REPUBLIC OF TURKEY
FIRAT UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

PERFORMANCE MEASUREMENT FOR DISTRIBUTED SYSTEMS USING OPNET PRINCIPLES

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Master Thesis
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February-2017

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MASTER THESİS

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Submission Date to the Institute: 3 May 2017
Thesis Presentation Date: 18 May 2017

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May - 2017

ACKNOWLEDGMENT

First of all, my thanks are addressed to GOD for inspiring me with patience and strength to fulfill the study. Deepest gratitude with great respect is due to my Supervisor Prof. Dr. Mehmet KAYA for his continuous encouragement, endless patience, precious remarks, and professional advice. My gratitude and appreciation are dedicated to the Dean of the Engineering Faculty and to all of Computer Engineering Department teachers and employees for their valuable helps and guidance during the stages of the study. Special thanks are extended to Assoc. Prof. Dr. Subhi R. M. Zeebaree for his professional advice and for taking part as an advisory committee in my thesis presentation and their inestimable feedbacks which enhanced and improved my research. I would like to express my gratitude and special thanks to Turkey Government and Presidency for Turks aboard and related communities for providing the master degree for me. Acknowledging my beloved family for their supports and encouragements in the hard times, I am forever indebted to my family especially my mother, and my lovely wife for all their helps both materially and morally. I would like to record a word of gratitude, appreciation and thanks for beautiful Elazig City and its all people for their help and good behavior. Finally, I'm grateful to all of my friends and to whoever helped me in conducting this study.

Bishar R. Ibrahim

ELAZIG - 2017

CONTENTS

Page No

ABSTRACT

Performance Measurement for Distributed Systems Using OPNET Principles

Nowadays, as Distributed Systems enters the new century Extending network services for example, real time measurement and monitoring are likewise driving the requirement for more data transfer in the communication network and dependable communication infrastructure. These requirements will flourish further as new remote real-time protection and control applications become more possible and pervasive. (Performance Measurement for Distributed Systems Using OPNET Principles) was further developed utilizing Optimized Network Engineering Tools (OPNET). It's the designing Principles simulator particular for network research and development. For network-efficiency evaluation, a professional simulation tool, called Optimized Network Engineering Tool (OPNET), is depended on to check the system with large networks for both 2TA and 3TA. The results showed that 3TA is more powerful than 2TA in term of data protection and time delay by splitting the services between both of http-server and database-server. Hence it will provide more performance specially when dealing with very large networks with hundred (or thousands) clients.

Keywords: OPNET Modeler, Simulation, Network Design and Analysis.

ÖZET

OPNET İlkelerini Kullanan Dağıtık Sistemler için Performans Ölçümü

Günümüzde dağıtık sistemler yeni yüzyıla uzanan ağ hizmetlerine girdiği için, gerçek zamanlı ölçüm ve izleme, aynı şekilde iletişim ağı ve güvenilir iletişim altyapısında daha fazla veri aktarımı gereksinimini de beraberinde getirmiştir. Yeni uzaktan gerçek zamanlı koruma ve kontrol uygulamaları daha olası ve yaygın hale geldiği için, bu gereksinimler daha da gelişecektir. (OPNET İlkelerini Kullanan Dağıtık Sistemler için Performans Ölçümü) Optimize Edilmiş Ağ Mühendisliği Araçları (OPNET) kullanılarak daha da geliştirilmiştir. Özellikle ağ araştırma ve geliştirme için tasarım simülatörüdür. Ağ verimliliğini değerlendirme için, Optimize Edilmiş Ağ Mühendisliği Aracı (OPNET) olarak adlandırılan profesyonel bir simülasyon aracı, hem 2TA hem de 3TA için geniş ağlar ile sistemi kontrol etmeye bağlıdır. Sonuçlar, 3TA'nın hem http sunucusu hem de veri tabanı sunucusu arasında servisleri böldüğünden veri koruma ve zaman gecikmesi açısından 2TA'dan daha güçlü olduğunu gösterdi. Bu nedenle, özellikle yüzlerce (veya binlerce) müşteriyle çok büyük ağlar ile uğraşırken daha fazla performans sağlayacaktır.

Anahtar Kelimeler: OPNET Modelleyici, Simülasyon, Ağ Tasarımı ve Analizi

LIST OF FIGURES

Page No

LIST OF TABLES

Page No

ABBREVIATIONS

2TA : Two-Tier Architecture
3TA : Three-Tier Architecture
API : Application Program Interface
ARPANET : Advanced Research Projects Agency Network
CGI : Computer Generate Imagery
CPU : Central Processing Unit
CSMA/CD : Carrier Sense Multiple Access with Collision Detection
DBMS : Data Base Management Software
DES : Data Encryption Standard
E2E : End to End
FSM : Limited State Machine
FTP : File Transfer Protocol
GIG : Global information Grid
GUI : Graphic User Interface
HD : High Definition
HTML : Hyper Text Markup Language
HTTP : Hyper Text Transfer protocol
ICT : Information and Communication Technology
IEPS-W : Information Embedded Power System over Wide Area Network
IP : Internet Protocol
ISO : International Organization for Standardization
JDBC : Java Data Base Connectivity
LAMP : Linux Apache MySQL and PHP
LAN : Local Area Networks
LD : Laser Diode
LDC : Laser Diode Cathode
MAN : Metropolitan Area Network
MDBS : Multi Dispersed Data Base
NOS : Network Operating System
NS2 : Network Simulation 2

OBJ **:** Object File

OPNET **:** Optimized Network Engineering Tool

OSI **:** Open System Interconnection

OS **:** Operating System

PC **:** Personal Computers

PDF **:** Probability Density Function

PHP **:** Hypertext Preprocessor

RAM **:** Read Only Memory

SD **:** Server Delay

SL **:** Server Load

SQL **:** Structure Query Language

TCP/IP **:** Transmission Control Protocol/Internet Protocol

TNT **:** Total Network Delay

WAIS **:** Wide Area Information Server

WAMP **:** Windows, Apache, MYSQL, PHP

WAN **:** Wide Area Network

WBDB **:** Web Based Data Base

XML **:** Extensible Markup Language

1. INTRODUCTION

1.1. Overview

Distributed systems services are hard to develop due to their complex and decentralized nature. The Service Oriented Architecture facilitates the improvement of such systems by supporting modular. Major drawbacks of such concentrated web based system are link failure and low or no fault tolerance. In an unreliable network, it is common place that service is inaccessible due to connection failure [1]. Usage access control is considered as the next reproduction access control model with recognizing properties of decision continuity. It has been proven efficient to improve security administration with adaptable authorization administration. Utilization control enables finer-grained control over utilization of digital objects that offers a better access control to private information in systems [2]. Information and communication technology (ICT) is not only advantages for the business segment but likewise has a lot to offer for the public sector as well. In fact, the public sector can benefit the most by the advancement of ICT as it offers numerous potential benefits in terms of improvements for elderly care professionals and decision makers [3, 4].

Quantitative analysis of programming systems is being recognized as an essential issue in the software advancement process. Performance analysis can help to address quantitative system analysis from the early phases of the software advancement life cycle, e.g., to compare design alternatives or to recognize system bottlenecks. Early identification of performance problems is desirable as the cost of design change increments with the later periods of the software development cycle [5].

Recently, a need for an end to end quality of service over hybrid networks has become evident. Deferral, jitter and dependability are likewise important properties for the quality of network. This is because different applications has diverse necessities, and therefore require diverse properties from the network [6].

As another generation of design communication system, network has grown greatly amid the previous ten years. Supplied by great design, dynamic topology, organizing and other unique features, it is usually utilized in emergency operations, catastrophe relief

efforts and military networks. In any case, this new design network has lots of technical challenges and potential advantages need to be discovered and conquered. Without a doubt, we will soon be having the capacity to see network deployment wherever in the near future [7].

Computer networks have become extremely important in our everyday life, since most companies and foundations rely on the appropriate functioning of their computer networks. As to analyze computer networks execution, both analytical and simulation methods can be utilized. Analytical methods are based upon numerical analysis that characterizes a network as a set of equations. This approximation usually suggests utilizing few restrictive presumptions, which tend to be not too much realistic, since networks are complex systems formed up by hardware and programming protocols, applications, queuing policies, etc. Then again, simulation techniques can be utilized to demonstrate in detail the dynamic nature of real computer networks Simulation allows engineers to test diverse network designs even before the network physically exists) and to perform what-if analysis with models of the already existent networks without presenting them to failures or out of commission periods [8].

Communication has become a basic service in our everyday lives. The exchange of data generates high information traffic in the systems. Analyzing and modeling network traffic is becoming one of the greatest challenges for communication companies when arranging networks and developing communication apparatus their aims. Late examinations of local area network traffic and wide area network traffic have challenged the commonly assumed models for network traffic, e.g., the Poisson distribution. Once traffic come after a Poisson entry process, it would have a characteristic burst length which would tendency to be smoothed by standard up a long enough time scale. While, measuring of real traffic indicate that important traffic variance (burstiness) is present on an extensive range of time scales. Traffic that is burst on numerous or all time scales can be depicted statistically utilizing the notion of self-similarity [9].

