

## A COMPARATIVE EVALUATION OF THE NETWORKS OF THREE NIGERIAN FEDERAL UNIVERSITIES FOR EFFECTIVE LIBRARY SERVICES

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### **Abstract**

*This paper is a comparative evaluation of the networks of three Nigerian federal universities and how such networks can be used to enhance library services. The university networks included in this study are the Federal University of Technology Minna Network (FUTMINnet), University of Jos Network (UNIJOSnet) and University of Lagos Network (UNILAGnet). University of Minna (FUTMIN), established in the 1980s, belongs to the third generation of Nigerian universities; University of Jos (UNIJOS) (established in the 1970s) belongs to the second generation, while University of Lagos (UNILAG) (which was established in the 1960s) belongs to the first generation. Both FUTMIN and UNIJOS are located in North Central geo-political zone of Nigeria while UNILAG is located in the South West zone. The research design employs the survey technique (involving the use of questionnaire, interview and direct observation) to study the wired and wireless connections of the networks of the three universities and compare them against criteria such as network media, bandwidth, latency, and users' response. Specifically, 100 semi-structured questionnaires were administered to the network users of each of the three universities, giving a total of 300 questionnaires. The study reveals that with respect to wireless service, UNIJOSnet is the fastest while in terms of the wired service, UNILAGnet is the fastest. FUTMINNet services, when compared with the UNIJOSNet and UNILAGNet, are not satisfying its users as a result of poor management of available network infrastructures, which in turn affects the quality of library services offered to users. Wireless services of UNIJOSNet make access to library services easier and faster as users can log on to the network at any time of the day; while wired networks of UNILAGNet has the advantage of easy download of online materials but limited to certain times of the day. A case is made to improve the services of the three networks by upgrading and expanding the existing network components and infrastructures of all the networks, especially FUTMINnet.*

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**KEYWORDS: COMPARATIVE, AREA NETWORKS, LIBRARY SERVICES, NIGERIAN FEDERAL UNIVERSITIES,**

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## **Introduction**

Networking involves four basic functions of the computer: acquisition, storage, processing and dissemination of information which are essential features of modern library services. Networks can be Local Area Network (LAN), Wide Area Network (WAN) or Metropolitan Area Network (MAN). Local Area Network (LAN) connects computers and devices in a limited geographical area, such as one office, one building, or a group of buildings close together (for instance, a university campus). A Metropolitan Area Network (MAN) is a communication network covering a city or suburb (Williams & Sawyer, 2001). Wide Area Network (WAN) is a communication network that covers a wide geographical area, such as a country or the world.

LAN connections can be through the use of cables such as twisted pair, coaxial and fiber optics (i.e. wired) or with the use of infrared waves, microwaves, or radio waves (i.e. wireless). When LAN connection is through the use of wireless technology, it is referred to as Wireless Local Area Network (WLAN). Wireless Local Area Networks is a type of Local Area Network that uses radio frequency technology to transmit network messages through the air for relatively short distances like across an office building, or university campus. Also known as Wi-Fi (i.e. Wireless Fidelity) or 802.11 connections, they are becoming more widespread especially on university campuses. The main network structure usually uses cables while wireless transmissions are usually in the 2.4 GHz band ([www.broadbandinfo.com](http://www.broadbandinfo.com)). WLAN allows an Internet connection that can be accessed by wireless clients or network users through their wireless adapter inbuilt on the computer system (usually a laptop, although a desktop can also be used) or through an external wireless adapter attached to the computer system. A wireless network uses radio waves, just as cell phones, televisions and radios do.

This type of network connection is becoming widespread especially in Nigerian universities. The aim of setting up such network is basically to assist in achieving the university's objectives of developing and sustaining rich academic programmes that meet students and regional needs; and they are recognised for their excellence in teaching, learning, research, other services and community development. They also serve as main ingredients for e-library service which is fast developing as the state-of-the-art business in library operations. Campus Area Network refers to communication between two or more networked computers in a limited geographical area, such as a campus ([www.compnetworking.about.com](http://www.compnetworking.about.com)). Designing a campus network is usually a Herculean task and equally as challenging as the evaluation of an existing network. Evaluation is a process by which the performance and effectiveness of a system is assessed, in order to

establish the degree to which the goals and objectives are achieved (Harter & Hert, 1997). Throughout this paper, Local Area Network (LAN) and Wireless Local Area Network (WLAN) will be used interchangeably with Campus Area Network and University Network.

