

e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 2, Feb. 2015 Available at http://internationaljournalofresearch.org

Technological Framework for E-Banking in Nigeria

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ABSTRACT

The advent of information technology has brought about enormous changes, challenging how organizations are structured and how businesses are run. Yet, information technology is not static; it is continuously evolving, breaking new barriers, defining new horizons, and bringing new dimensions to human lifestyles. One of the greatest concerns of every business organization is customer satisfaction. In the banking industry, most customers are motivated by accuracy of records and timely provision of services. Particularly, most of them measure the service standard of banks on how timely transactions are completed. Various devices have emerged to enhance the speed and quality of service delivery and radically change how banking services are being handled. It is noteworthy that technology has a significant effect on bank efficiency and effectiveness. This has reduced to some extent complaints of customers. A lot of efforts are however required to fully utilize the numerous technological capabilities. Banks in Nigeria should explore technology in general and the internet in particular more intensely to avail themselves of the bountiful opportunities locally and globally. Banks should also ensure safety of e-banking transactions. Likewise, an interface between law and technology is strongly required to regulate the influence of the ever evolving technology on *e-banking in particular and business in general.*

1. INTRODUCTION

The focus of this paper is on the technological framework for e-banking in Nigeria. The paper discusses the subject matter by analyzing the nature of technology, the nature of internet and the interface between law and technology.

Technology is clearly a key factor in developing countries especially in terms of the rather high know-how technical required for the manufacturing of reliable information technology systems and thus against the backdrop of a rapidly changing information technology.¹

The advent of information technology has brought about enormous changes, challenging how organizations are structured and how businesses are run. Yet, information technology is not static; it is continuously evolving, breaking new barriers, defining new horizons, and bringing new dimensions to human lifestyles.²

Technology could be said to have come to banks first as a way of processing large amounts of routine business data, especially the storage and retrieval of financial information as an alternative mostly to conventional book keeping.³

One of the greatest concerns of every business organization is customer satisfaction. In the banking industry, most customers are motivated by accuracy of records and timely provision of services. Particularly, most of them measure the service standard of banks on how timely

¹O. A. Odegbami, "Considerations of Key Factors for an Information Technology Policy for Nigeria" in E. E. Woherem (ed), Information Technology in the Nigerian Banking Industry, (Spectrum Books Limited, Ibadan, 2000), p.161.

² D. Adeyeri and E. E. Woherem, "The Telephone and Computer in Banking: Constraints and Challenges in Nigeria" in E. E. Woherem (ed), op cit, p.95.

Ibid, pp.96-97.



e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 2, Feb. 2015 Available at http://internationaljournalofresearch.org

transactions are completed. The development of e-banking has changed the banking relationships of the personnel and that of the customer, which has many advantages over the traditional banking. This includes saving cost, marketing and communications, the offering of services regardless of geographic area, time and it increases customer base. Various devices have emerged to enhance the speed and quality of service delivery and radically change how banking services are being handled.⁴

2. NATURE OF TECHNOLOGY

From the beginning of human era, technology has been one of the most essential and most important factors for the development of mankind.⁵ Computer systems have however, now evolved as a new technological tool with most powerful and profound impact on virtually every facet of human activities.⁶

The first attempt to automate the manual processes of banks was done through mechanization. This is the process of using electromechanical devices such as note counters and accounting calculators to effect speedy processing of basic banking transactions, like computation and counting of currency notes. About a decade after the Second World War, the computer finally left the exclusive domain of the military and research institutions; and gradually found an entrance into commerce.⁷ There is no

- http://www.arraydev.com/commerce/jibc/2008-04/Agboola_fianl_accepted.pdf>.(28 December 2012).
- ⁵ P. I. Idowu, et al, *The Effect of Information Technology on the Growth of the Banking Industry in Nigeria*,

<www.ejisdc.org/ojs2/index.php/ejisdc/article/viewFi le/55/55> (20 April 2012).

⁶ O. A. Odegbami, op cit, p.158.

pp.82-83.

doubt that computer systems will increasingly pervade everyday lives of mankind.⁸ Technology has dynamically thrived through many generations in human life; each generation with its concept of modern technology. As such, modernization in technology is a continuous process and is currently flourishing. In view of the above, the paper proceeds to define the word technology in order to appreciate what it entails.