For network-efficiency evaluation, a professional simulation tool, called Optimized Network Engineering Tool (OPNET), will be depended to check the framework with vast networks for multi-tier architectures such as: Two Tier Architecture (2TA) and Three Tier Architecture (3TA) OPNET Technologies Inc. is a software business that gives

performance administration for computer networks and applications. OPNET is a high level event based network level simulation tool Simulation operates at “packet level”, originally built for the simulation of settled networks. OPNET contains an immense library of exact models of commercially available systems network hardware and protocols. These days, the conceivable for wireless network simulations are likewise very wide. The simulator has a lot of potential; however there exists typically a lack of the new wireless systems. Much of the work considering new technologies must be done by oneself. OPNET can be utilized as an exploration tool or as a network design/analysis tool end client. The threshold for the use is high for the developer, yet low for the end client. The OPNET is a very intense network simulator. Main intentions are to optimize cost, execution and accessibility. The objective of this tool is to learn the basics of how to utilize Modeler interface, and additionally some basic modeling theory. The following tasks are considered:

- construct and analyze models.
- Configure the object palette with the required models.
- Set up software and profile configurations.
- particularize background utilization that changes over a time on a link.
- Simulate multiple scenarios simultaneously.
- Apply filter to graphs of results and analyze the outcome.

The OPNET tool is a professional one that can helps for designing and implementing enormous networks, particularly those relying on the principles of the Client/Server. The average delay time for the general network or related with portion of it can be measured. Likewise, the amount of dataflow can be measured for little or tremendous numbers of utilized hosts. This tool provides for the configuration of the designed network [5]. The OPNET software was utilized to simulate the diverse scenarios of the networks which unmistakably explain the way the information is transmitted and received. We likewise discover a lot about various topologies and how subnets can be utilized to effectively connect nodes in a network. The easy-to-utilize and drag-and-drop nature of OPNET

helped a lot in simulating networks in star topology, making diverse types of servers for every department of a campus network [10].

1.2 Literature Survey

We have depicted three OPNET modules that have been developed for a Computer Networks class. The first module introduces students to OPNET, and how to build, test, and analyze network models. The context of this module is a company that has a local area network (LAN) on a first floor office building, and plans to add an extra network on another floor. In the second module, students develop models of a company's wide area network (WAN). The models are utilized to study how the execution of the network is influenced by the diverse design decisions that are made to upgrade the network. The third module examines the impact of various network configurations on TCP (Transmission Control Protocol) congestion windows. This paper likewise discusses ways in which the OPNET modules have been developed with that students learn computer network concepts, and not exactly how to utilize OPNET software [11].

In order to Addresses the problem of performance analysis of programming systems described at a high state of detail we embrace a model-based approach: beginning from a software model, we derive a performance model which is then assessed. This kind of approach has the benefit of being applicable since the early programming improvement stages; in contrast, a measurement-based approach comprising on identifying problems by direct measurements on a running system can't. We consider programming descriptions, and recently it is being likewise considered for performance assessment purposes. We define the performance model as a procedure-oriented simulation model. Simulation is a capable modeling technique which can represent general and unconstrained system models that the software model can be more precisely represented. Programming particulars into simulation models are depicted Performance and Time specification. The system is depicted in term of Use Case, Activity and Deployment graphs. Utilize Case graphs correspond to workloads applied to the system. Activity diagrams give a high-level portrayal of the computation steps performed by the system, and Deployment diagrams depict the physical resources on which the computations take place. A procedure -oriented simulation model can then be automatically derived from the clarified particular. The portrayed algorithm has been implemented in a prototype tool called OPNET- (OPNET

Performance Simulator), which is shown on a case study to demonstrate the legitimacy of the approach. The OPNET -tool and is depends on a general-purpose process-oriented simulation library. It parses annotated OPNET models, automatically builds the corresponding simulation model and implements it. Execution outcome are inserted into the original OPNET model as labeled values, therefore to give feedback to the client [5].

Different power system communication rule are being utilized within IEPS-W to transfer critical data in real time alongside decades old Supervisory Control and Data getting System. Vast of the protocol in utilized aren't originally created to use in wide area pc network environment. Notwithstanding, protocol developers upgrade their protocols and utilize it in wide area computer network. This requires experimental investigation of dissimilar power system communication protocols before employing it on the power grid. An experimental platform was set up at more Network Switching Center owned by SP (Distribution organization based) in order to experimentally analyses the performance characteristic of Distributed Network Protocol over wide area network (WAN). In this experiment, real time data were sent from Intelligent Electronic instrument to utility control focus utilizing WAN. Experimental work uncover that measuring delays associated with Distributed Network Protocol over WAN is high, as this type of network is a great deal more complicate due to the additional complicates of routing and switching. This requires encourage advancement of Distributed Network Protocol to be dependably utilized in IEPS-W. Consequently, At long last, another protocol has been advance based on Distributed Network protocol to reliably and safely transfer power system data for IEPS-W [12].

Preliminary discrete-event simulation study carried out on the computer system that gives support to the intranet. The main purpose of this study, developed with the OPNET simulation programming, was to help the computer network managers to obtain a better comprehension of its inside operation. Other objectives of our thesis are related to the finding of possible performance problems (bottle necks, powerless points in the structure, etc.), and to the testing of new designs of the network that could increase its performance, reliability and availability levels. At long last, we talk how discrete event simulation programming can help computer networking students to enhance their practical knowledge on this subject [8].

End-to end delay (E2E) for networks. In the course of E2E performance assessment, simulation approach is acknowledged utilizing simulation tool OPNET. Delay has been measured for both scenarios in different cases under the varying client speed of the node. Moreover, packet loss for two network scenarios has been studied and displayed in indistinguishable cases as for E2E delay measurement. Comparative execution analysis of the two networks has been finished by the simulation output diagrams. In light of the outcome analysis, the performance quality of a network with and without the presence of extra network traffic the decided and discussed. The default parameters in OPNET For it have been utilized during simulation [13].

Distinguish the causes that impede this technology to support real time networks and to propose possible solutions. Initially the standard was tested thoroughly utilizing a data traffic model which emulates a multi-channel real time environment. Broadcasting was found to be the optimal communication method, in order to satisfy the intolerance of live, when it comes to delay. The outcomes were analyzed and the disadvantage was identified in the hereditary weakness, from numerous sources in the similar network. To resolve this, a series of alterations was proposed for the Medium Access Control algorithm of the standard. Already utilized in unicast transmission then, an alternative "random back off" method was proposed taking into account the characteristics of networks. The outcomes demonstrated that significant enhance in throughput can be achieved utilizing the above modifications but further improvement was required, when it comes to delay, keeping in mind the globally accepted standards for real time delivery. All revisions were designed to work as an alternative mode of the existing technology rather as an independent proprietary framework likewise tested and analyzed at the last some portion of this research. The outcome showed suitably adjusted, is able to support multiple broadcasting transmissions and therefore it can be the platform whereupon which, the future wireless audio systems will be created [14].

Electronic System that deals with real time accessibility is controlled by an administrator. This system gives the feature that all prototypes are coordinated in one homepage. The proposed system deals with both of Two Tier Architecture (2TA) and Three Tier Architecture (3TA) who have been designed and executed in this proposition. The proposed Electronic System encourages a completely automating and finishes system

and eliminates any paperwork, saves time and incorporates every center segment (i.e., laboratories, and receptionists, managerial) and is available online. The engaging of the proposed framework is in diminishing pre-visit and post visit as the patient can reserve appointments and get the result of lab-tests via the internet. As to decide the server proficiency (time reaction and information flow) technique is ready application, namely Wireshark (Network Protocol Analyzer). techniques will help to discover out least reaction time with 2TA and 3TA, over two unique platforms Operating System (OSs) which are; Microsoft Windows-7 and the open source OS For system-efficiency assessment, a professional simulation tool, called Optimized Network Engineering Tool (OPNET), is relied on to check the system with huge networks for both 2TA and 3TA. The outcomes demonstrated that 3TA is more powerful than 2TA in term of information insurance and time delay by splitting the services between both of http-server and database-server. Subsequently it will give more performance uniquely when dealing with very huge networks with thousands (or millions) clients [4].

1.3 Problem Statement

The problem of this proposed thesis is to determine the performance of different organizations of network. The performance measurement includes Total-Network-Delay (TND), Server Delay (SD) and Server-Load (SL).

1.4 Aims of Thesis

The important points of the proposed thesis can be summarized by the below points:

- Scope of the study will cover different scenarios of proposed distributed networks.
- In general, there will be two main networks assumed to be distributed among. These networks will contain diverse number of computers, everyone them considered as clients to be connected to server-side.
- Server-side comprises of either one computer that will have (Web-application and Database system or two computers that will have both (Web-application and Database system.

- It is important to treat with small, medium and large networks. This option will enable us to have enough information about any proposed network with the expected performance.
- The performance measurement includes: delayed time at server-side, overall delay-time of the network, and dataflow rate at the servers and clients.

1.5 Contribution to Knowledge

The main point to be extracted from this thesis is getting the desired performance features of any existed or proposed computers-network in order to enhance the existed networks and to avoid the future failures for the proposed networks.

1.6 Thesis Structure

The thesis spans in five chapters which are covering the research works carried out in achieving the aim and objectives described earlier in section.

Chapter 1: gives a brief overview, literature survey, Problem Statement, aim and Contribution to knowledge behind this research and briefly highlights the contributions made to the development of Distribute measurement networking systems.

