Computing, Information Systems, Development Informatics & Allied Research Journal
Vol. 8 No. 3, September, 2017 - www.cisdijournal.net

Sensitivity Analysis of Communication Protocols in Computer Network Nodes

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ABSTRACT

Interaction between service providers and users is required for information access on demand in heterogeneous environments. Connecting millions of users is by networks. One of the ways such interaction outlines is through major links of networks which consists essentially of network switches (or nodes), and transmission links (for interconnection). These links (wire, cable, radio, satellite, fiber optics facilities) accommodate a large number of users, up to the limit of a switch. Users have their respective traffic route or switche by the network nodes, along an appropriate routing path. This research work investigates the communication protocols between computer networks nodes and evaluates the performance analysis of the communication networks. In identifying vital research issues systematically, we propose analytical framework which consists of two modules: optimization of performance of communication networks and Efficient Network servicing modules. One of the ways networking is being facilitated currently is through data communications networks. Computer network can be utilized to enhance the overall performance of some application tasks to various service provision environments. It is an effective tool for data transmission activities in a highly interactive environment. Object oriented paradigm approach is considered in the design and implementation of communication protocol because of its reusability and extensibility. In this research work, the protocol design is based on object Oriented design model. Proper analysis of the existing systems was made and some factors were put into consideration. The efficiency of the new system was implemented and sensitively analyzed in different service environment to determine its requirements and specifications.

Keywords: Upper Respiratory tract infections, Fuzzy inference systems, symptoms, diagnosis

CISDI Journal Reference Format
Imeh, Umoren, Onukwugha, Chinwe & Yakise, Eyo (2017 Sensitivity Analysis of Communication Protocols In Computer Network Nodes. Computing, Information Systems, Development Informatics & Allied Research Journal. Vol 8 No 3. Pp 15-26
Available online at www.cisdijournal.net

1. INTRODUCTION

Currently, computers are available in many offices and homes. Hence, there is need to share data and programs among various computers. With the advancement of data communication facilities the communication between computers has increased and thus it has extended the power of computer beyond a confined room. Presently, a user sitting at one location can communicate with computers of any remote site through communication channel. The information exchanged between devices on a network or other communications medium is governed by sequence of rules or conventions that can be set out in a technical specification called a communication protocol standard. The nature of the communication, the actual data exchanged and any state-dependent behaviors are defined by the specification. The devices or communication systems use well-defined formats for exchanging messages and each message has an exact meaning intended to provoke a defined response of the receiver. According to [7], a data communications protocol is a system of digital message formats and rules for exchanging those messages in or between computing systems and in telecommunications.

[9] argues that there is no generally accepted formal definition of "protocol" in computer science as a field and other related fields, an informal definition, could be "a set of procedures to be followed when communicating". Nevertheless, a protocol definition defines and describes the syntax, semantics, and synchronization of communication which may include signaling, authentication and error detection and correction capabilities; the specified behavior is typically independent of how it is to be implemented. A data communications protocol can therefore be implemented as hardware or software or both. The data communications protocols in use on the Internet are designed to function in very complex and diverse settings. To ease design, data communications protocols are structured using a layering scheme as a basis. Instead of using a single universal protocol to handle all transmission tasks, a set of cooperating protocols fitting the layering scheme is used. However, the layering scheme in use on the Internet is called the TCP/IP model. The actual protocols are collectively called the Internet protocol suite. The group responsible for this design is called the Internet Engineering Task Force (IETF). Obviously the number of layers of a layering scheme and the way the layers are defined can have a drastic impact on the protocols involved and the rules can be expressed by algorithms and data structures. Hence, this research work is to model a communication protocol to control transmission of data between two or more computer network nodes using simple sets of laid down rules (The workings of the protocol).

2. STATEMENT OF PROBLEM

The problem of a Information systems arises in network communication systems. When computer nodes seeks to communicate with one or more computer system simultaneously. The system units requires a set of rules for communication process to be established. Nevertheless, the process involved in communication protocol design and implementation lack some essential features such as modularity, simplicity, reusability and extensibility rather based on the traditional procedural paradigm. Hence, this research project evaluates communication protocols between computer network nodes poised to solve the aforementioned problems by using an object oriented approach.

The work is intended to analyze the performance of a communication protocol between two network nodes, and the targeted objectives are as follows:

a. Identify the components of the data communication protocol designed.
b. Develop the formal specification of the data communication protocol of the proposed system using an object oriented approach.
c. Test the protocol using any two or more enabled system platforms to generates realistic analytical findings.