2.1 Definition of Technology

It is essential at this juncture to proffer definition for technology as a concept so as to properly appreciate the concept. Technology may be conceived as the totality of knowledge, skills and experience required for facilitating a job.⁹ It is defined as the theoretical knowledge of industry and the industrial arts or the application of science to the arts.¹⁰ In other words, technology is the practical use of scientific knowledge in industry and everyday life; it is practical sciences as a group; or the technical skills and achievements of a particular time in history of civilization or of a group of people.¹¹ Technology is also viewed as tool used by individuals in carrying out their tasks.¹² Technology may equally be seen as the scientific knowledge used in practical ways in industry.¹³ High technology is however the most modern methods and machines, especially electronic ones.¹⁴ From the foregoing definitions proffered by different authors, technology may simply be

¹² D. L. Goodhue and R. L. Thompson, *Task-Technology Fit and Individual Performance*,
 <iris.nyit.edu/~kkhoo/Spring2008/Topics/TTF/000Ta
 skTech_MIS.pdf> (25 September 2012).

¹⁴ Ibid, p.565.

⁴ A. A. Agboola, "Optimizing the use of Information and Communication Technology in Nigerian Banks", *Journal of Internet Banking and Commerce*, (2008), Vol.13.

⁷ E. E. Woherem and R. Alamutu, "The Networked Bank: LANs, WANs, the Internet, Intranet and GroupWare Systems", in E. E. Woherem (ed), op cit,

⁸ O. A. Odegbami, op cit, p.161.

⁹ Ibid, p.161.

¹⁰ A. H. Marckwardt, et.al, *Webster Comprehensive Dictionary*, International Edition, Vol.II, (J. G. Ferguson Publishing Company, Chicago, 1977), p.1288.

p. 1288. ¹¹ M. Robinson and G. Davidson, *Chambers 21st Century Dictionary*, (Chambers Harrap Publishers Ltd, Edinburgh, 2002), p. 1450.

¹³ A. S. Hornby, *Oxford Advanced Learner's Dictionary of Current English*, 6th Edition, (Oxford University Press, Oxford, 2001), p.1230.



defined as the use of scientific knowledge, skills and experience to facilitate an activity.

An understanding of what technology entails is relevant towards discussing its utility as a strong tool for the provision of e-banking services. In this regard, a conceptual analysis of the nature of analogue and digital technologies and the nature of the internet will be undertaken. This is so looking at the difference in speed, accuracy and reliability between analogue and digital technologies; and the fact that internet is very crucial to businesses conducted electronically in general and e-banking in particular. It will however begin by looking at the analogue and digital technologies.¹⁵

2.2 Analogue Technology

Analogue technology has been around for decades. It is the process of taking an audio or video signal and translating it into electronic pulses. It is less complicated a concept and it is fairly inexpensive to use. However, its signals have size limitations as to how much data they can carry.¹⁶ Analogue technology results in a degradation of quality of the data conveyed. The nature of the technology rationalizes for the difference in the quality of the transmission. It transmits the whole information at once, thereby, forcing degradation in the quality of the data.¹⁷

2.3 Digital Technology

Digital technology is the process of breaking signal into a binary format where the audio or video data is represented by a series of "1s" and "0s", transferring it to the other end where another device receives all the numbers and reassembles them into the original signal. The

beauty of this technology is that it knows what it should be when it reaches the end of the transmission. That way, it corrects any errors that might have occurred in the data transfer. The nature of the technology allows it to cram lots of those "1s" and "0s" together into same space an analogue signal uses.¹⁸ A basic characteristic of digital technology is that data is transmitted in perfect quality, without loss or interruption to any of its constituent parts. Digital technology eliminates the quality reducing tendencies of the data. It allows the making and transmission of perfect copies which are identical.¹⁹ Digital technology uses the electromagnetic spectrum to transmit signals. This arms it with both speed and accuracy in the way it transmits data. It can effectively transmit data, graphics, audio and video in a harmonized fashion much more than it had ever been done. It is for this feature that it evinces two further characteristics - the ability to compress and stream data or media; and real time delivery. It is the technology for the future simply for its high repetitive accuracy.²⁰

Modern technology is greatly influenced by the development in computer technology which accounts for the reason of referring to this generation as computer-based age. In line with this, the paper proceeds to study the nature of computer.