Chapter 2: Primarily concerns about Distributed Systems technology and the Networking Concept. Firstly, it explains Internet Computing and provides an understanding of what it can do, in terms of functionality and importance. Additionally, it addresses methods and phases of Performance Measurement for Distributed.

Chapter 3: A number of experiments show how Distributed Systems is implemented using OPNET tools and techniques. Furthermore, information is gathered about the Distributed Systems acquisition, research methodology, introduction, general structure of the proposed system and depended scenarios.

Chapter 4: This chapter shows a summary of the results achieved throughout the designed in a real time. This chapter likewise concludes whether the objectives and research questions determined in the first chapter have been resolved or not. System implementation and results introduction implemented results discussion evaluation and comparison. Is entitled Performance Analysis the performance with different architectures

using a standard tool named OPNET Tools Likewise, a professional evaluation and designing tool called OPNET has been addressed.

Chapter 5: Conclusion and future work discusses the contributions of this research work. It likewise discusses the limitations of the features introduced in this research work, and future directions of our research.

2. BACKGROUND THEORY

2.1 Distributed Systems

Distributed system is a system comprising of a gathering of independent machines connected by communication networks and equipped with programming systems designed to produce a coordinated and consistent computing environment. Distributed systems enable people to comprising and coordinate their activities more effectively and efficiently. The key purposes of the distributed programming can be represented by: resource sharing, openness, concurrency, scalability, fault-tolerance and transparency [15, 16].

A. Resource sharing. In a distributed framework, the resources - hardware, programming and information can be easily shared among clients. Such as, a printer can be shared among a group of clients.
B. Openness. The openness of distributed systems is accomplished by specifying the key software interface of the framework and creation it available to software designers that the system can be extended in many ways.
C. Simultaneous. The processing Simultaneous can be accomplished by sending requests to numerous machines connected by networks at the same time.
D. Scalability. A distributed system running on an accumulation of a few numbers of machines can be easily extended to a large number of machines to increase the processing power.
E. Fault-tolerance. Machines connected by networks can be viewed as repetitive resources; a software system can be installed on numerous machines that in the face of hardware faults or software failures, the faults or failures can be detected and endured by other machines.
F. Transparency. Distributed systems can give many forms of transparency for example:
    1. Location transparency, which permits local and remote information to be accessed in a unified way.
    2. Failure transparency, which empowers the masking of failures automatically.
    3. Replication transparency, which permits duplicating programming/data on numerous machines invisibly.

Computing in the late 1990s has reached the state of Web-based distributed computing. A premise of this form of account is distributed computing which is carried out on distributed computing systems. These frameworks comprise the following three essential components:

A) Personal computers and effective server computers.
B) Local and quick wide area networks and web.
C) Systems, in specifically distributed operating systems, and application programming.

2.1.1 Networking Concept

Networking basically refers to the technology which strives to connect two or more computers into a cohesive network in which transfer of data can take place mutually. It is quintessential to a horde of technologies which are based on networking as the backbone. Some of the initial ideas in this topic deal with the issue of understanding the different kinds of topologies that can be implemented like [10]:

1. Bus topology.
2. Ring topology.
3. Star topology.
4. Mesh topology.

Each of these topologies is implemented in a unique way. In bus topology, a common cable connects all the nodes and provides for the backbone of a network basically. In star topology, every node is connected to a focal hub. In ring topology, information moves around in a single direction around the ring from one node onto the next. Every node acts as a repeater likewise. In mesh topology, every node is connected to every other node. The Network operating system (NOS) screens the exchange and flow of files and other information. There are two kinds of NOS: peer-to-peer or client-server NOS's.

- Server-based or centralized: A centralized server serves the clients
- Peer-to-peer: Clients share the resources among themselves

The International Standards Organization (ISO) The OSI model defines seven layers of system services. Each layer wraps the previous layer's information and header with its own

header. On the receiving end, every layer strips off the header that corresponds to its separate level [3].

2.1.1.1 Network History

The following table [38] demonstrates a brief networking history.

Table 2 .1. Network History

1966	ARPA packet-switching experimentation
1969	First Arpanet nodes operational
1972	Distributed e-mail invented
1973	Non-U.S. computers linked to Arpanet
1975	Arpanet transitioned to Defense Communications Agency
1980	TCP/IP experimentation began
1981	New host added every 20 days
1983	TCP/IP switchover completed
1986	NSFnet backbone created
1990	Arpanet retired
1991	Gopher introduced
1991	WWW invented
1992	Mosaic introduced
1995	Internet backbone privatized
1996	OC-3 (155 Mbps) backbone built

2.1.1.2 Network Architecture

The early success of the ARPANET (sponsored by the Advanced Research Projects Agency (ARPA) and created during the late 1960s and early 1970s) and different networks, and the immediate business potential of packet switching, satellite, and local network technology made it clear that computer networking was speedily becoming an important area of development and trade. It was likewise apparent that to use the full potential of such computer networks, universal standards would be required to guarantee

that any system could communicate with any other system anyplace in the world. For Standardization (ISO) Technical Committee 97 on Information Processing to create standards for “opens system interconnection (OSI)”. The expression “open” was selected to emphasize that by same to OSI standards, a system would be open to communication with any other framework anyplace in the world obeying the same standards. The OSI reference model is a seven-layer model for inter-process communication. Its design is contained of application, Presentation, session, transport, network, data link and physical layers, and the corresponding protocols, as delineated in Table 2.2.

Table 2.2. OSI Architecture

Application
Presentation
Session
Transport
Network
Data link
physical

The early-created ARPANET adopts another kind of network engineering, i.e., four-layer design: application, transport, Internet, and network interface, as delineated in Table 2.3. The current Internet based on ARPANET uses this engineering, which is otherwise known as TCP/IP reference model. In this model, the system interface (or access) layer depends on the data link and physical layers of the network, and the application layer relates to application and presentation layers of the OSI model, therefore there is no session layer in the TCP/IP model.

Table 2.3. TCP/IP Reference Model

Application
Transport
Internet
network

2.1.1.3 Network Fault Tolerance

Network dependability refers to the reliability of the general network to give communication in the event of failure of a component or segments in the network. The term network fault tolerance refers to how resilient the system is against the failure of a segment. Why fault tolerance in a networked world? A key pointer of today's worldwide business systems is the reliability and uptime [17]. This concern is crucial for e-commerce sites and mission-critical business applications. Costly and capable servers and system components that are designed as stand-alone systems can be very reliable, however even an hour of downtime per month can be fatal to online-just businesses.

2.1.2 The Client-Server Model in A Distributed Computing System

A distributed computing system is a set of application and system thesis, and data dispersed across a number of independent PCs connected by a communication network. In order to give requested services to clients the system and relevant application programs must be executed. Because services are given as an outline of executing programs on a number of computers with data stored on one or more locations, the whole computing activity is called dispersed computing [4].

2.1.2.1 Basic Concepts of Client and Server Model

The problem is how to formalize the advancement of disseminated computing. The above shows that the main issue of distributed computing is thesis in execution, which is called processes. The second problem is that these procedures cooperate or compete in order to give the requested services. This implies that these procedures are synchronized.

A natural model of distributed computing is the client-server model, which is able to deal with the issues generated by distribution, could be utilized to portray computation processes and their behavior when giving services to users, and permits design of system and application programming for distributed computing systems. According to this model there are two procedures, the client, which requests a service from another process, and the server, which is the service provider. The server performs the asked service and sends back a response. This reaction could be a processing result, a confirmation of completion of the requested operation or even a notice about a disappointment of an operation. From the

client's point of view a distributed computing system can give the following services: printing, electronic mail, file service, verification, naming, database service and computing service. These services are given by proper servers. Because of the restricted number of servers implied by a confined number of resources on which these servers were implemented, clients compete for these servers.

A relationship between this abstract model and its physical usage is appeared in Figure 2.1. In specific the basic things of the model: the client and server, and demand and response are appeared. For this case, the client and server processes execute on two different computers. They communicate at the virtual intelligent level by exchanging asked and reactions. To accomplish this virtual communication, physical messages are sent between these two procedures. This infers that operating systems of computers and a communication system of a distributed computing system are effectively required in the service provision.

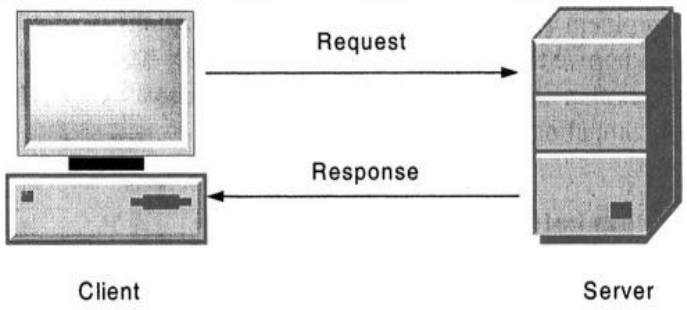


Figure 2.1. The Basic Client-Server Model

A more detailed client-server model has three parts:

- Service: A service is a software entity that runs on at least one machine. It gives an abstraction of a set of well-defined operations in response to applications' solicitations.
- Server: A server is an instance of a specific service running on a solitary machine.
- Client: A client is a software entity that exploits services provided by servers. A client can but does not have to interface directly with a human client.

