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TCP/IP Protocol: A Suitable Communication Network

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***Abstract*— In data communication, a number of procedures is normally followed prior to information transmission between a remote terminal and a computer system. In addition, a series of signals must be exchanged to prepare and send the information across the network. , this article provides a comparative analysis between Transmission Control Protocol/Internet Protocol (TCP/IP) and other commonly used protocol that is applied in communication networks in Nigeria. From the analysis carried out, it was affirmed that TCP/IP is the most reliable and dependable protocol for internet communication worldwide. In Nigeria in particular, between 70 percent and 90 percent of computers today use any of the window-based operating system (from Windows 95, Windows NT to Windows XP) which support TCP/IP protocol thereby removing extra cost to acquire communication network protocols.**

***Index Terms*— Protocol, Internet, Computer, Communication .**

I. INTRODUCTION

A protocol is the set of rules and conventions used to impose a standardized structural language for the communication between multiple parties [1]. They can also be said to be those sequential procedures and processes that are normally followed to ensure a successful transfer of information from sender to receiver. Protocol can be grouped into: Routable protocol, Non-routable protocols, Connectionless protocol and Connection- Oriented Protocols. A Routable protocol is a protocol that has the ability to communicate across a router to different LAN networks on the internet. They are usually more complicated because they need extra layers to handle the routing features. Example are, the Routing Information Protocol (RIP), and the Open Shortest Path First Protocol (OSPFP). Non-routable protocols were the oldest protocols designed before networks grew as large as they are today. They are simpler, faster and limited to LAN networks only. Beside these features, they have some extension because of its non-intelligent nature. Though they provide better transfer speeds due to fewer overheads and less complexity in data transfer management. Examples are HDLC, SDLC, and X.25 protocols. Connectionless protocols are protocols that send out data across a network with no feedback as to know whether it arrived at the destination device. These protocols are very fast due to fewer networks mainly when data are to be sent to multiples of computer systems at the same time or required, such as in video or audio transmission. Examples are Internet Protocol (IP) and the User Datagram Protocol (UDP), While Connection- Oriented Protocols are protocols used to ensure that data arrives at its destination correctly when sent across a network; the protocol sends acknowledgements to indicate that data were successfully received. An example of a connection-oriented protocol is the Transmission Control Protocol (TCP). However, TCP/ IP which is the combination of Transmission Control Protocol, a connection-oriented protocol and the internet protocol, a connectionless protocol, were developed by the US Department of Defense (DoD) research project to connect a number of different networks designed by different vendors into a network of networks("the internet")[2]. It was initially successful because it delivered a few basic services that everyone needs (file transfer, electronic mail, remote log in) across a very large number of clients and server systems. Several computers in a small department can use TCP/IP along with other protocols on a single Local Area Network (LAN). The internet protocol (IP) component provides routing from the department to the enterprise network, then to regional networks and finally to the global internet. On the battle field, a communication network will sustain damage, so the DoD designed TCP/IP to be robust and automatically recover from any node or phone line failure [3]. This design allows the construct ion of very large networks with less central management. However, because of the automatic recovery, network problems can go undiagnosed and unmaintained for long periods of time. Truly, TCP/IP is the de facto standard for Network protocols.

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II. BACKGROUND INFORMATION

The roots of TCP/IP can be traced back to research conducted by the United States Department of Defense (DoD) Advanced Research Projects Agency (DARPA) in the late 1960s and early 1970s[4]. The following list highlights some important TCP/IP milestones. In 1970, ARPANET hosts started to use Network Control Protocol (NCP), a preliminary form of what would become the Transmission Control Protocol (TCP). In 1972, the Telnet protocol was introduced. Telnet is used for terminal emulation to connect dissimilar systems. In the early 1970s, these systems were different types of mainframe computers. In 1973, the File Transfer Protocol (FTP) was introduced. FTP is used to exchange files between dissimilar systems. In 1974, the Transmission Control Protocol (TCP) was specified in detail. TCP replaced NCP and provided enhanced reliable communication services. In 1981, the Internet Protocol (IP) (also known as IP version 4 [IPv4]) was specified in detail. IP provides addressing and routing functions for end-to-end delivery. In 1982, the Defense Communications Agency (DCA) and ARPA established the Transmission Control Protocol (TCP) and Internet Protocol (IP) as the TCP/IP protocol suite. In 1983, ARPANET