2.4 Nature of Computer

Computer is any electronic device of computational machinery using programmed instructions which has one or more of the capabilities of storage, retrieval, memory, logic, arithmetic or communication and includes all input, output, processing, storage, software, or communication facilities which are connected or related to such a device in a system or network

¹⁵ M. L. Ahmadu, "Internet: A Unifying Platform for the Global Muslim Community", in: M. L. Ahmadu, et. al, (eds), *Contemporary Issues in Islamic Jurisprudence*, (Rawel Fortune Resources, Benin City, 2009), p.202.

 ¹⁶ P. Wotel, *Analog. Digital. What's the Difference?*,
 <telecom.hellodirect.com/docs/Tutorials/AnalogVsDi
 gital.1.05/501.asp> (29 September 2012).

¹⁷ M. L. Ahmadu, op cit, p.202

¹⁸ P. Wotel, op cit.

¹⁹ M. L. Ahmadu, op cit, p.202

²⁰ M. L. Ahmadu, "Information Technology and Legislative Processes in Nigeria", in M. L. Ahmadu (ed), *Legal Prisms: Directions in Nigerian Law and Practice*, (Usmanu Danfodiyo University Press, Sokoto, 2012), p.2.



International Journal of Research (IJR) e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 2, Feb. 2015

Available at http://internationaljournalofresearch.org

or control function by the manipulation of signals, including electronic, magnetic or optical and shall include any input, output, data storage, processing or communication facilities directly related to or operating in conjunction with any such device or system or computer network.²¹

Computer is an electronic device that uses instructions provided to it and stored in its memory unit, to accept data input from its peripherals. It processes the data input using its arithmetic and logic processing units, and then produces outputs from its internal processing, while storing the result for use in the future. This includes things like handheld computers, palmtops, notebooks, personal digital assistants (PDAs), tablets, desktops, workstations, minis, computers mainframe as well as supercomputers.²²

programmable general-purpose The first computer called electronic numerical integrator and calculator (ENIAC) was developed at the University of Pennsylvania in 1964. The computer used to be huge and usually filled up a whole garage with tubes running around it. Computer technology has progressed rapidly that computers are now shrunk to desktops, notebooks, palmtops, tablets and pads. The subsequent computers have much more power and functionality than ENIAC and the early mainframes. Computers thus empower people not just by the increased functionality, but because they have led to the liberation of individuals from their mundane activities.²³

Computer systems are made up of two major components for the purposes of their data processing functions. The two parts are hardware and software. Computer hardware refers to the physical components of the computer. Software on the other hand refers to

the sets of instructions that are fed into the machine that enable the computer to process data. A computer needs an input device, a processing device and an output device in order to carry out data processing. It also needs a storage device in order to store the data it processes. There are two types of software application software such as word-processors. spreadsheets, transaction processing systems, databases and personal information management systems; and system software which comprises of operating system. Operating system enables applications to be run. It is the interface between the application software, the user and the equipment.²⁴

Computers and telecommunications are the two main technologies constituting information technology. In line with this, it is expedient to examine information technology as a concept.

2.5 **Information Technology**

Information technology refers to the new technology of gathering, storing, manipulating and transferring information. At the heart of the technology lie two major branches of technology, namely computing _ and telecommunications.²⁵ It also refers to all technologies based on microelectronics or computers and those based on telecommunications, computer systems, fax systems, telex and other information-based systems offering services for storing, retrieving and transmitting data and information.²⁶ It is a systemized body of tools, techniques and infrastructure for gathering, collecting, storing, processing and transmitting data and information.²⁷ It is the process of utilizing technology to communicate information in text,

²¹ Section 34, National Information Technology Development Agency (NITDA) Act, Cap 315 Laws of the Federal Republic of Nigeria (LFRN), 2010.

²² E. E. Woherem, "Understanding IT and Uses", in

E. E. Woherem (ed), op cit, p.2. ²³ Ibid.

²⁴ Ibid. p.3.

²⁵ E. E. Woherem, "The Constraints and Challenges of Information Technology in the Nigerian Banking Industry", in E. E. Woherem (ed), op cit, p.52. ²⁶ S. B. Osineye and E. E. Woherem, "Towards an Information Technology Policy for Nigeria", in E. E. Woherem (ed), Information Technology in the Nigerian Banking Industry, (Spectrum Books

Limited, Ibadan, 2000), p.134.