2.1.3 Internet Computing

The Web is a collection of resources including Gopher, FTP, HTTP, Telnet, Usenet, WAIS, and others, which can be gotten via a Web program. It comprises of a lot of Web pages, which are interactive media of content, graphics and other forms of data and multimedia for example sounds and movies that Internet clients can access at whenever [18].

There are a lot of challenges for the present Web. The Web is almost infinite at the current time and contains every part of society. On the Web today, content is king. Any site that successfully attracts repeated guests has to have fresh and constantly refreshed substance. Moreover, clients feel comfortable just if they can get the important, fresh information rapidly. The issue is how we can fulfill the requests from clients. An effective web site is big and constantly changing, for example many product pages and a lot of update each month. As a web site grows one keep running into two problems: the web site has much information that guests can't rapidly discover what they want. Additionally it is desirable that the guests be able to enter data and create the site interactive. The problem is that the people giving the substance for a site are not the similar people handling its design. Oftentimes, the substance supplier doesn’t even know HTML.

Maintenance of a substance -driven site can be a real pain, as well. Many sites are locked into a dry, outdated design because modifying those hundreds of HTML files to mirror another design would take forever. Server-side can help facilitate the burden a little, but one still ends up with hundreds of files that need to be maintained should one wish to make a fundamental change to the site. At last, the Web today substance of various information resources, for example texts, pictures, and other forms of multimedia [19]. How can the Web query the substance and distribute them on the Web pages? How can the Web acknowledge dynamic data distributing?

One solution to these challenges is database-driven site design [20, 21]. By achieving accomplishing partition between the design of a site and the substance the site presents, one can work with each without disturbing the other. Instead of writing an HTML file for each page of a site, one just needs to write a page for every kind of information one wants

to be able to present. Rather of interminably pasting new substance into the tired page designs, it would be more efficient to make a simple substance administration system that permits the writers to post new substance themselves without a lick of HTML [22].

The World Wide Web is just about the best way ever to distribute data – it is quick, nearly ubiquitous, and relies on no specific computer platform. And databases are just about the best way to store and access data - they are structured and searchable. A database is a structured configuration for organizing and maintaining information that can be easily retrieved. The database administration system is a closed framework in the configuration that all operations on the data managed by the DBMS will be stored back to the database. Clearly in this substance we are limiting ourselves to the digital world where capacity organizations span the range from plain text files to complex object-oriented databases.

Therefore, we can join these two technologies, both for Web distributes who need to post up-to-the-minute pages and for web clients who need to acquire valuable updated information quickly. Web based database is a key segment of many applications, for example applications in electronic business, information retrieval, and multimedia.

2.2 Web-Based Database

After Web and databases are incorporated together, another term "Web-based database" (WBDB) emerges. Generally speaking, a web-based database is a database that resides entirely on an Internet server. Access to the database is through a web browser and ordinarily uses a password system that permit for restricted access to clients depending on the privileges they have been given. Web-based databases can be utilized for a scope of functions; a few illustrations are creation of product catalogs:

- A back end for internet business allowing for instant update of costs, product details etc.
- Frequently update can pamphlets, company activities, minutes of gatherings etc.
- Maintenance of client or client details for email, reference etc.

Web-based databases possess a number of benefits [23]:

1. Maintenance and refreshing. A Web-based database separates substance (database) from presentation (an HTML page). It implies that the owner of a site is can refresh the

substance of the site without constantly having to go through its webmaster or designer. Making a Web template once and merging it with new substance (database) is a more reliable way than distributing information with a consistent design.

2. Re usability and molecularity. By designing extra formats, one can easily reuse substance on another Web site or modify it to fit a new design. For clients, databases create site searches more exact: they can be limited to certain fields, returning better-quality hits over full-text searches.
3. Distribution of data refresh. With the correct interface, even a novice client can go into the database to refresh information; the Web distributing system can then send out the changes quickly.
4. Security. Databases help ensure that substance are accessed by approved clients. Wide scopes of features are available for most Web-based databases. some of the more generally ones include:

A) Password access and privilege-based confinements.

B) Capacity to download database documents as text or tab delimited files that can be read by a database or spreadsheet program on the local PC.

C) Capacity to include pictures, email connections and hyperlinks to other site pages in the database result. Furthermore, some new functions can be created utilizing the combined features from Web-based databases, for example, [24]:

1. Keeping track of the origin and modification history of each article by the utilization of a DBMS;

2. Acquiring valuable new data by tracking and logging client activity and client contribution in the process of interaction;

3. Dynamically personalizing (or at least fine-tuning) the downloaded sit pages according to the information about the present page and client's experience.

Web-based database is JUST in time, and right now works in many fields. The researchers' tasks are to create it develop rapidly and satisfy the client's requirement by growing new methods, languages, and frameworks.

A Web-based database system is thought to be a huge distributed database system and at the same time, it is different from a dispersed database system in the below:

A) Number of clients: For traditional database a limited number of clients are served where as in Web-based database system the number of clients is vast. In this way, a Web-based database system ought to have the capacity to support large number of transactions with reasonable reaction time large number of clients 328. In a Web-based database influences the overall performance of the system. Such as, in an online reservation system the database servers ought to be scalable to handle large volume of database solicitations. This becomes more critical when there are more write solicitations like booking of a passenger seat or refreshing customer details. Recovery of the lost transactions in these frameworks, therefore, is an important task for reliable execution.

B) Transaction processing: to new aspect where traditional DBMS is various from Web-based database framework is transaction processing. In traditional DBMS locking mechanism is utilized to give concurrency control. Locking mechanism gives lock on data things for write transaction. The other write transactions has to hold up until the transaction holding lock on data things is finished commit or abort. One noteworthy characteristics of debit-credit kind transaction is that it will not hold lock for a long time. For web-based databases, even a straightforward transaction may hold lock for a period of time that is long enough to degrade the performance of the system due to communication failure. Such as, in the online reservation system a user can't hold lock on data things for long time while creating the reservation. Because, a modified model of transaction processing for Web-based database system is required.

C) Delivery of query outline: Two essential cases ought to be considered. A complex query and query with huge result size. In the first case, long execution time is required and in the last case long result retrieval time is required. In traditional DBMSs, result is delivered after the query execution is finished. In a Web-based database framework, notwithstanding, long holding up time can't be tolerated. In such a framework, when the primary page of outcome is available it is sent to the client promptly. The database server keeps on to process the original query concurrently while the server transmits the available information over the web. The issue arises when database server fails during the transmission of outcome to the user. Recovery techniques ought to be available to recover the lost outcome pages after the availability of server.

2.2.1 Architectures of WBDB

Engineering is a subject of design and implementation and mirrors the spatial arrangement of application information and the spatial-temporal distribution of computation. There are diverse WBDB frameworks according to different technologies and necessities. Generally speaking, WBDB can be considered as a single large database and likewise numerous data sources. There are great deals of technologies that can be utilized for WBDB. Languages for web applications and web servers are Java, PHP, Perl, HTML, DHTML, XML, SQL and forth. Get to technologies include CGI, JavaScript, Servlet, JDBC, and ODBC. Common enterprise databases include Oracle, Sybase, Informix, DB2, m-SQL, MySQL, SQL-Server, and Butler-SQL [25, 26]. We by and large order classify WBDB architectures into the following types: two-tier architecture and three-tier architecture.

2.2.1.1 Two-Tier Architecture of WBDB

The minimal spatial configuration of a WBDB is the two-tier architecture. The basic system is appeared in Figure 2.2.

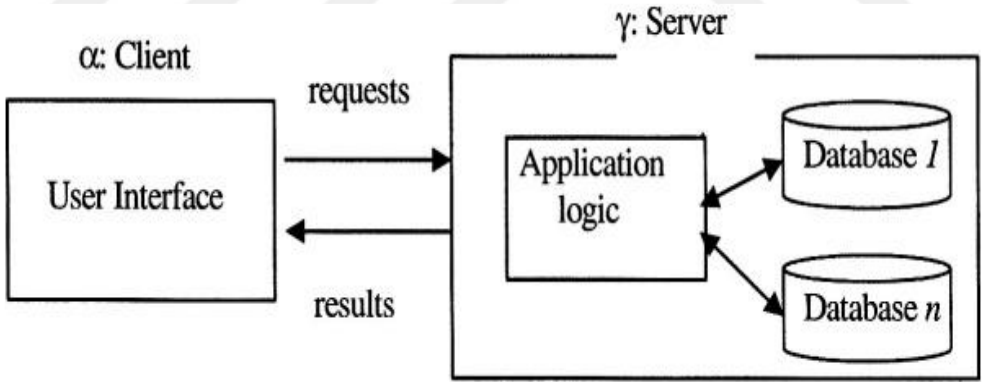


Figure 2.2. Two-Tier Architecture of WBDB

It nearly resembles the traditional client-server paradigm. But there are still a few contrasts between them. The two-tier architecture includes client we called it (a) and server we called it (Y) here (a) and (Y) are utilized to represent the diverse parts in WBDB. The two-tier solution user are thin, likewise are lightweight applications responsible just for rendering the presentation. Application logic and information reside on the server side [27]. Technologies required in two-tier architecture are JDBC, XML, and SQL.