3. BACKGROUND LITERATURE

We're acquainted with some sorts of communication in our day to day activities for communication of information and messages we use telephone and postal communication systems. Similarly data and information from one computer system can be transmitted to other systems across geographical areas [3]. Thus data transmission is the movement of information using some standard schemes. These techniques include electrical signals carried along a conductor, optical signals along an optical fibers and electromagnetic areas. Suppose a manager has to write several letters to various clients. First he has to use his Personal Computer (PC) and Word Processing package to prepare the letter, if the PC is connected to the entire client's PC through networking, he can send the letters to all the clients within minutes. Thus irrespective of geographical areas, if PCs are connected through communication channel, the data and information, computer files and any other programs can be transmitted to other computer systems within seconds.

The modern form of communication like e-mail and Internet is possible only because of computer networking. [1] identified four basic requirements for working of a communication system.

1. The sender (source) who creates the message to be transmitted
2. A medium that carries the message
3. The receiver (sink) who receives the message

[6] identified four basic terms frequently used in data communication. They are:

- **Data:** A collection of facts in raw forms that become information after processing.
- **Signals:** Electric or electromagnetic encoding of data.
- **Signaling:** Propagation of signals across a communication medium.
- **Transmission:** Communication of data achieved by the processing of signals.

3.1 Communication Protocols

According to Perrig et al (2000), data communication software instructs computer systems and devices as to how exactly data is to be transferred from one place to another. The procedure of data transformation in the form of software is commonly known as protocol [8]. They further identified that data transmission software or protocols perform the following functions for the efficient and error free transmission of data.

1. **Data sequencing:** A long message to be transmitted is broken into smaller packets of fixed size for error free data transmission.
2. **Data Routing**: It is the process of finding the most efficient route between source and destination before sending the data.
3. **Flow control**: All machines are not equally efficient in terms of speed. Hence the flow control regulates the process of sending data between fast sender and slow receiver.
4. **Error Control**: Error detecting and recovering is the one of the main functions of communication software. It ensures that data are transmitted without any error.

3.2 Data Communication Modes

[8] also opined there are three ways for transmitting data from one point to another as shown below:

1. **Simplex**: In simplex mode the communication can take place in one direction. The receiver receives the signal from the transmitting device. In this mode the flow of information is Uni-directional. Hence it is rarely used for data communication. This is illustrated in fig. 1

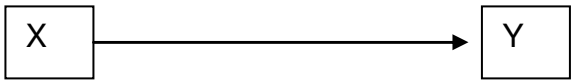

Fig. 1 Simplex X to Y

2. **Half-duplex:** In half-duplex mode the communication channel is used in both directions, but only in one direction at a time. Thus a half-duplex line can alternately send and receive data. This is illustrated in fig. 2 below.

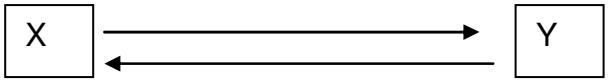

Fig. 2 Half-duplex X to Y or X to Y

3. **Full-duplex:** In full duplex the communication channel is used in both directions at the same time. Use of full-duplex line improves the efficiency as the line turnaround time required in half-duplex arrangement is eliminated. Example of this mode of transmission is the telephone line as shown in fig. 3 below.

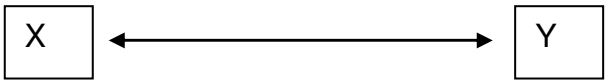

Fig. 3 Full-duplex X to Y and X to Y

3.4.2 Computer Network

According to [10] computer network is interconnection of various computer systems located at different places. In computer network two or more computers are linked together with a medium and data communication devices for the purpose of communication data and sharing resources. The computer that provides resources to other computers on a network is known as server. In the network the individual computers, which access shared network resources, are known as nodes.

3.4.3 Basic Types of Computer Networks

There are many different types of networks. However, from an end user's point of view there are two basic types:

a. **Local-Area Networks (LANs):** The computers are geographically close together (that is, in the same building).
b. **Wide-Area Networks (WANs):** The computers are farther apart and are connected by telephone lines or radio waves.
c. **Wide Area Network (WAN):** A WAN is a computer network that spans a relatively large geographical area. Typically, A WAN consists of two or more local-area networks (LANs). Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the Internet.

