or rarely accessible are not transparency to them.

Research Question 3: Are the staff satisfied with the service quality of the provision of Internet facility by LAUTECH ICT unit?

Table5 gives a study of the level of staff's satisfaction with the quality of the provision of Internet facility by the ICT unit of the University.

Results in that Table5 showed that teaching, non-teaching and technologist are not satisfied with the quality of the Internet services, here (30.0%) of the teaching staff and (13.5%) non-teaching staff and (2.7%) technologist. Whereas (14.0%), (5.4%) and (1.0%) of both said that they are satisfied with the quality of the Internet services, while (47.8.0%) of teaching staff and (13.9%) of the non-teaching staff and (2.7%) of technologist said that the network connection frustrating when using LAUTECH internet network. Therefore one can say that though there is Internet facility in the University and the service is of high quality but it is not all members of staff that are satisfied with the quality of the service.

Research Question 4: What are the major problems encountered in the use of Internet facility among staff of Ladoke Akintola University of Technology?

Responses on research question 4 were gathered through an interview with the respondents. When asked on the major problems encountered in the use of Internet facilities among the staff, the responses are:

Respondent 1: "Majority are not versatile with the use of the Computer, Low internet connectivity at times affect the effective use of the internet".

Respondent 2: "I think attitude, awareness and proficiency level of staff"

Respondent 3: "Priority, choice and attitude"

Respondent 4: "Little knowledge of how things work"

Respondent 5: "Natural occurrences"

From the responses given by the respondents, it can be deduced that the staff making use of the Internet facilities need to be educated on the use of these facilities in order for them to better enjoy the services.



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Table 4: Frequency of use and access to the Internet facilities

ITEMS	Teaching Staff					Non-Teaching Staff					Technologist				
	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed
There is always internet access in LAUTECH	5.3%	13.2%	11.8%	25.0%	5.2%	0.0%	9.2%	13.2%	11.8%	0.0%	2.3%	0.0%	3.0%	0.0%	0.0%
The internet connection in LAUTECH is accessible only on rare occasion	5.2%	15.8%	28.7%	5.3%	0.0%	5.0%	5.6%	23.7%	0.0%	5.3%	0.0%	0.0%	0.0%	0.0%	0.0%
There are problems with regard to the internet access in LAUTECH	10.5%	5.3%	34.2%	10.5%	0.0%	0.0%	5.3%	28.9%	0.0%	0.0%	0.0%	0.0%	5.3%	0.0%	0.0%
There is low network when trying to access the internet	5.0%	8.2%	42.1%	5.3%	0.0%	5.3%	10.0%	23.7%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%
The level of accessibility of the internet facilities makes me annoyed most times	5.3%	5.3%	38.2%	10.5%	1.3%	0.0%	2.0%	23.0%	5.3%	3.9%	0.0%	0.0%	5.3%	0.0%	0.0%

Table 5: Satisfaction of Quality of Internet service among the staff

ITEMS	Teaching Staff					Non-Teaching Staff					Technologist				
	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed
The internet facility of LAUTECH has high quality	14.0%	8.6%	5.4%	30.0%	8.1%	4.1%	5.4%	0.0%	8.2%	13.5%	1.0%	0.0%	0.0%	0.0%	1.7%
There is no interruption on the network when been used	0.0%	8.1%	30.4%	12.0%	10.3%	2.7%	0.0%	32.4%	4.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
There is breakage in network during use	4.8%	1.4%	20.1%	13.5%	8.1%	13.5%	9.2%	22.6%	4.1%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%
Using LAUTECH internet network is frustrating	0.0%	12.2%	47.8%	2.7%	8.3%	0.0%	0.0%	13.9%	2.7%	9.7%	0.0%	0.0%	2.7%	0.0%	0.0%
One can just depend on LAUTECH Internet network	8.1%	2.7%	37.5%	12.5%	0.0%	0.0%	2.3%	16.7%	15.3%	2.1%	0.0%	0.0%	2.8%	0.0%	0.0%

Research Question 5: What management strategies are deployed to ensure bandwidth management by the ICT management unit and how efficient are they?

Responses to research question 5 were also gathered through the interview. Some of the respondents claimed that they are not aware of any management strategy deployed in ensuring bandwidth management by the ICT unit. Some of the responses include:



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Respondent 1: "By ensuring that user's account given to staff is solely used by staff and not students using MAC Address (Media Access Control) filtering.

Respondent 2: "Regular node check, regular upgrade of cpu, staff training & awareness.

From the responses given, it can be deduced that there is no blue print on strategies to ensure bandwidth management.

Research Question 6: What are the problems encountered in ensuring efficient management of bandwidth in the university?