2.2.1.2 Three-Tier Architecture of WBDB

The three-tier architecture is a mainstream model, which contains generally user (we called it x application server we called it B and data server we called it Y see Figure 2.3. A full-fledged WBDB requires these three fundamental components although they can represent different types of technologies. In the following, we conversation some current three-tier architectures of WBDB .In the three-tier model of a database gateway, the three components are user API library, server API library, and glue [28]. The (a) component is the client API library, which comprises of client-side APIs. They decide the format and meaning of the solicitations that the client applications may problem. Glue is the B segment, which owns translation and mapping mechanisms. It transforms the user API to the DBMS (Database Management System) server's API, and vice versa for the information returned to the user. The server API library on the database server-side is the Y component. It administrations the database service available to the clients. The services change in terms of confirmation from the DBMS.

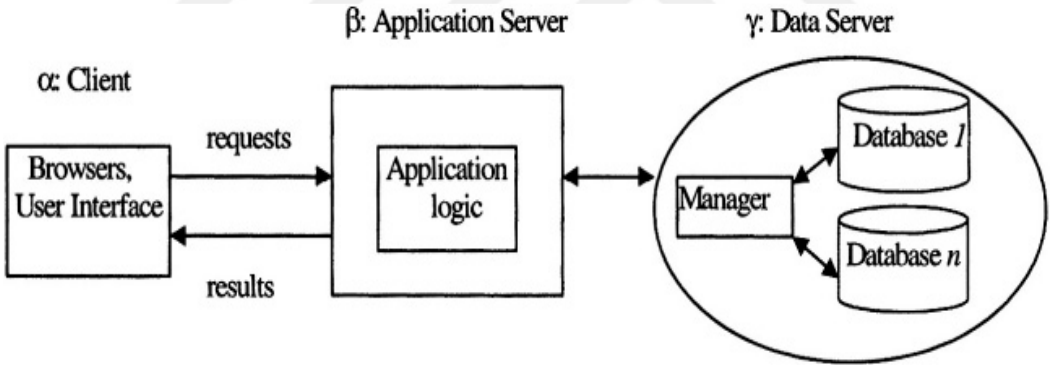


Figure 2.3. Three-Tier Architecture of WBDB

The TP (transaction-processing) screen model is likewise a type of three-tier architecture. In this context, client application (a segment) comprises of the user interface functions, for example screen logic, screen handling, input handling, and some approval functions. Application server (B component) gives all of the details of application services. Resource administrations (Y component) can give all of the lower-level services, for example communication between the database and the application services.

The extended client/server model is normal three-tier architecture. In such a model, the client Web browser (a component) sends solicitations to the Web server (B component).

The Web server transfers the solicitations to a database server (Y component). After the database server processes the solicitations, the outcomes are recovered to the client Web browser by the reverse pathway. In the transition, the web server can handle the outcomes from the database [29].

In the multi-dispersed databases (MDBS) scenario, the Web server B requests the MDBS Y to retrieve the solicitation information [28]. The server does this by issuing a worldwide-level SQL query to the MDBS. The MDBS then disintegrates the whole query and generates the local queries according to diverse components of engaging database servers. Then these local queries can be problem to corresponding database servers that may be overseen by the DBMS servers. But these DBMS servers can be accessed through all sorts of database access technologies. The MDBS integrates the local outcomes it gets from all the database servers and lastly presents a worldwide outcome to the web server. In this case, the MDBS handles all the operations including information locating, interrelating, and coordinating. The web server just sends the solicitations from clients, which is different from the normal client/server model. Every one technology can be utilized in the three-tier architecture according to diverse user requirements. The three-tier or even n-tier models are basic models to structure a WBDB.

2.3 An Overview of Network Simulation Tools

At the present day, it is nearby difficult to design an integral networking system only based on theoretical calculation. As well as, if we conduct the study, design and advancement in a real network environment, we will not just incur high, but likewise have difficulties with data information and investigation. In practical work, it is predominant to utilize network simulation software to simulate and evaluate network execution [7].

There are a few network modeling and simulation tools accessible today. QualNet, J-Sim, Prowler, NetSim from Cisco, PlanetSim, OPNET-Guru and others are some of the well-notable platforms. Their regular characteristic is that they give modeling capacities up to a formed-level. That intends that networks can be designed and tested using just existing particular or generic models and business distributed protocols. The network simulation platforms that give full creating capacities and permit engineers and researchers to make

their own models and protocols and likewise modify existing ones are, according to author's opinion, OPNET Modeler[14**].**

2.3.1 OPNET Modeler

OPNET Modeler is a manufacture standard network simulator that is accessible as a business product. It is as well as a DES platform based on C and C++ and permits users to access the source code of everyone its models and likewise make new ones. It has a wildish documentation with many tutorials and paradigms covering all areas and likewise a designing hold up department. OPNET give a fully graphical design environment and a very large selection of generic models but everyone models of commercial network devices from legally vendors. It is the dominant network simulation platform in the business and in government research establishments globally. It is likewise highly accepted from the academic research similarity. For this exploration OPNET Modeler has been utilized mostly because its reliability, the wide accessibility of its models and its simple in terms of network design. Likewise, OPNET gives a “wireless suite” with extra futures for wireless network design and implementation.

2.3.2 OPNET’s General Characteristics

OPNET was primes created in 1986 by two Ph.Ds. from Massachusetts organization of Technology and the business OPNET was built up in 1987. Currently there are about 2700 OPNET clients which spread all over fields including undertakings, internet service supply, device manufacturers as well as military, schooling, banking and protection [30, 7].

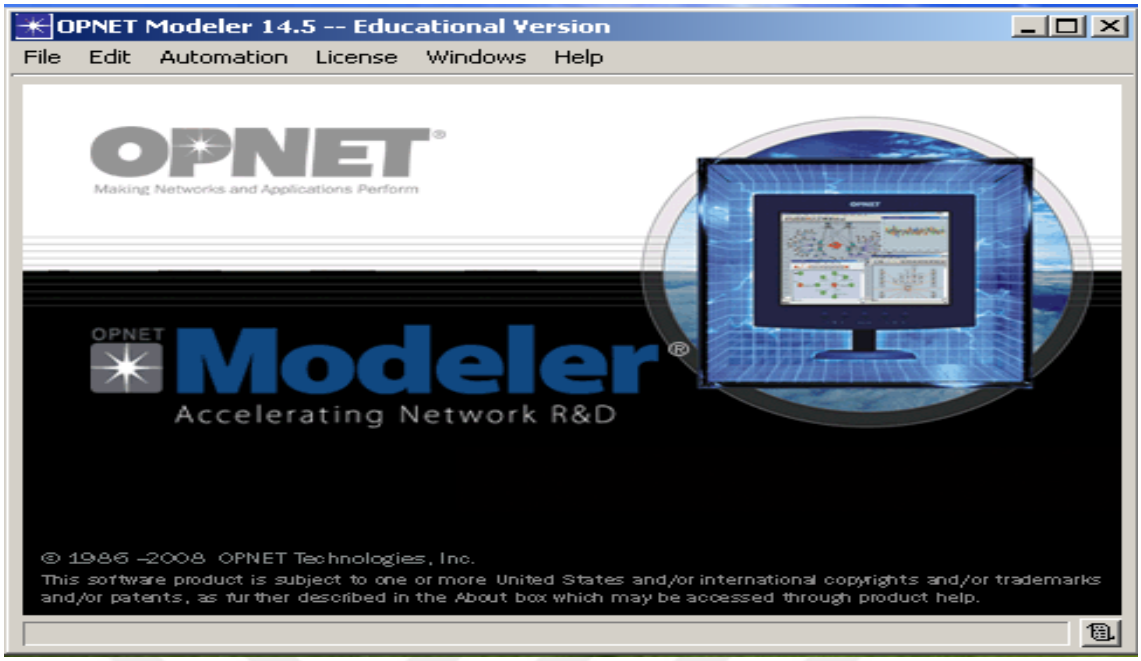


Figure 2.4. GUI Interface of OPNET

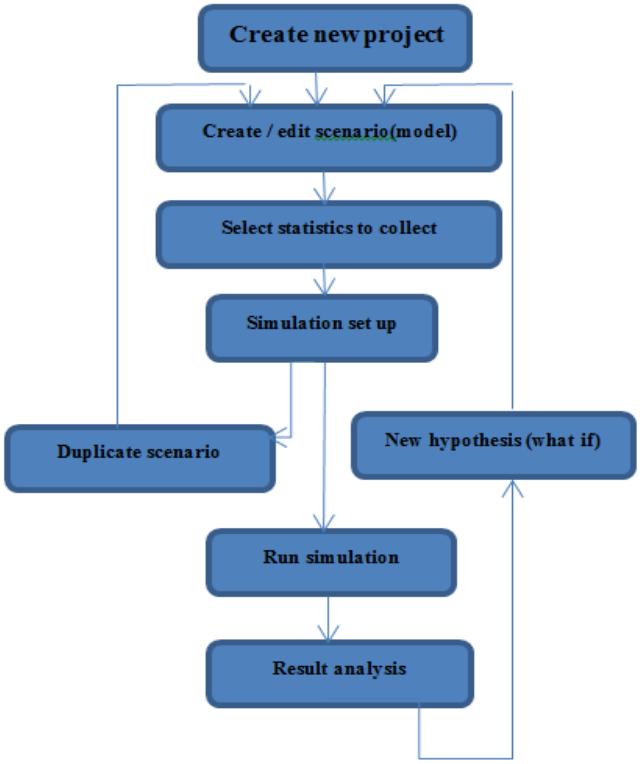


Figure 2.5. OPNET Modeling & Simulation Flow

OPNET is a high level occurrence based network simulation platform. The simulation operates at "packet level" based on the above depicted DES framework. It gives a broad

gathering of generic and economically accessible network hardware and protocol models. The simulation is controlled by a centralized “kernel process” which pass control to procedures that are executed in the models when ask. Kernel process is not accessible from the clients however every one model’s procedures are open source and accessible for modification. Designers can modify existing models and protocols and make new ones utilizing a C-type programing language called Proto-C. This is really a regular version of C which contains a large library of OPNET particular functions particularly designed for data network applications. OPNET gives an extensive capacity to adjust the network operation including traffic generation and application's demeanor. It likewise has a number of editing capacities like Probability Density Function (PDF) and Packet Format editors. Network models in OPNET after a hierarchical structure. They are isolated to three main domains, the Network domain the Node domain and the Process domain [14].