4. SYSTEM DESIGN

The proposed protocol system design follows an Object Oriented approach. This was chosen because the results in its implementations exhibit increased modularity, simplicity, flexibility, extensibility and reusability. This involves two terminal machines communicating via a designed protocol to automate and control the network.

4.1 The System Model

In other to achieve the stated objectives of the new proposed system, the various components have been mapped into the architecture as shown in fig. 3.1 below

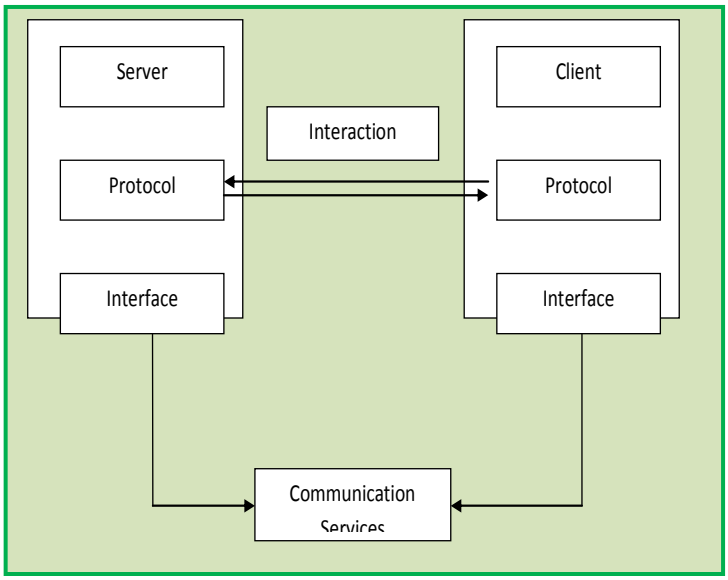

Fig. 3.1: Architecture of the proposed system

4.2 Components of the Proposed System

The proposed system has three major components. They are:

4.2.1 The Protocol

The protocol design for modules interaction is based on two semantics:

a. **Concurrency:** When a thread of control is suspended or blocked, its body lines are converted to dashed. Automatic conversion can be obtained based on the semantics of the posted and received messages. The con object for example in fig. 3.2 is executed by both threads i.e. the Client instance thread and the InputSegmentHandler instance thread which is used to handle connection objects and It is responsible for creating and destroying connection instances, as well as finding the connection instance that has a set of specified characteristics..

b. **Synchronization:** Operations with special semantics like set-timer (), wake-up(), wait() and notify() are defined and used to support synchronization between threads of execution. This is illustrated in fig. 3.2.

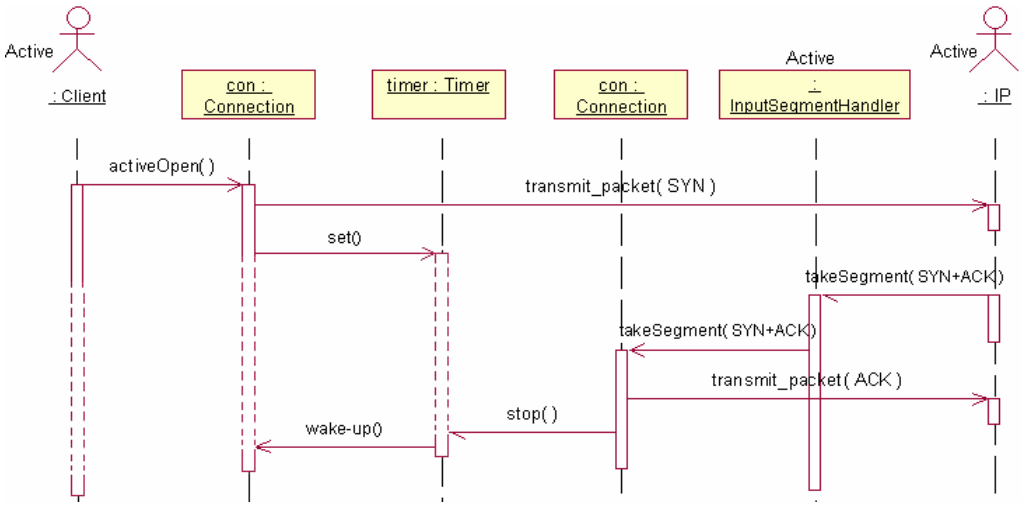

Fig. 3.2: Concurrency and Synchronization process of the protocol.