²⁷ D. Adeyeri and E. E. Woherem, op cit, p.95.



e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 2, Feb. 2015 Available at http://internationaljournalofresearch.org

graphics, audio or video or in any format combining these processes.²⁸ It is a modern handling of information by electronic means, which involves its access, storage, processing, transportation or transfer and delivery.²⁹ It has been defined by the National Information and Technology Development Agency (NITDA) Act to encompass all forms of technology used to create, store, exchange and use information in its various forms (business data. voice. conversation, still images, motion pictures, multimedia presentations and other forms including those not yet conceived).³⁰

It comprises in all the electronic infrastructure and facilities employed by banks in the accurate validation and processing of the incidence of high transaction volumes and/or values. Together with those facilities, the competitive interpretation of quality customer services and efficient database management for effective control and management, constitute the management information system (MIS) of every bank. Such electronic facilities consist of hardware, software and communications links between the service outlets of the same bank and similar outlets of different financial institutions to facilitate the sharing of common resources such as automated teller machines (ATMs).³¹

Information technology is today a major instrument for the automation of industrial and commercial activities to promote performance and boost profitability. Organizations are looking for ways to reduce operational costs and risks, achieve improved efficiency and deliver enhanced customer service.³² Information technology has particularly become the digital nervous system of banks. It is perceived as an

instrument for engendering competitive advantage in enterprises as it promotes greater efficiency and effectiveness in financial transactions.³³ Whether a bank would be successful or not depends on the extent to which it is investing in information technology and using it in an innovative fashion because right now banking transactions are conducted, and would continue to be conducted in cyberspace.³⁴

The ability of computers to communicate with one another from even very far locations has given rise to internet. The internet has become a pervasive communications facility. As such, the paper will now discuss nature of internet.

3. NATURE OF INTERNET

The internet and its communication miracles, result from a fundamental principle of network engineering - keep it simple, stupid (KISS). Every computer connected to the internet is capable of doing a few very simple tasks very quickly. By linking millions of comparatively simple systems together, complex functionality is achieved. The internet is an ingenious communications network in large part because it is so simple.³⁵ It is made up of a nebulous group of commercial and non-commercial computer networks, linked together through the help of telephone lines.³⁶ It is not controlled by any institution, agency, country or individual. It could be called a system based on organized anarchy. It is open to and accessible by anybody.³⁷ It represents one of the most successful examples of sustained investment and

²⁸ See M. L Ahmadu, ante footnote 20.

²⁹ P. I. Idowu, et al, op cit.

³⁰ Section 34, NITDA Act, LFRN, 2010.

³¹ G. Irechukwu, "Enhancing the Performance of Banking Operations through Appropriate Information Technology", in E. E. Woherem (ed), op cit, p.63. ³² E. E. Woherem, "Business Process Re-engineering

and Information Technology", in E. E. Woherem (ed), op cit, p.198.

³³ See E. E. Woherem, ante footnote 25, p.51.

³⁴ See E. E. Woherem, ante footnote 22, p.1.

³⁵ E. Zuckerman and A. McLaughlin, *Introduction to* Internet Architecture and Institutions.

<cyber.law.harvard.edu/digitaldemodracy/internetarc hitecture.html> (11 June 2012).

³⁶ E. E. Woherem, "Information Technology and Competitive Advantage: Issues of Government Policies and Corporate Strategy", in E. E. Woherem (ed), op cit, p.16. $\frac{1}{37}$ c -

See E. E. Woherem, ante footnote 22, p.9.



e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 2, Feb. 2015 Available at http://internationaljournalofresearch.org

commitment to research and development in information infrastructure.³⁸

3.1 Definition of Internet

Internet has been defined as a network of networks heterogeneous mutually interconnected.³⁹ It is also defined as an international computer network connecting other networks and computers from companies, universities, etc.⁴⁰ It is a network of computers that are globally interconnected. It has three characteristics - random transmission of data; ability to break down data during transit; and the capacity to reconstitute data at the point of receipt.⁴¹ In other words, it is a huge network of computer networks. It is the network that interconnects most of the other individual networks in the world through a common communication protocol called transport control protocol/internet protocol (TCP/IP).⁴² It is a network of computers linked together and working in a coordinated fashion. It is the primary technological platform for the transmission of digital and analogue data.43 Simply put from the foregoing definitions, internet is the interconnectivity of different computer networks.