Hierarchical network modeling, It take a form of hierarchical system modeling. From the protocol aspect, the node modeling after the OSI model: Application layer->TCP layer->IP layer->IP encapsulation layer->ARP layer->MAC layer->Physical layer. Figure 2.6. Give a graphical portrayal of OPNET’s hierarchical architecture.

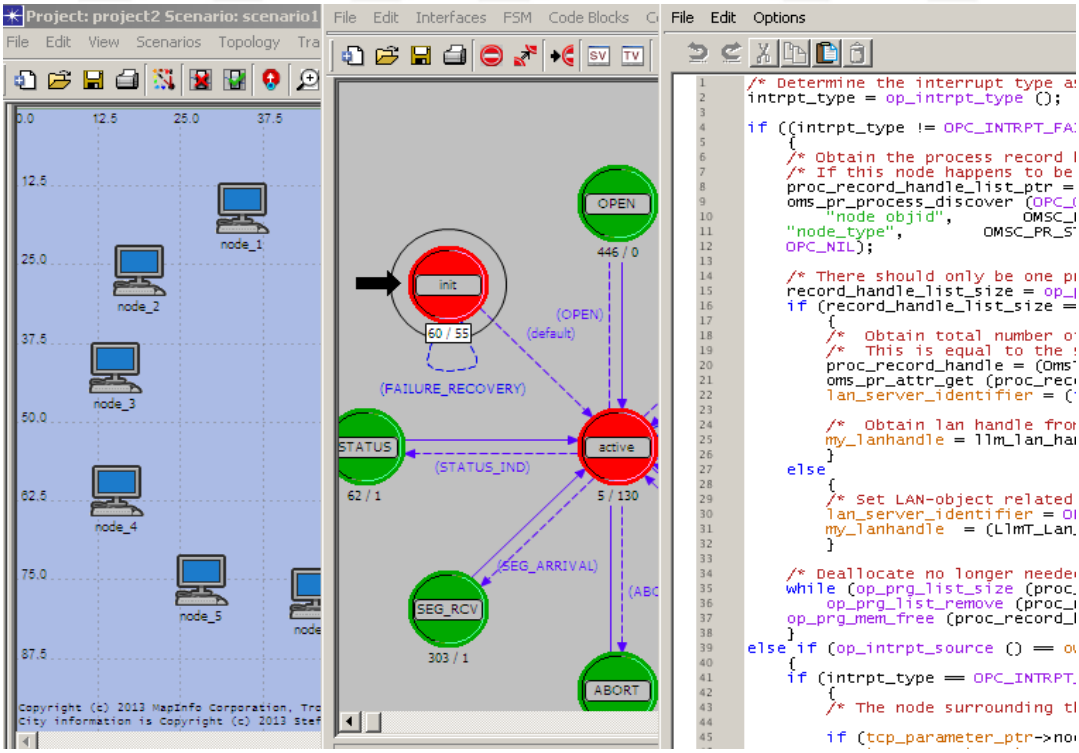


Figure 2.6. OPNET Modeler Hierarchical Architecture

2.3.2.1 Network Domain

The network domain is the segment of OPNET where the topology of the network below study is designed Figure 2.6. It can likewise be grouped in unrestricted number of sub-networks. The network is constructing by graphically adding nodes in the project rewrite and connecting them between each other with determined information links. In the case of wireless networks the wireless medium radio channel is appropriated. In addition geographical coordinates and mobile node trajectories are defined in this domain.

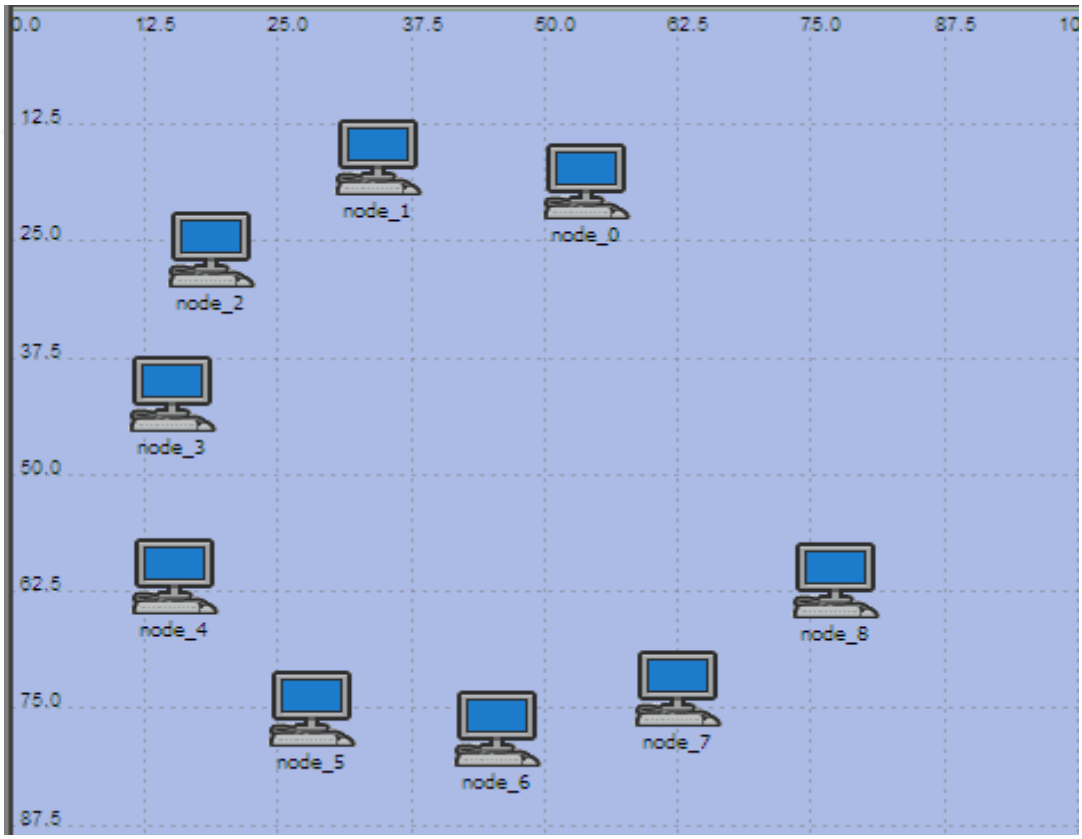


Figure 2.7. Nodes in the Network Domain

2.3.2.2 Node Domain

The node domain is the segment of OPNET where the characteristics and the operation of each individual node are defined Figure 2.8. Normal nodes incorporate workstations, packet switches, hubs and routers, satellite terminals, remote sensors and different components of a network infrastructure. The operation of each node is likewise defined utilizing various modules that are combined using a graphic way. Modules are the essential building blocks of node models. Modules incorporate processors lines, transmitters and

receivers. Processors are the essential useful purpose building blocks of node models and are completely programmable. Line offer all the functionality of processors however can likewise buffer and manage a collection of information packets. Transmitters are the outbound interfaces between objects interior a node and communication links outside it, while receivers are the inbound interfaces. There is an assortment of transmitters and receivers accessible for point-to-point and wireless data communication [31]. Show the collection of accessible modules Figure 2.8.