From fig. 3.2 above, three active objects have been shown: the Client instance, the IP instance and the InputSegmentHandler, which represents the protocol input thread. The arrival of a segment is passed as an asynchronous message from IP to the InputSegmentHandler. Synchronization between the Client and the InputSegmentHandler threads is obtained using an instance of Timer. The client thread which sets the Timer instance, is suspended (dashed lines) until a stop signal arrives, or there is a timeout. The suspended thread is then woken-up and returns to normal execution.

Thus, the use case diagram can be represented as shown in figure 3.3:

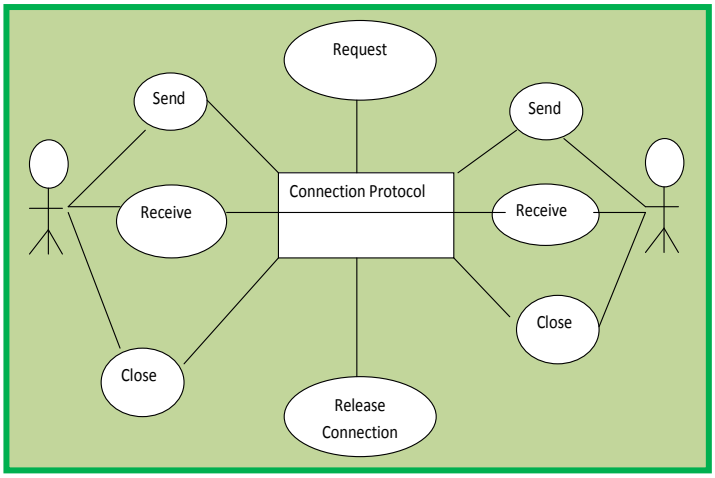

Fig. 3.3: Use Case model of the proposed protocol

Hence, the overall analysis class diagram of the proposed data communication protocol can be represented thus:

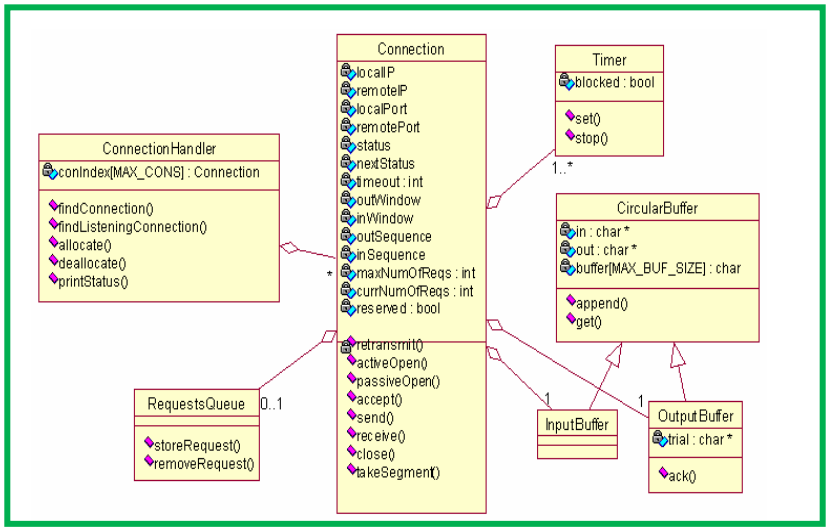

Fig. 3.4: Analysis Class Diagram of the proposed data communication protocol

The Connection class, which is the heart of this model, has data members. Method specifications are given according to the instance responsibilities. Method takeSegment() for example, processes the incoming from IP segments; it checks the segment's sequence number, acknowledgement number and flags, then copies any data to the connection's input buffer and, if necessary, it sends back an ACK segment. The analysis class diagram was refined to produce the design class diagram. Two active objects were identified: a) the InputSegmentHandler for handling incoming from IP segments and b) the OutputSegmentHandler for managing the transmission of segments.