3.2 Meaning of Network

A network is a series of computers that are connected electronically and that can share information digitally.⁴⁴ It is also a number of computers and other devices that are connected together so that equipment and information can be shared.⁴⁵ In other words, it is any set of computers usually referred to as hosts connected in such a way that each of them can inter-operate with others. The connection among hosts is made possible by two major components hardware and software. The hardware refers to the physical components of the networks, such as computers and communication lines ranging from the local telephone lines to fibre optic cables and even satellite connections that transfer data between computers. Software on the other hand, refers to the set of computer programs that rule the exchange of data through the hardware components. The software defining the network operations are often called protocols, since they define the set of standards that allows the handling of communications.⁴⁶ There are two identifiable basic configurations which are mainly determined by geographical size, among the various types of networks local area networks (LANs) which are used to connect hosts inside limited areas especially buildings. university departments. etc: metropolitan area networks (MANs) and wide area networks (WANs) which on the other hand, connect computers which are located over wide geographical areas by using fibre optic cables, long distance land lines, radio or satellite transmission.47

Digital computer networks interconnect multiple computers and other devices that are related to computer-based data. They are networks of computers based in different locations, such that data can be received or transferred from one location to another.⁴⁸ Digital computer networks differ from ordinary telecommunications networks in that, the former carries digital

³⁸ B. M. Leiner, et al, *The Past and Future History of the Internet*,

<http://bandwidthco.com/history/network/Past%20an d%20Future%20History%20of%20the%20Internet.p df> (19 November 2012), p.1.

³⁹ R. P. Satorras and A. Vespignani, *Evolution and Structure of the Internet – A Statistical Physics Approach*,

<http://books.google.com.ng/books?hl=en&lr=&id= EiySN0V4T_0C&oi=fnd&pg=PP1&dq=Evolution+o f+Internet&ots=JbqA_vMnVh&sig=YUib0d5x0ZKT Yk3Rn-

Fpq8zsJJQ&redir_esc=y#v=onepage&q=Evolution% 20of%20Internet&f=false> (05 November 2012), p 11

p.11. ⁴⁰ A. S. Hornby, op cit., p.627.

⁴¹ See M. L Ahmadu, ante footnote 20.

⁴² See E. E. Woherem, ante footnote 22, p.9.

⁴³ See M. L Ahmadu, ante footnote 15, p.205.

⁴⁴ See E. E. Woherem, ante footnote 22, p.9.

⁴⁵ A. S. Hornby, op cit, p.787.

 ⁴⁶ R. P. Satorras and A. Vespignani, op cit, pp.10-11.
 ⁴⁷ Ibid.

⁴⁸ E. E. Woherem and R. Alamutu, op cit, p.85.



International Journal of Research (IJR) e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 2, Feb. 2015

Available at http://internationaljournalofresearch.org

signals, whereas the latter carries analogue signals. Once the network is in place, users can send messages to one another electronically. They can also use it to automate some of their workflows, share computer resources such as software programs or printers, have access to a common bulletin-board, send data files to other users, and log in to remote computers.⁴⁹

Networks have become omnipresent in businesses, especially in the developed economies. They have become crucial to the survival of businesses especially banking business.⁵⁰

3.3 History of Internet

The origin of the present day internet is traceable to the United States Department of Defence's funding in 1969 of advanced research agency network (ARPANET).⁵¹ projects ARPANET's teams of hardware and software engineers configured four computers as an experimental network. The computers were located at Stanford Research Institute: University of California Los Angeles; University of California Santa Barbara; and University of Utah. Bolt, Beranek, and Newman Incorporation (BBN) coordinated the experiment and was awarded several contracts by the Department of Defence. BBN built the first interface message processors (IMP). The IMP is the mother of the file transfer protocol (FTP). On September 2, 1969, IMPs were first used with intermittent success, to transfer information among the major research institutions.⁵²

Three technical advances created the evolution of ARPANET to the internet – the development

⁵¹ Advanced Research Projects Agency Network (ARPANET) was later renamed Defense Advanced Research Projects Agency (DARPA).