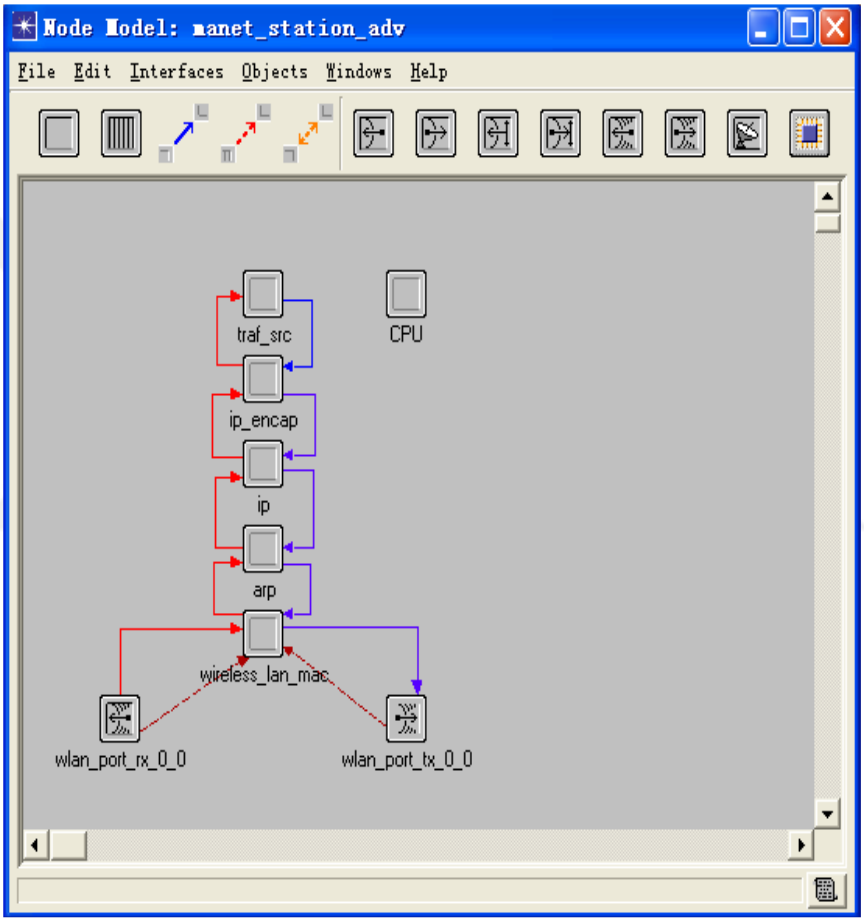


Figure 2.8. Node Domain Modules

The procedure module here represents the OSI model. The nodes are isolated into six layers which are wlan_port_rx_0_0、wlan_port_tx_0_0、wireless_lan_mac、arp、ip、ip_encap and traf_src from the lowest to the highest. Modules are connected between each other utilizing three sorts of connections; packet streams, statistic wires and syllogistic Tx/Rx associations. Packet streams carry information packets from a source to a goal module and

it is the “physical interconnection” between modules. Statistic wires carry a single data value from a source to a goal module in order to report the occurrence of an occasion. A logical Tx/Rx association is used to establish a relationship between a transmitter and a receiver to designate that they execute a function as a pair.

2.3.2.3 Process Domain

Process domain is the part of the software used to particularize the demeanor of processor and queue modules which are existed in the node domain Figure 6. In OPNET every module is modeled as a limited state machine (FSM). A FSM executes the demeanor of a module by determining what action the module can take in response to an occasion [32].

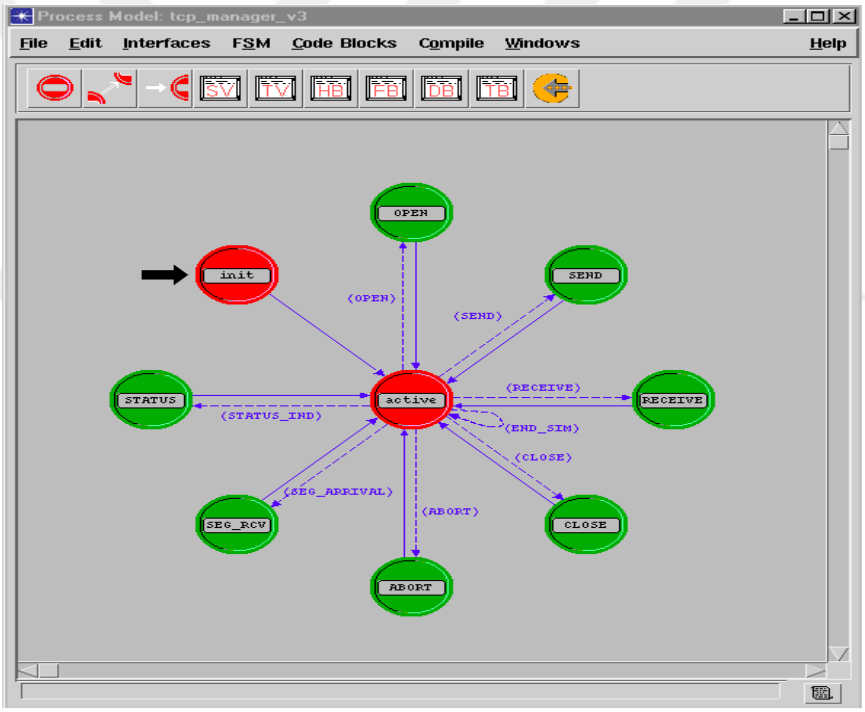


Figure 2.9. Process Domain

2.3.2.4 OPNET Process Modeling

Inside of every processor and line module in OPNET a process model is executed. A procedure model is a FSM that represent the logic and the demeanor of the module using states and transitions. A state is the condition of a module at a given sequential moment within the simulation time. A transition is the interchange of a state in answer to an

occasion. The condition of a module within the states and the transitions are defined in OPNET by programing code. Fragments of C/C++ code can be attached to each piece of an FSM. This code, increased by OPNET-partitioned functions, is called Proto-C [32]. Each state in OPNET is partitioned in two primary parts. The enter executive and the leave executive.

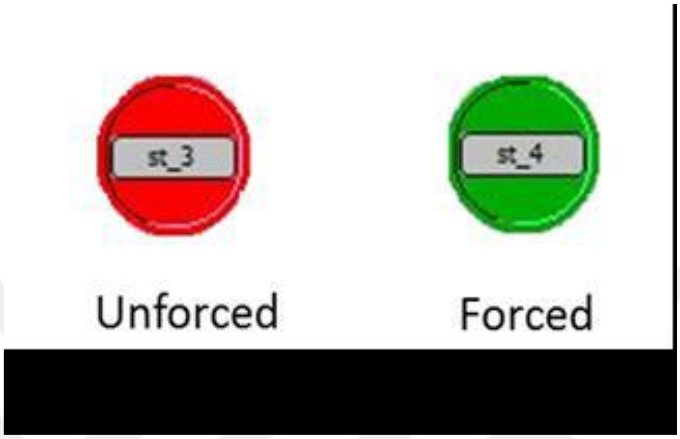


Figure 2.10. Type of States in OPNET Modeler

Code can be attached autonomously in each part. OPNET utilizes two sorts of states; constrained (green) and unforced (red), Figure 2.10. Parts of the code that characterizes the module's operation can be joined to the transitions. When the process enters a constrained state it executes the piece of code in enter executive, then executes the piece of code in leave executive Figure 2.11. And transition to the following state. When the procedure enters an unforced state, in the wake of executing the code in enter executive the process model blocks. It stops execution and returns control to the Simulation Kernel. The next time the procedure model is invoked, execution continues with the leave official of the unforced procedure.

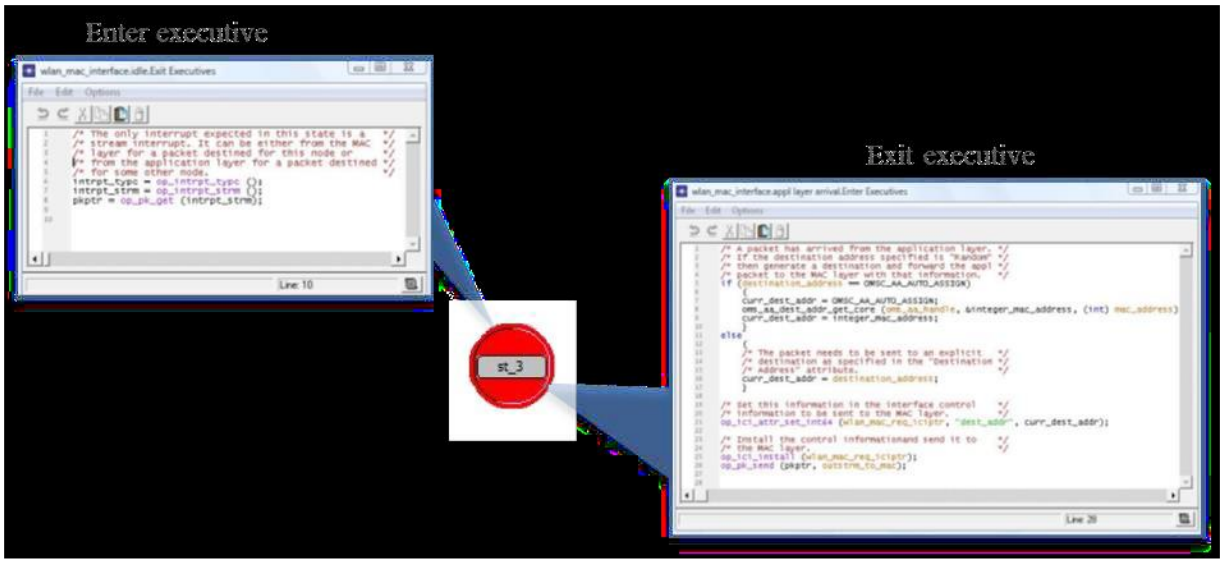


Fig 2.11: Enter and Exit Executives of a OPNET State

3. RESEARCH METHODOLOGY

3.1 Introduction

The current revolution is based on data. Frameworks and concepts based on obtaining and distributing information have been made to meet this require. However, these systems require a flexible platform equipped with communication mechanisms to connect and relay information to each other effectively. Current operational communications system relies based tool that is inflexible, limited, expensive, and overloaded.