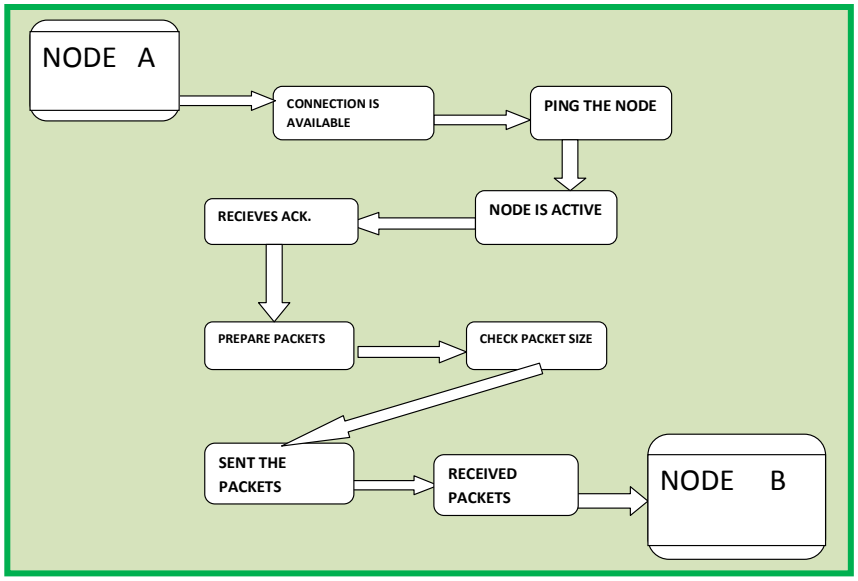

Fig. 3.5 Logical steps in the protocol interaction

4.2.2 The Rules

1. Ensure connection is available:
2. Ping the node that communication is to be made:
3. Makes sure the node is active not passive:
4. Receive acknowledgement from the node:
5. Prepare packets that are to be sent:
6. Check the size of packets that are to be sent:
7. Sent the packets
8. Giving a feedback massage about the packets sent, whether it is received or not:

4.2.3. The Interface:

The interface serves as the medium through which inputs are made and also at the same time gives the output.

5. SYSTEMS PERFORMANCE ANALYSIS

This section has to do with the basic concepts of the implementation techniques. In section 5.1 the implementation procedure is discussed. In section 5.2, the system interaction guideline is presented while system documentation and testing is presented in section 5.4.

5.1 Implementation Procedure

The application is package and represented as an Icon. On double clicking on the Icon, the application loads and displays the serve interface as shown below on Figure. 5.1.

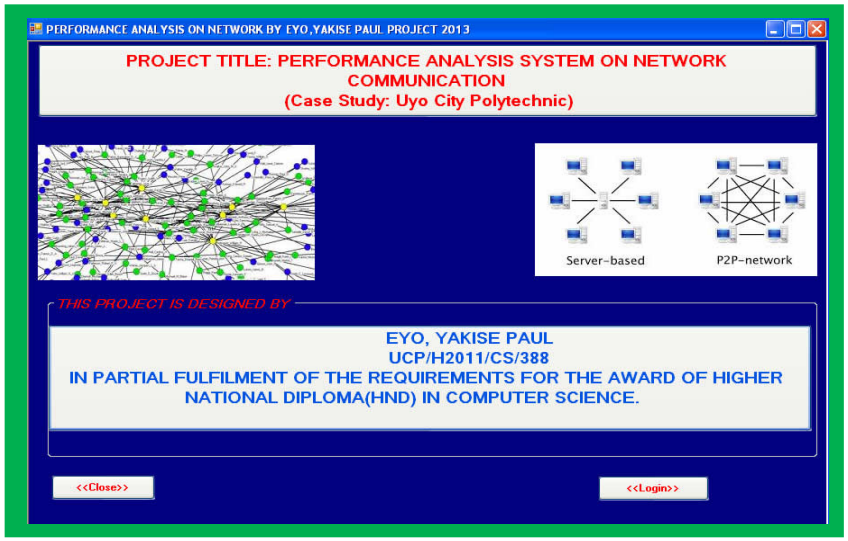

Fig. 5.1: Application service interface

5.2 User Guidelines for Interaction Process

1. Check IF connection is available:
2. Make connection available:
3. Launch the application for communication
4. Select node(computer to communicate with)
5. Check if node is active by checking the ip (ping):
6. Acknowledgement is sent to the requesting node for success or failure
7. Start the communication(sending and receiving packets)