⁵² S. M. Marson, A Selective History of Internet Technology and Social Work,

of the TCP/IP which was more user-friendly than its predecessor network control program (NCP); Xerox completed a long series of experiments that led to the development of the Ethernet; and in an effort to maximize the use of the network among institutions of higher education, ARPANET established a contract with BBN and the University of California Berkeley to invent a low-cost TCP/IP.⁵³

By early 1980s, the network traffic increased to the point of becoming sluggish. As a result, ARPANET was split in 1983. MILNET was used for military sites and ARPANET was used for non-military traffic. However, as a result of unceasing growth, standardized protocols were required by the United States Secretary of Defence. Unknowingly, these standardizations laid the ground work for the successful commercialization of the internet. Utilizing these standards. the National Science Foundation funded or partially funded six supercomputer centres known as National Science Foundation Net (NSFNET). These centres merged into a backbone of the internet. NSFNET permitted an easier access in order for researchers to share their ideas in a more userfriendly environment. Time could be spent developing scientific ideas rather than spending countless hours figuring out the network.⁵

kev innovation occurred Α with Paul Mockapetris's (University of Southern California) November 1983 memo entitled domain name system (DNS). To compensate for the unexpected increase of addresses, he proposed an international system which includes seven top-level domains - com (commercial); edu (educational); gov (government); mil (military); net (networking organizations); org (non-commercial organizations); int (international organizations).⁵⁵

By 1992, the internet had continued to grow without any controls. No single entity could

⁴⁹ Ibid.

⁵⁰ Ibid.

<http://libres.uncg.edu/ir/uncp/f/A%20Selective%20 History%20of%20Internet%20Technology%20and% 20Social%20Work.pdf > (19 November 2012), pp1-3.

⁵³ Ibid.

⁵⁴ Ibid.

⁵⁵ Ibid.



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claim authority over internet. The real success of the internet is not attributed to the various technical consortia; rather it is consistently attributed to cooperation among the users. If any person or a group of persons violates the border of reasonableness, users work together to establish a position.⁵⁶

However, internet is now open to, and accessible by anybody and for whatever purpose. This informs the reason why it is fondly referred to as a system of organized chaos.

3.4 Internet Architecture

The various networks composing the internet are connected through specific devices referred to as routers which control the communication amongst hosts in both the same and different networks. Routers provide the physical connectivity of the network. They also continuously exchange updates on the network status, routing paths, and other vital information needed to keep alive the internet, and choose the best routing for data.⁵⁷

Other important components of the internet are bridges, repeaters, switches and public exchange points. Bridges are devices that connect two or more networks by forwarding only a certain kind of traffic, thereby acting as filters. Repeaters are devices that just propagate the signal from a cable to another without taking any routing decisions. Switches are devices that join multiple hosts together in LANs. Exchange points on the other hand, interconnect autonomously administered networks in public points where several routers are interconnected by shared media.⁵⁸

The large heterogeneity of internet is reflected also at the software level since each network can rely on different protocols. Internet routers therefore have to be able to translate from one protocol to another, by working on the basis of a general protocol that plays the role of the universal language and addressing system of the internet. The internet is indeed built on a whole family of cooperative protocols often referred to as the internet protocol suites.⁵⁹

The internet is a packet switched network in the sense that whoever is using the internet does not have a dedicated connection or circuit between two points which makes that specific part of the network unavailable to all other users even when the communication is put on hold. Instead, in a packet switched network, all the communications between two hosts are mixed together with everyone else's data put in common pipes, delivered to the specified destination address, and only finally sorted out at the destination address. The entities supervising this process are internet routers which perform all these operations by following a set of standard protocols.⁶⁰

The internet TCP/IP protocol suite contains a family of protocols of which the TCP and IP are the most important ones. The IP defines a unique address space for the internet in which each host receives its own IP number (IP address). When a host sends a packet of data to a given address. the router forwards it to the destination address. Routers do not necessarily have physical connection to all other routers in the internet. Router rather handles the packet by looking at the destination address and sending it to the neighbouring router closer to the destination address (the best next hop toward the final destination). Routing protocol algorithms determine the decision of the router as to which is the next hop router. This feature provides the network with the great advantage that all routers are equally important, so that failure of any one of them does not preclude the functioning of the network, since routers can decide to forward packets through a different path in real time.⁶¹

TCP performs the role of breaking down the data into packets of small and manageable size,

⁵⁶ Ibid.