Responses to research question 6 were also gathered through the interview. When asked on the problems encountered in ensuring efficient bandwidth management, there response are as follows:

Respondent 1: "Insufficient funds"

Respondent 2: "Poor equipment deployment"

Respondent 3: "I think lack of infrastructure (Devices and hardware/software)

Based on the responses to research question 6, there is need for the university to invest in proper network monitoring tools (i.e. hardware and software) in order to be able to effectively manage the available bandwidth.

C. Discussion of Findings

The findings of this study was classified into three: Internet ease of access and level of use, User satisfaction on Internet Service quality, and Bandwidth Management Utilization and management strategies.

1. Internet Ease of Access and Level of Use

Findings showed that the number of staff that use Internet facility provided in the University is very low compare to the number of staff in the university. This could therefore mean that the majority of staff have no access to Internet facility provided by the University. Also it is worthy of note that even though for teaching staff, work runs from Monday to Friday mostly, it could be considered that teaching staff access the Internet more than the non-teaching staff because they tend to surf net for research purposes. On the other hand, it could be that the non-teaching staff and technologist only use the Internet when necessary, probably to check e-mails.

Findings also revealed that there is always Internet access in the University but even though it is available, it is not easily accessible as most of the respondents agreed that the Internet connection in the university is accessible on rare occasion. This is buttressed by the fact that majority of the respondents admitted that there is always low network connectivity. This could also be as a result of unstable power supply and lack of power backup for most of the Internet devices as stated in [29], or it could be due to uncontrolled downloads or virus infection on the network which is part of the bandwidth utilization challenges revealed in [9] study.

Findings also showed that the use of Internet facilities among the three categories of respondents is not equal. That is, the teaching staff makes use of the facilities more in comparison to the non-teaching and technologist. The findings also showed that teaching, non-teaching staff and technologist have other networks that they subscribed to for Internet access. The significant high level of use of the Internet facilities any time among the teaching staff could be connected to the fact that they are not restricted to a particular time of the day or day of the week to use the facilities. It is also worthy of note that according to [2] revealed that readiness to integrate ICT into teaching and learning is still low, yet it can be assumed that this is gradually improving, but it still could be improved upon if there is actual funding or technical expertise in this area.

2. User Satisfaction on Internet Service Quality

Findings showed that most of the respondents testified to it that the Internet facility provided by Ladoké Akintola University of Technology has high quality but that there is always interruption in the network during use. It was also gathered that despite the interrupt, staff still make use of the internet provided from Ladoké Akintola University of Technology ICT unit.

The Information system model underlying this study is that of [38], stating that perceived usefulness and user satisfaction has an influence on the net benefit of a system use. Also, perceived usefulness influences user satisfaction. Though the findings of the study indicate that larger percentage of staff admitted that the internet accessibility is unsatisfactory because its usage to achieve a particular goal is not met according to the study model, usefulness influences user satisfaction [38].

3. Bandwidth Management Utilization and Management Strategies

The findings equally showed that the ICT unit ensures that the user account and password given to staff is solely used by staff and not students and this is done by using machine address configuration (MAC) filtering in some



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locations. The unit also provides support for staff, in helping them to solve some of these access issues, such as retrieving forgotten passwords or usernames and other connection issues. Another strategy deployed in managing bandwidth among staff is frequent monitoring of the activities on the access points, checking the node regularly and staff training and awareness on the need to keep safe their user name and password.

D Summary

This study investigated the accessibility of Internet facilities and its frequency of usage and possible bandwidth management strategies in the university, LAUTECH as a case study. It should however be worthy of note that though the facilities are in place it does not mean its accessible to the users. Moreover, being accessible does not guarantee the users satisfaction with the quality of service. The study provided information on the frequency use of Internet facilities in the University by the teaching, non-teaching and technologist staff and the user satisfaction level. The issue of bandwidth management strategies approach employed is not clearly defined due to lack of information on currently use methods by the ICT unit of the university.

In this research, it was discovered that it is only few staff that utilize the Internet facilities provided by LAUTECH in comparison to the total number of staff in the university. There is need to enlighten more staff to utilize these facilities for research and educational purposes. It was found that majority of respondents who subscribe to the Internet facilities are not satisfied with it due to intermittent network failure and interruptions. More than half of the respondents from three categories of staff considered believe that the university Internet facility has problem, and that was the reason for them having alternative means of internet connection and not depending solely on the university internet service.

In conclusion, it was gathered from the study that there is no concrete means of managing the bandwidth resources by the network administrators which could be a major reason for the frustrations being experienced by the users.

V. CONCLUSION

From the study more efforts should be channel towards providing necessary bandwidth management tools and skills in order to maximize the available bandwidth and managing it for the benefits of its users. Lack of internet infrastructure (hardware and software devices) facilities is preventing the productive usage of the Internet at the universities, which in turn yields to its low accessibility quality. Managing bandwidth to provide quality of services for university mission critical applications is important since it is not practical to meet the increased demand for bandwidth by simply buying more. It is commendable that quite a small number of the three categories of staff are on the university network.

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