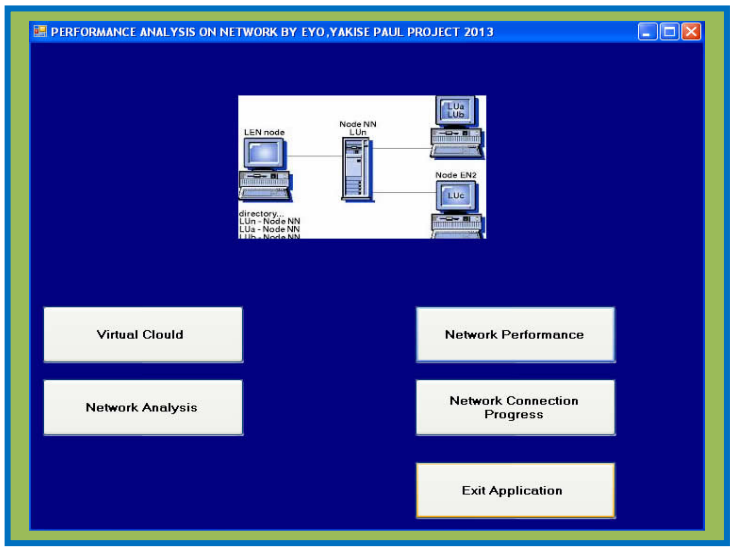

Fig. 5.2 The Administrative interface

The user at the client end who wishes to send packets across to the server connects to the network by signing in as a guest and also click connect as shown in Fig. 5.3.

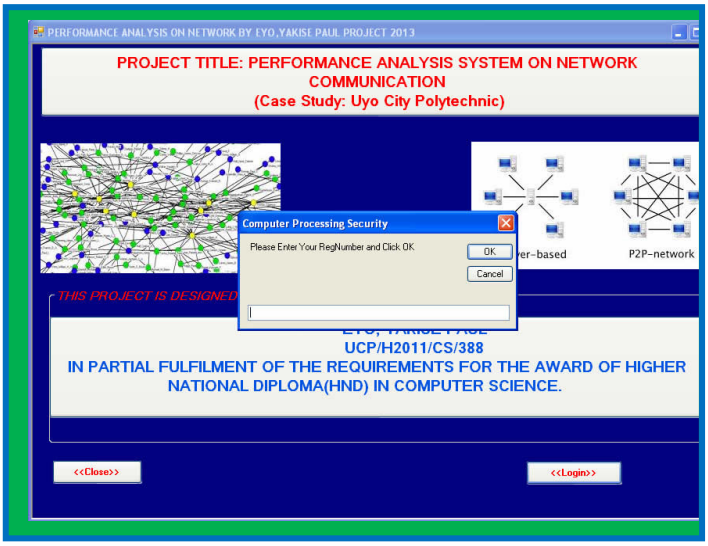

Figure 5.3: Processing Security display

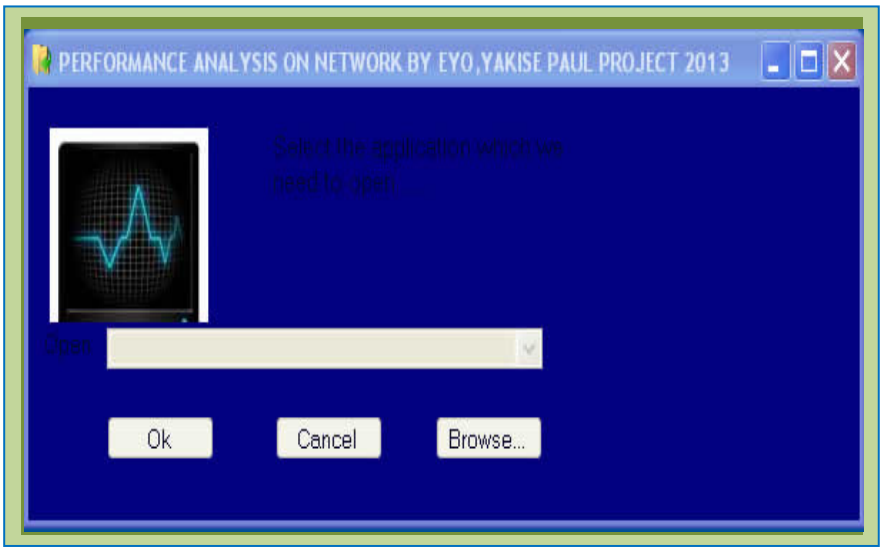

Fig. 5.4: A Node Interface

On getting connected to the network, the system automatically logs the times tap, Host IP, Host name, and system port number.