⁵⁷ R. P. Satorras and A. Vespignani, op cit, pp.11-13.

⁵⁸ Ibid.

⁵⁹ Ibid.

⁶⁰ Ibid.

⁶¹ Ibid.



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stamped with the origin and destination IP. Each data packet is numbered and labelled by the TCP so that the TCP software can collect and reassemble the data packets in the proper order on receipt by the destination host. The TCP thus allows the packets to be sent through different paths, providing further flexibility to internet data transmission. When a router is overloaded, it builds up a queue of data packets to be handled. If the number of packets in the queue becomes excessively large thereby overflowing the memory buffer, the router just discards newly arrived packets. The TCP handles these situations by sending re-transmission messages and executing checks of the transmission delays that allow the sending host to resend packets only if really necessary.⁶²

The internet protocol suite also contains other application-level protocols such as file transfer protocol (FTP); telnet protocol; and simple mail transfer protocol (SMTP). These are high-level software that control large file transfer between hosts; remote sessions on a given host; and e-mail exchange respectively.⁶³

The dynamic nature of technology has made it difficult to solely utilize law to regulate its applicability. Interface between law and technology is therefore expedient to successfully regulate the application of technology in ebanking business in particular, and in our day to day activities in general. In line with this, the paper proceeds to discuss interface between law and technology.

4. INTERFACE BETWEEN LAW AND TECHNOLOGY

Law has often exhibited a rather ambivalent attitude toward technology. This is attributable to the fact that technological progress threatens legal rights and duties.⁶⁴

Digital technology advances so rapidly that it surpasses legal attempts to regulate it at any given time. As new rules are developed to tackle the technology, new technologies emerge. This development creates quandaries in the way the law regulates technology. The convergence of technologies also poses additional regulatory However, despite these, challenges. the convergence process will continue because of its enormous advantages. All these go to advocate that an effective way to make the legal mechanism relevant to emerging digital technologies is for the law to make the technology regulate its development.⁶⁵

An understanding of the problems of the interface between law and technology is better appreciated through five key issues – conflict of laws; security of online transactions; authentication of digital signatures; integrity of digital data; and establishment of certification authority.⁶⁶

4.1 E-Conflict of Laws

E-Conflict of laws relates to the aspect of jurisdiction whether locally, nationally or internationally, which is further manifested in the areas of the location for the adjudication of online commercial disputes; choice of law to resolve the disputes; and the potential for foreign recognition and enforcement of judgements in cyberspace.⁶⁷ This could be alleviated or even eradicated by conferring territorial jurisdiction

content/uploads/Journal%20Issues/Volume%2026/Iss ue%203/Montagnani.pdf> (28 November 2012). ⁶⁵ M. L. Ahmadu, *Information and Communications Technology in Nigeria: Some Lessons on the Law and Practice of Electronic Commerce*, being an Inaugural Lecture delivered at ETF III Hall of Usmanu Danfodiyo University, Sokoto on Thursday 9th December, 2010.

⁶² Ibid.

⁶³ Ibid.

⁶⁴ M. L. Montagnani, A New Interface Between Copyright Law and Technology: How User-Generated Content will Shape the Future of Online Distribution, <http://www.cardozoaelj.com/wp-

⁶⁶ M. L. Ahmadu, *Background Study on Cyber-Legislation in the South Pacific*, APT/ITU/PITA Workshop on Principles of Cyber Legislation for Pacific Island Countries, Auckland, New Zealand, 28-30 April 2007.

⁶⁷ Ibid; C. M. V. Clarkson and J. Hill, *The Conflict of Laws*, (Oxford University Press, New York, 2011), pp.1-20.



on courts located in the area where either of the parties involved in the transaction does business or where the transaction was completed, and the law of the area should be the applicable law in that respect.

Furthermore, there should be a collaborative relationship among the developing countries in particular, and the world in general to facilitate foreign recognition and enforcement of judgements in cyberspace.