For a while now, there have been series of complaints about the network service of FUTMINNet. Some network users get so frustrated that they start wishing that they were in other universities that, according to them, offer better services. None really thought of how to help improve the network and make it serve the entire university community better. This research work gathered all the series of complaints and 'wishes' of these network users, and decided to carry out a research that would study other older existing university networks that are believed to serve their own users better, and then make recommendations on how to make (FUTMINNet) better.

This paper covers performance evaluation of Campus Area Network of three (3) Universities in Nigeria- FUTMINNet, UNILAGNet and UNIJOSNet. The study measures the performance of these networks with regard to achievement of the objective for which they were set up. The parameters used for comparison are:

- a. Bandwidth – data rate supported by a network interface or connection.
- b. Latency rate – the minimum time a network needs to send the smallest possible amount of data from source to destination.
- c. Network media/components – these can be bounded/wired media (e.g. coaxial, twisted-pair, fibre optic cables) or unbounded/wireless media (e.g. radio waves, microwaves, satellite connections etc.)
- d. Users response based on their interaction with the networks.

The paper is limited only to the comparative analysis and does not cover detailed designing of Campus Area Network (both wired and wireless) of the universities under study. Also, due to time and financial constraints, only a selected older university networks were studied out of all the university networks in Nigerian universities. The relative impact of the state of the campus networks on library services is also highlighted. The findings of this study can only be applied to university networks that operate either wired, wireless or both network connections on their campuses.

### **Review of Related Literature**

The first computers were large mainframes that were too large and expensive for individuals to own. They were also not networked as most computers are today, tasks are sent in batches hence processing and getting results takes a longer time. Terminals did no processing of their own; everything was done on the mainframe. Computer networking has changed enormously over the past decade. Networks have evolved from an academic curiosity to an essential tool for users in business, government and universities (Berry, 1993). A few years ago, every computer manufacturer had its own network architecture, no two of which were compatible. That has changed now. The entire computer industry has now agreed to an International Standard for describing network architectures. This standard is known as Open System Interconnection (OSI) Reference Model (Henshall & Shaw, 1998). Backed by the International Standards Organization, OSI is an international standard that defines seven layers of protocols for worldwide computer communications (Williams & Sawyer, 2001). A computer network is an interconnected group of computers for the purpose of resource and information sharing. Some of these resources include: printers, faxes, electronic messages, files and documents. Users are not only more productive because several people can enter data at the same time but they can also evaluate and process shared data. They can share information throughout buildings (LAN), the city (MAN), the country and the World (WAN). Internet connection can be via telephone lines, cables, satellites, and other wireless connections. An important aspect of communication network development is the emergence of electronic library.

### **Electronic Library**

An electronic library is a type of service that allows users, without actually stepping into the library, to read library books and conduct research at home, in the office, or at school, using the Internet. Service which enables users to effectively employ electronic data by using an in-library network is also referred to as an "electronic library service." This is a new library service that applies fast advancing data processing technology and networking technology, and it is expected to become a highly convenient, epoch-making mode of service ([www.ndl.go.jp](http://www.ndl.go.jp)). The electronic library is an information system that employs computers and networks. To facilitate use of the electronic library, together with digitisation of materials, a computer system which can provide digitised data must be configured. Several innovations in communication technology have led to faster and more reliable links and better information transfers (Mischa, 1997). The term 'electronic library' is being used here in broad terms to mean a collection of networked digital information resources and associated technical and managerial infrastructure. The

electronic library is assumed to include data and metadata in various formats which are created or assembled in order to provide a service to end users. The terms 'electronic library', 'e-library', 'digital library', and 'virtual library' are used as synonyms. Managing the development and delivery of electronic library services is one of the major current challenges for university library and information services. When deciding whether or not to build a virtual library, the numerous advantages and disadvantages need to be taken into consideration.

### **Advantages**

- i. Immediate access to resources: - virtual libraries are available anytime, which helps in facilitating just-in-time learning.
- ii. Information updated immediately: - ability to respond to immediate needs of users, provide resources at short notice, contains up-to-date information.
- iii. No physical boundaries: - people from all over the world can access information as long as there is an Internet connection.
- iv. Support different learning styles: - access material in a variety of formats, tailored to characteristics of the learner or community of learners, range of resources to meet the information needs of different users, and can be customised for particular schools, grades and subjects.
- v. Accessible for the disabled:- offers an alternative for those who have physical difficulty accessing resources in a regular library; through use of audio and video, resources are made available to the visually and hearing impaired; integrate voice, video, and text for users involved in distance education in remote locations.
- vi. Information retrieval- provides user-friendly interfaces, giving clickable access to resources, use any search term such as word, phrase, title, name, subject to search entire collection.
- vii. Storage of information- potential to store much more information than traditional library and requires very little physical space to contain information.
- viii. Networking capabilities- one digital library can provide a link to any other resources of other digital libraries; a seamlessly integrated resource sharing can also occur.