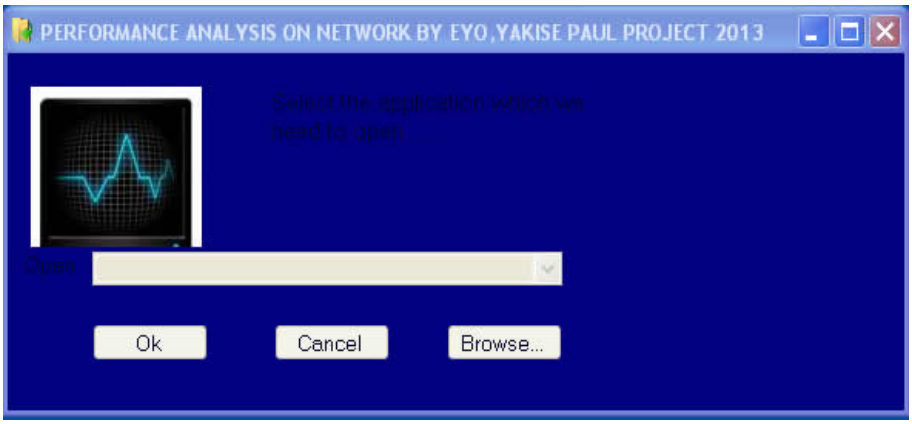

Fig. 5.5 Performance Analysis and IP Address check interface

In figure 5.4 above, the administrator can carry out the following function:

a. Determine IP Address classes
b. Carry out Ping Operations
c. Checks if a node is active or passive.

In figure 5.5: A particular node has been acknowledged which means that the node is ready to communicate with the other node that is connected in the network.

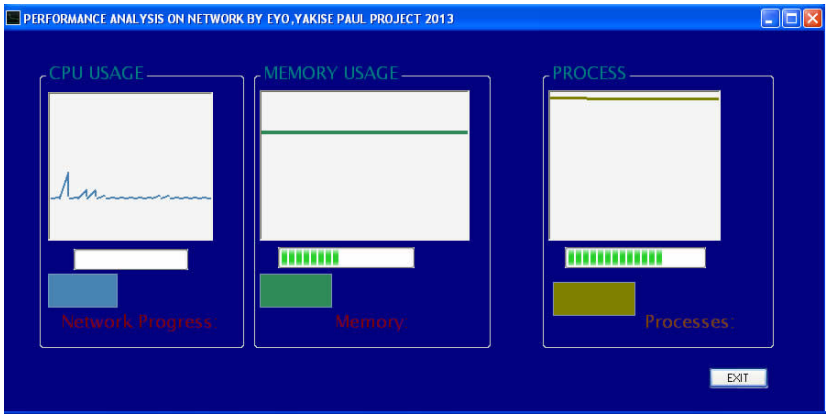

Fig. 5.6 Nodes Ready for Communication

In figure 5.6, the interface shows that nodes A and node B are ready to communicate with each other since all the requirements needed is complete. When the green light shows, the nodes now are ready for communication.

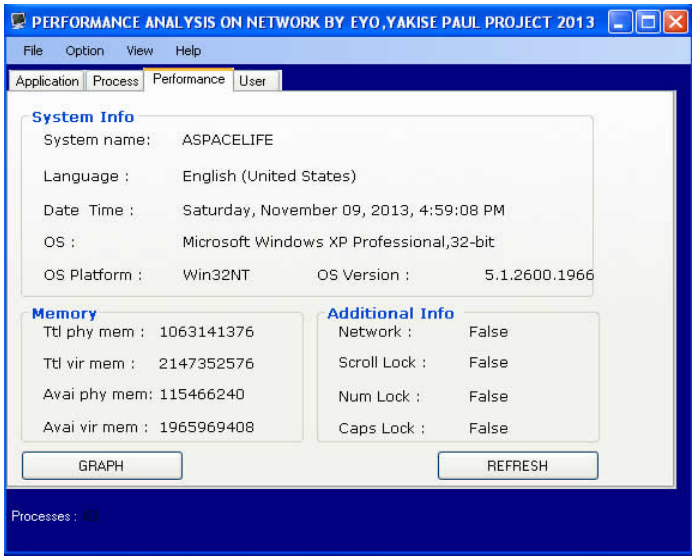

Fig. 5.7a: Network performance Evaluation

Figure (5.7a and 5.7c); illustrate the performance of the network communication. T