4.2 Security of Online Transactions

The use of technology to transact online has brought with it the problem of useridentification because of the remote nature of the transaction, the physical distance separating the parties and the ability to make instantaneous changes to electronic documents with little or no trace of detection. The cost-factor associated with putting in a place, a reliable electronic identification system will for some time to come make the technology suspect, at least from a legal point of view.⁶⁸

4.3 Authentication of Digital Signatures

Flowing from the issue of security of online transactions is also the problem of writing and authenticating digital signatures. This is equally very crucial to commercial transactions. The use of private and public keys encoded in electronic documents to authenticate or validate electronic transactions is widely regarded as a means of safeguarding the integrity of online transactions and business deals. While encryption technology is aiding the process of authenticating digital signatures, appropriate laws will however be needed to support the transition from conventional to electronic signature systems. At present, most countries are behind and need to catch-up by promulgating suitable laws to deal with issues pertaining to digital signatures; privacy of online public records and computer crimes, to mention but a few.⁶⁹

4.4 Integrity of Digital Data

Another fundamental problem associated with creating and regulating 'round the clock' electronic databases relates to data integrity. It is of utmost importance for the databases to be accurate and up-to-date. This helps to prevent fraud and can regulate unauthorised access or misuse. Because electronic banking transactions aggregate and process enormous amount of data and do so from different sources, the integrity of electronic or digitally managed records must therefore be of utmost consideration in the establishment and management of reliable online banking systems and services. The corollary is for the legal framework to provide an effective protection mechanism with checks and balances on the access, utilisation and the management of digitally generated data.⁷⁰

4.5 Establishment of Digital Certification Authority

It may be difficult for a country to establish and manage a national certification authority to process digital signatures as a means of validating automated public decisions and electronic transactions. There are financial and technical issues associated with the storage of digital signatures and the protection of such databases from viral and other attacks. For a certification authority to be a reliable manager of digital signatures, it must eliminate the major risks of using digital signatures between the sender and recipient. Most countries in general and Nigeria in particular need to put in place coherent national policies and legal frameworks

⁶⁸See M. L. Ahmadu, ante footnote 66; A. K. Ghosh and T. M. Swaminatha, *Software Security and Privacy Risks in Mobile E-Commerce*, <https://www.cs.indiana.edu/~shiny/oral_qual/files/p

⁵¹⁻ghosh.pdf> (30 May 2014), pp.51-57.

⁶⁹ See M. L. Ahmadu, ante footnote 66; R. L. Rivest, et al, *A Method for Obtaining Digital Signatures and Public-Key Cryptosystems*, <

http://ocw.bib.upct.es/pluginfile.php/5337/mod_resou rce/content/1/rsa_base.pdf> (30 May 2014), pp.121-123.

⁷⁰ See M. L. Ahmadu, ante footnote 66; J. C. Wallis, et al, *Know thy Sensor: Trust, Data Quality, and Data Integrity in Scientific Digital Libraries*,
<file:///C:/Users/user/Downloads/eScholarship%20U
C%20item%204xx221vv.pdf> (30 May 2014), p.382.



to address the establishment and management of national digital certification agencies. In the alternative, various stakeholders may consider establishing a regional certification facility to serve this need.⁷¹

5. CONCLUSION

The paper examined the technological framework for e-banking in Nigeria. It began with the nature of technology by defining technology, and analysing analogue and digital technologies, as well as nature of computer and information technology. It further discussed the nature of internet, providing the definition, history and the architecture of the internet. It also gave the meaning of network as a corollary to internet. The paper also examined the interface between law and technology.

It is noteworthy that technology has a significant effect on bank efficiency and effectiveness. This has reduced to some extent complaints of customers. Prior to the introduction of ebanking, customers' experience has been poor in terms of time to service customer and operational service. E-banking operations have continued to change payment systems in Nigeria. A lot of efforts are however required to fully utilize the numerous technological capabilities. Banks in Nigeria should explore technology in general and the internet in particular more intensely to avail themselves of the bountiful opportunities locally and globally. Banks should also ensure safety of e-banking transactions.

⁷¹ See M. L. Ahmadu, ante footnote 66; S. Yi and R. Kravets, *MOCA: MObile Certificate Authority for Wireless Ad Hoc Networks*,

<https://www.ideals.illinois.edu/bitstream/handle/214 2/10930/MOCA%20MObile%20Certificate%20Auth ority%20for%20Wireless%20Ad%20Hoc%20Netwo rks.pdf?sequence=2> (30 May 2014), pp.1-8.