switched from NCP to TCP/IP. In 1984, the Domain Name System (DNS) was introduced. DNS resolves domain names (such as www.example.com) to IP addresses (such as 192.168.5.18). In 1995, Internet service providers (ISPs) began to offer Internet access to businesses and individuals. In 1996, the Hypertext Transfer Protocol (HTTP) was introduced. The World Wide Web uses HTTP. In 1996, the first set of IP version 6 (IPv6) standards were published [5].

III. THE TCP/IP SUITE STRUCTURE

This protocol suite was developed along with the internet. It was created to guarantee and safeguard data integrity as well as sustain communications in the occurrence of a distressing situation like during the period of wars. It has over the years developed into the gigantic, worldwide network known as the internet. Several protocols make up the internet protocol suite of which Transmission control protocol (TCP) and internet Protocol (IP) are the best known. Owing to the great success of the Internet, TCP and IP have become the major standards even in the private computer networks. The entire protocol suite is referred to as TCP/IP suite [6]. Communications between computers on a network is done through protocol suits. A protocol suit consists of a layered architecture where each layer depicts some functionality which can be carried out by a protocol. Each layer usually has more than one protocol options to carry out the responsibility that the layer adheres to. TCP/IP is normally considered to be a 4 layer system. The 4 layers are as follows :

1. Application layer
2. Transport layer
3. Network layer
4. Data link layer

1. Application layer

This is the top layer of TCP/IP protocol suite. This layer includes applications or processes that use transport layer protocols to deliver the data to destination computers.

At each layer there are certain protocol options to carry out the task designated to that particular layer. So, application layer also has various protocols that applications use to communicate with the second layer, the transport layer. Some of the popular application layer protocols are :

- HTTP (Hypertext transfer protocol)
- FTP (File transfer protocol)
- SMTP (Simple mail transfer protocol)
- SNMP (Simple network management protocol) etc

2. Transport Layer

This layer provides backbone to data flow between two hosts. This layer receives data from the application layer above it. There are many protocols that work at this layer but the two most commonly used protocols at transport layer are TCP and UDP. TCP is used where a reliable connection is required while UDP is used in case of unreliable connections. **TCP** divides the data (coming from the application layer) into proper sized chunks and then passes these chunks onto the network. It acknowledges received packets, waits for the acknowledgments of the packets it sent and sets timeout to resend the packets if acknowledgements are not received in time. The term 'reliable connection' is used where it is not desired to lose any information that is being transferred over the network through this connection. So, the protocol used for this type of connection must provide the mechanism to achieve this desired characteristic. For example, while downloading a file, it is not desired to lose any information (bytes) as it may lead to corruption of downloaded content. **UDP** provides a comparatively simpler but unreliable service by sending packets from one host to another. UDP does not take any extra measures to ensure that the data sent is received by the target host or not. The term 'unreliable connection' are used where loss of some information does not hamper the task being fulfilled through this connection. For example while streaming a video, loss of few bytes of information due to some reason is acceptable as this does not harm the user experience much.

3. Network Layer

This layer is also known as Internet layer. The main purpose of this layer is to organize or handle the movement of data on network. By movement of data, we generally mean routing of data over the network. The main protocol used at this layer is IP. While ICMP(used by popular 'ping' command) and IGMP are also used at this layer.

4. Data Link Layer

This layer is also known as network interface layer. This layer normally consists of device drivers in the OS and the network interface card attached to the system. Both the device drivers and the network interface card take care of the communication details with the media being used to transfer the data over the network. In most of the cases, this media is in the form of cables. Some of the famous protocols that are used at this layer include ARP(Address resolution protocol), PPP(Point to point protocol) etc. Figure 1 shows a TCP/IP Suit Structure