- ix. Directs students to relevant resources- students spend more time thinking about information rather than participating in time consuming searching; it complement the library's print resources and can be customized to meet the needs of a particular school community.

### **Disadvantages**

There are some **disadvantages** or concerns that need attention and consideration when creating a virtual library. Some of these include:

- i. Restricted by copyright law: works cannot be shared over different periods of time like a traditional library, content is public domain or self-generated; if copyright exists, permission needs to be requested.
- ii. Requires connectivity: instability of Internet sites requires regular checks to be carried out to ensure that web links are still active; if there is no Internet connection, the VL will be inaccessible. Even when there is access to the Internet, users still lack skill to utilize the available information.
- iii. Skilled professionals are required: to organise, maintain and help students, to guide students in their selection, evaluation and use of electronic choices, need the knowledge of Boolean searching and advanced searching skills.
- iv. Increased number of resources challenges student selection: purchase of online materials is not tailored for a particular community of learners hence, students face difficulty in selecting quality material from the increased assortment of resources.

Establishing and maintaining a virtual library requires consideration of both the advantages and disadvantages in order to create an effective library and offer efficient library services. However, with careful design and the support of skilled information professionals, virtual libraries can provide a powerful environment for student learning (Gunn, 2002).

### **Research Methodology**

Survey research design was used for the study which concerns itself with the present and attempts to determine the current status of the phenomena under investigation. This method was used to identify the technologies behind the network design of the three university networks under study, and the opinion of the network users. The criteria used for data collection were divided into three: bandwidth, latency, network media and users' satisfaction. For each of these criteria, interview, questionnaire and direct observation

method were used for data collection. Three hundred copies of questionnaire were distributed, one hundred in each university under study. Ninety questionnaires were returned in FUTMINNA, eighty-four in UNIJOS, while sixty was returned in UNILAG; making seventy-eight percent (78%) of total questionnaire returned. The highest number of respondents came from the FUTMINNet while the least is from the UNILAGNet while UNIJOSNet was also well represented.

### **Analysis and Interpretation of Results**

The tables below represent the analyses of data gathered from Network Administrator/ Designer of the three university networks under study. One questionnaire was administered to each Network Administrator and the following data were gathered from the questionnaire

The three university networks have similar category of users ranging from staff (academic and non-academic) to students from all levels. Although external community can also use the networks it is strictly on commercial basis. The university networks operate on both wired and wireless connections. UNIJOSNet has the largest number of wireless users of 4,000 while UNILAGNet have the largest number of wired users. (2,500). FUTMINNet has the least number of both wired and wireless users; 250 in each case. UNIJOSNet emphasises more on mobility of its users and as such expands its wireless connection from time to time. UNILAGNet on the other hand, (because of the possibility of improper management and security reasons), focused only on wired connection of its users. FUTMINNet, however, operates both wired and wireless connections concurrently although the network still needs a lot of improvements. As can be seen from Table 1, UNIJOSNet has large capable NOC staff ranging from interns to apprentices and professionals that help monitor and manage their network compared to the other universities under study. UNIJOSNet also has various hotspots where users can browse at all times comfortably.

**Table 1: Overview of the three University Networks**

<b>Parameters</b>	<b>FUTMINNet</b>	<b>UNI JOSNet</b>	<b>UNILAGNet</b>
<b>Department</b>	ICT Centre	Computer Centre	CITS
<b>Composition of the Network Users</b>	Staff (academic & non-academic) Students (all levels)	Staff (academic & non-academic) Students (all levels)	Staff (academic & non-academic) Students (all levels)
<b>Number of registered users on the Network</b>	Wireless Users- Over 200, Wired Users- Over 200	Wireless Users- 4,000, Wired Users- 250	Wireless Users- 250, Wired Users- 2,500
<b>Number of Network Operations Center Staff</b>	Technical Staff- 5	Technical Staff- Over 500 (interns, apprentices & technical staff)	Technical Staff- 15 Interns- 12
<b>Buildings served by the Network</b>	All departments in various schools & Senate building	Wireless network covers all major buildings	All major buildings operate on wired connection except Faculty of Science & CITS that operates on Wireless
<b>Major Hotspot locations on campus</b>	Plans on the way	Bauchi road, Naraguta, JUTH & Staff Quarters	CITS & Faculty of Science
<b>Highest traffic duration based on the use of network</b>	Morning & Afternoon	Afternoon	Afternoon
<b>E-Mail system</b>	Web Mail (Linux platform)	Squirrel Mail,	UNILAG Web Outlook express
<b>Resources shared on the network UPS, Stabilizers</b>	Printers, Scanners Over 100	File sharing through Printers, Scanners Over 2,000	Printers, Scanners Over 2,000
<b>Source of alternate Power Supply</b>	Generator, Inverters	Generators, Inverters	Generator, Inverters
<b>Office equipment like air conditioner, server racks, cabinet, trunks etc</b>	Available	Available	Available