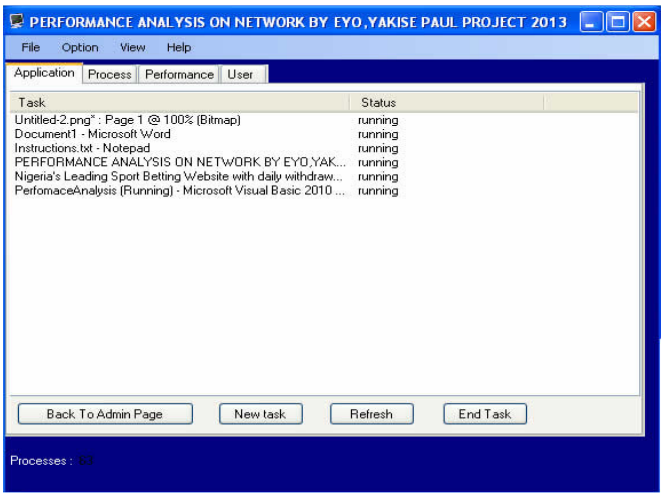

Fig. 5.7b: Network performance Evaluation

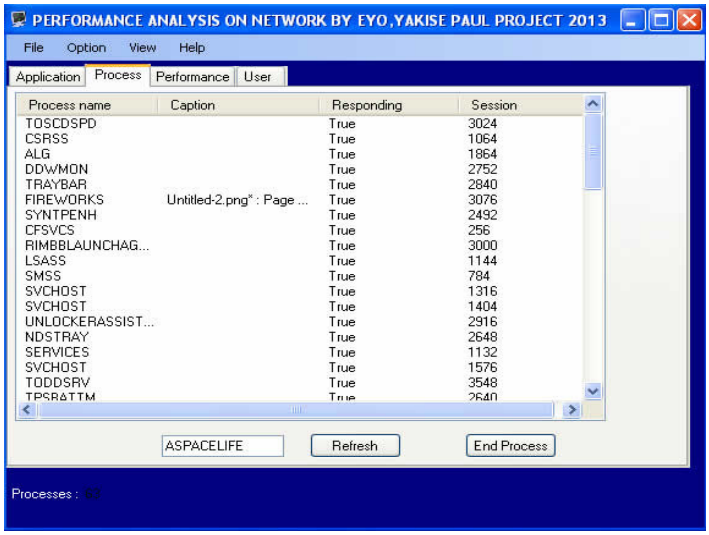

Fig. 5.7c: Network performance Evaluation

5.3 System Testing

The new system was tested on two connected system node based on wireless LAN Area Network (WLAN) and found to meet its specification. Five different users log In at various time slots and used the system effectively on the network and at the end, they were satisfied with the result of the system to justify the improvement.

6. RECOMMENDATIONS

With the advancement of data communication facilities, the communication between computers has increased and thus it has extended the power of computer beyond the computer room. Hence, we highly recommend that this research work be further investigated by others, where many factors beyond the scope of this research project will be put into consideration.

7. CONCLUSION

Communication Protocol is an intriguing technology. It promises better performance when it is optimized. In this paper, we have analyzed the performance of Communication protocol in a Realistic Computer Networks Node and revealed the problems associated with communication protocols in Computer Network Communication Systems. We have also offered a computer Network Nodes Model, implementing same using realistic platform for the purpose of improving the performance of the system, taken into consideration different network structure and divers propagation exponents. The paper has facilitated to establish a practical solution that improves the performance of Computer Networks. The analytical findings have provided best practical environment for computer network operators. The emergence of information and communication Technology has made computers to be available in many offices, homes and therefore need to share data and programs among various computers. Basically, it is pertinent for efficient and robust data communication protocols to be put in place to enable easy access to data and packets transfer.

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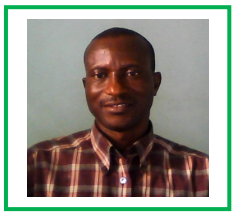
Lead Author's Brief



UMOREN, Imeh Jonah, PhD obtained his B. Sc. (Hons) from University of Uyo (1999), Master of Science MSc. (2007), and Degree of Doctor of Philosophy PhD (2014) in Computer Science from University of Port Harcourt respectively. The prolific academic's was trained in Data Processing and Unix Technologies from University of Calabar (1996-1998). He held a Total **E&P** Research and Development (R&D) grant for Science and Technology from 2010-2012. Dr. Umoren, has taught Computer Science courses in several Private and Public Technology based Institutions in Nigeria. Currently, he is an Academic Staff in the Department of Computer Science, Akwa Ibom State University (AKSU), Nigeria. He is a chic researcher. His research interest are; Mobile Computing, Ad-Hoc Networks, Wireless Sensor Networks. He is an author, co-author and a reviewer of several published articles on Computational Intelligence, Ubiquitous/Machine Learning, Intelligent Handoff Management Systems, Computer Science and Information Technology based systems.