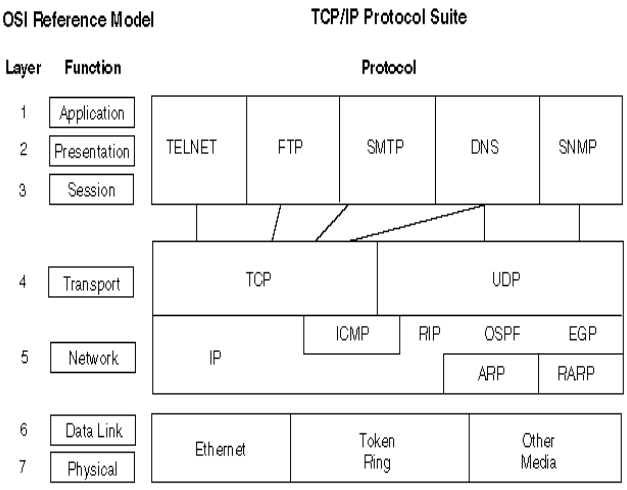

Figure 1: TCP/IP Suit Structure

IV. METHODOLOGY

In the course of carrying out this research, data were obtained from different sources especially; visits were made to networking and software vendors in Nigeria. Amongst them is AfiHub Information Technology, Incomtel Nigeria Ltd. Also, reasonable data were got from journals on communication networks, Internet resources and textbooks, which was a good comparative analysis of the findings.

A. Findings

In view of this research work, it has been duly observed that TCP/IP protocol unlike other protocol suites is not strict adherent of Open System Interconnect (OSI) hierarchy operations. This means that each segment of a protocol can use one of the segments below in the stack without necessarily having to go through an intermediate layer. In addition, a lower layer protocol can close down a higher layer protocol without requesting the higher layer protocol at both ends to communicate. Secondly, it was observed that many other protocols are usually restricted to some given communication networks in operation. Hence, they can be said to be Network specific. In TCP/IP protocol, if one of the elements necessary for data transmission is not available, transmission will not take place, quite unlike other protocol suites, where data transmissions can take place but with some losses. For the comparative analysis of TCP/IP protocol and other protocol suites, the data obtained are based on Local Area Network (LAN), since other protocols areas of operations are limited to LAN while TCP/IP can connect several LANs in different geographical locations thereby forming a Wide Area Network (WAN). More importantly, the compiled data on the various protocols were obtained from companies and firms visited during the course of this research, all based in Nigeria. They include AfiHub Information Technology, Incomtel Nigeria Ltd and many other personal consultations with IT professionals in Nigeria. In each of the findings, the research was done under the following deterministic properties of network communication protocol, Viz:

a. Speed

The speed of data transferred over the various protocols in consideration depends largely on the media and Network Interface Card (NIC) used. For example, older NIC like the 10 base T allows a maximum data throughput of 10 megabyte per second (10MB/S) while the new one can allow data passage up to 100MB/s. The findings show that when a lower speed NIC is used, the transmission limit of the protocol for data channels is increased.

b. Cost

This research has shown that, the cost of installing any protocol(s) is almost the same. The more expensive ones are determined by the extent of their capacity utilization. For example, installing TcP/IP in one system in a home is considered very expensive compared to other protocols. This is as a result of its under-utilization, because the resource information capacity and other uses cannot be fully exploited by a family.

c. Usage

TCP/IP protocol compared to other network protocols is used by a greater majority of establishments, in both public and private enterprises. Presently, based on statistical data available, about 70% computer users make use of Microsoft windows operating system in Nigerian, which also supports TCP/IP [7]. As a deterministic property, coverage of protocol is a significant factor for assessing the rate or level of performance of protocols.

d. Security

Every protocol has its own convention for transmitting messages between two devices within the same network [8]. On LAN networks in general, messages are sent between system devices by supplying the six-byte unique identifier call the “MAC” address. However, in an SNA network, every device has logical unit with its own network address. The same pattern DECNET, Appletalk, and Novell IPX protocols respectively, all have a scheme for assigning numbers to each of the workstations attached to the network. Comparatively and on top of these local or vendor specific networks address is TCP/IP, which assigns a unique number to every workstation throughout the WAN network across the globe. This “IP number” is a four-byte value that by convention is expressed by converting each byte into a decimal number (from 0 to 255) and separating the bytes with a period. For example, the Pc Lube and Tune server is 130. 132. 59. 234. Secondly, on demerits of TCP/IP, any Pc workstation connected to the Internet can be accessed if the IP address is known. This security lapse is being exploited by hackers worldwide.