The three university networks connect to the Internet via satellite while making use of both C-band and Ku-band frequency bands. UNILAGNet does not make use of antennae because of its limited wireless network service. FUTMINNet and UNIJOSNet make use of the Omni Directional and Sectorial antennae. One can see the high bandwidth rate of UNIJOSNet (1.2Gbps/6Mbps), both uplink/downlink, compared to FUTMINNet (512/2048kbps) that runs at a very slow bandwidth rate. Bandwidth in use on UNILAGNet, though not as high as UNIJOSNet, is still preferable, as the findings depict.

**Table 2: Mode of Connection to the Internet**

Parameters	FUTMINNet	UNIJOSNet	UNILAGNet
Mode of connection to the internet	Via Satellite	Via Satellite	Via Satellite
Type of Frequency Band	C-band (2.4GHz) - Bosso campus Ku-band- GK campus	C-band (2.4GHz)- both campuses	C-band (2.4GHz)- both campuses
Type of antennae installed	Omni, Directional & Sectorial	Omni, Directional & Sectorial	NIL
Bandwidth rate	512/2048kbps 128/302kbps	1.2Gbps/6Mbps	6Mbps/4Mbps
Latency Level (Delay in response time)	High	Low	Low

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**Table 3: Users Assessment of the Three University Networks**

Parameters	FUTMINN Freq %	UNI JOSNet Freq %	UNILAGNet Freq %	TOTAL Freq %
<b>Users Response on Frequency of Use of the Network</b>				
Daily	22 24.4	54 64.3	23 38.3	99 42.3
Once a week	34	22 26.2	21 35	77 32.9
Once a month	21 23.3	4 4.76	2 3.33	27 11.5
Rarely use it	13 14.4	4 4.76	8 13.3	25 10.7
Don't use it	0 0	0 0	0 10	6 2.6
<b>TOTAL</b>	90 100	84 100	60 100	234 100
<b>Users Response on Network Assessment</b>				
Excellent	0 0	8 9.5	12 20	20 8.5
Very Good	8 8.9	22 26.2	18 30	48 20.5
Good	52 57.8	38 45.2	22 36.7	112 47.9
Poor	22 24.4	10 11.9	2 33.3	34 14.5
Very Poor	8 8.9	6 7.1	6 10	20 8.5
<b>TOTAL</b>	100	100	100	100

**Users Response on Network Response to Request**

<b>Excellent</b>	0	2	11	13
	0	2.4	18.3	5.6
<b>Very Fast</b>	4	12	13	29
	4.4	14.3	21.7	12.4
<b>Fast</b>	36	52	24	112
	40	61.9	40	47.9
<b>Slow</b>	36	8	6	50
	40	9.5	10	21.4
<b>Very Slow</b>	14	10	6	30
	15.6	11.9	10	12.8
<b>TOTAL</b>	100	100	100	100

(latency, network components and users response), FUTMINNet can be best described as a 'mis-managed' network. This is because, on the average, the network components and bandwidth in use, if well utilized, can effectively support the number of FUTMINNet users. How this can be achieved as discussed in the recommendations.

**Recommendations**

The management of FUT Minna university network services should:

- i. Increase the number of Network Operations Centre (NOC) staff or technical staff. This should include not only professional staff but also interns and apprentices;
- ii. Source for external funding and support from private international organizations and financial institutions;
- iii. Upgrade and expand the existing network components and infrastructures as well as bandwidth, to meet up with the increasing number of users and the current trends in University Networks, especially in efficient e-library service delivery;
- iv. Organise training, workshop, seminars for technical staff to meet up with the ever-changing and dynamic ICT world;

- v. Improve the overall performance and access to the network service which would, in turn, improve access to electronic library services.

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