e. Loss Recovery ability

TCP/IP was originally designed to solve the error that occurs whenever there is a loss of node or a line on the network. That is, any error detected on the network is a problem that must be corrected or repaired. Today, IP networks are robust in performances, in that they can automatically (and silently) reconfigure themselves when something goes wrong. Even, if the network in question has more redundancy built into it, communication is steadily maintained, though such redundancy is prohibitively expensive[9]. Also, TCP was designed to recover from node or line failures where the network propagation adopts routing-table changes to all router nodes. Definitely, the updating takes some time; hence TCP is slow to initiate recovery. More so, the TCP algorithms are not tuned to optimally handle packet loss due to traffic congestion. Instead, the traditional Internet response to traffic problems has been to increase the speed of channels and equipment in order to be ahead of growth in demand. Most importantly here is that, TCP treats the data as a stream of bytes. It logically assigns a sequence number to each byte. The TCP packet has a header that infers, “the packet starts with byte 379642 and contains 200 bytes of data”. The receiver can detect missing or incorrectly sequenced packets. TCP acknowledges data that have been received and retransmits data that has been lost. In conclusion, TCP design shows that error recovery is done end-to-end between the client and server systems, a feature that is not significant to other protocols. On the other hand, there is no formal standard

for tracking errors (problems) at the middle of the network, a property other protocols shows a reasonable merit over TCP, though each TCP network has adopted some adhoc tools to handle this drawback.

V. DISCUSSION

TCP/IP protocol has a greater level of coverage compared to other protocols for a given LAN network[10]. It provides a greater range for communication and is best suited for many interconnected LANs which invariably become WAN. On the other hand, comparing the coverage provided by the Internet worldwide, which uses TCP/IP protocol, goes a long way to prove that TCP/IP protocol is a "de facto" standard for larger area coverage among protocols. The speed and security level of TCP/IP protocol operation is based on the fact that communication is across larger number of different computer networks interconnected around the globe [10]. Also, the open nature of TCP/IP protocol makes it highly prone to unwanted and illegal hackers or access from a remote host. In the areas of usage, TCP/IP is popular, rapid and second to know. As the entire world is being brought together into a global village is the aftermath of Internet communication whose protocol, the TCP/IP is the brain behind this feat. In fact more establishments, large, medium and small, government agencies, educational institutions, companies and so on, now connect to internet by day using TCP/IP protocol.

VI. CONCLUSION

This research paper has revived various features of TCP/IP protocol which makes it an acceptable and a widely used protocol, hence, internetwork communications. From the analysis carried out, it was affirmed that TCP/IP is the most reliable and dependable protocol for internet communication worldwide.

REFERENCES

[1]. Shvetima G. (2000): Internet protocol; The foundations, ACM Crossroads.

[2].Kessler G.C (2003) An Overview of TCP/IP protocol and the internet. www.grey Kessler.net/library/tcpip.html

[3]. Gilbert H: Introduction to TcP/Ip. http:/pcit.cis.yale.edu/pcit

[4] CISCO. 2000. "Internetworking Technologies Handbook." pp. 1-2

[5]. Aru, O., Iroegbu C., and Enyenihi, H., ,,,,Analysis of Data Security Approach for Digital Computers"". International Journal of Modern Engineering Research, Vol. 3, Issue. 6, Nov - Dec. 2013 pp-3449-3451

[6].Lammle, T. (1999): Cisco certified Network Association Study Guide, sybex Inc., Alameda USA.

[7].Adeyinka A. (2002): IP Addressing. Understanding the TCP/Ip protocol addressing scheme, Pc word.

[8]. Brain kantor, Phil lapsely (1986): Network News Transfer protocol, www.mibsoftware.com/user/nntp/oo7.htm

[9]. Lammle, T. (1999): Cisco certified Network Association Study Guide, sybex Inc., Alameda USA.

[10]. Hedrick C.L. Introduction to Internet Protocol URL: file:/c/TEmP/Introduction to the Internet protocols.htm.

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