The main parts of the system get for Distributed Systems will be explained. General the proposed system has been designed with 2TA and 3TA. The system necessities are likewise addressed here with its two portion (software and hardware), and the features of used hosts addressed here too. In order to explain the activity of the proposed system, the implementation steps of the proposed system will be described in relative with the associated design-steps.

3.2 Concept of Operation

Concepts and systems need a flexible platform equipped with communication mechanisms to connect and relay information to each other efficiently.

3.2.1 Communication Network

Networking technologies have connected almost the entire world together. The concept of a Global Information Grid (GIG) communication system would power data limitless. [33]:

A) Types of Network: Wide Area Network (WAN) is a computer network that spans a relatively huge geographical area. Typically, a WAN consists of two or more local-area networks (LANs). PC connected to a wide-area network is often connected through public networks, for example office or between cities. They can likewise be connected through leased lines. The biggest WAN in existence today is the Internet.

A Local Area Network (LAN), Metropolitan Area Network (MAM), and Wide Area Network (WAN) are all examples of communication systems. WAN covers a vast

geographical area. Ordinarily, a WAN comprises of a number of device is routed through these internal nodes to the specified destination device. A LAN is a communication network that interconnects an assortment of devices and gives a means for data exchange among those devices. The extent of the LAN is small, normally a single building, or a cluster of buildings.

B) Switch Technique: For the transmission of information beyond a local area, communication is ordinarily achieved by transmitting information from source to destination through a network of intermediate switching nodes. The switching nodes are not concerned with the substance of the information. Until, their purpose is to provide a switching ease that will move that data from node to node until they reach their destination. The end devices that hope to communicate may be referred to as stations. The stations may be PC, terminals, telephones, or other communicating devices.

C) Packet Switching: Information is transmitted in blocks called packets. An ordinary upper bound on packet length is 1,000 octets (bytes). If a source has a longer message to send, the message is separated up into a series of packets. Every packet comprises of a portion of the information, or all of the information for a short message that a station wants to transmit, in addition to a packet header that contains control data. The control information, at a minimum, includes the information that the network requires in order to be capacity to route the packet through the network and deliver it to the intended destination. At every node en route, the packet is received, stored briefly, and passed on to the next node. [34].

3.2.2 Ethernet Technology

Ethernet is effortlessly the most successful local area networking technology of the last 20 years. Ethernet is a (carrier sense multiple access with collision detection (CSMA/CD)) local area network technology. As demonstrated by the CSMA name, Ethernet is a multiple access network, implying that a set of hosts send and receive frames over a shared link. Thusly, Ethernet can be viewed as a bus with multiple hosts connected to it. The ―carrier sense‖ in CSMA/CD means that all hosts can recognize between an idle and a busy link. The ―collision detect‖ implies that a host listens as it transmits and can subsequently distinguish when a frame it is transmitting has interfered (collided) with a

frame transmitted by another host. An Ethernet portion is typically implemented on ―10 BASE-T‖ technology, where the ―10‖ implies that the network operates at 10-Mbps; ―Base‖ refers to the fact that the cable is utilized in a baseband framework, and the ―T‖ stands for twisted pair. The bits are encoded utilizing a Manchester encoding scheme. The Ethernet standard has recently been extended to contain a 100-Mbps version called Fast Ethernet, and a 1000-Mbps version called Gigabit Ethernet. Both 100-Mbps and 1000Mbps Ethernets are designed to be utilized in full-duplex, point-to-point configurations, which imply that they are normally utilized in switched networks. Ethernet has been around for many years and is very popular. Ethernet is extremely simple to administer and maintain. There are no switches that cannot succeed, there are no routing tables to refresh, and it is easy to expand the number of hosts. It is likewise very inexpensive to implement. Research on Ethernet has display that it works best under lightly loaded conditions [35]. Fast Ethernet or ―100BASE-T" gives transmission speeds up to 100 megabits per second and is typically utilized for LAN backbone systems, supporting workstations with 10BASE-T cards. Gigabit Ethernet gives an even higher level of backbone support at 1000 megabits per second (1 Gigabit or 1 billion bits per second). 10-Gigabit Ethernet gives up to 10 billion bits per second.

3.3 The Proposed Structure

Any electronic system should be designed according to known rules which can be called standard rules. One of these rules is the architecture of the system that will be the core of the general structure to build the related algorithms. Firstly, there was 1TA that relies on the features of the mainframes whereas the have been represented by terminals. Then other architectures have been showed up; like 2TA (i.e. using one host as a server and many hosts as clients).Likewise 3TA i.e. utilizing two hosts as servers and many hosts as clients. The rank of the architecture can be increases by increasing number of the servers, either in cascade directing by connecting more than two servers serially dividing the database system into sequence of continued parts, or in cascade direction by Connecting more than two servers in parallel dividing the database system into many parts of on level steps the proposed system is designed to run either on 2TA or 3TA (because there is no need to 1TA). Both tiered architectures are client/server base networked computers with any network scales. There are few areas of concern when First setting laboratory system: Back-

end, Application Data and Front-end. In 3TA frameworks, the progression that has the highest priority in the system foundation schedule is the design of back-end module because most of the errors in the systems return to the inaccuracy of the back-end module. It is preferred to test the capacity of operating such these systems with more than one operating systems Because of that the most renowned OSs nowadays are Windows, these OS have been depended in this proposed framework taking in consideration that these OSs might be utilized by other works. The hardware part comprises of two sub-parts; first segment is related to the servers-side and the other relates to the clients-side. Servers-side can be organized into two structures; either comprising of one host which contains both of application tier and the database tier (2TA) as shown in figure 3.1.Comprising of two hosts (3TA) as display in Figure 3.1. First host is specified for the application tier and the other indicated for database tier.

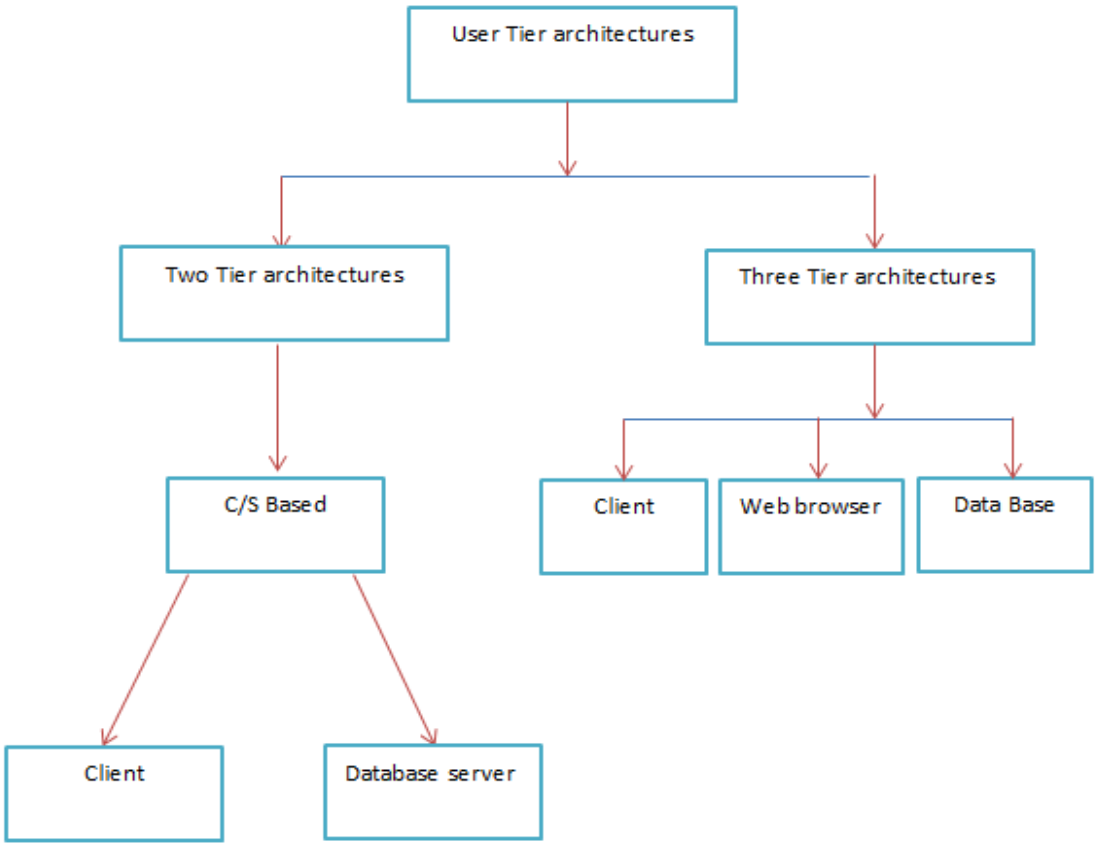


Figure 3.1. 2TA and 3TA Architectures

a) Client-Server Architectures:

Single-tiered: dumb terminal/mainframe configuration.

Two-tiered: client/single server configuration.

Three-tiered: each layer on isolated machine.

Traditional two-tiered configurations:

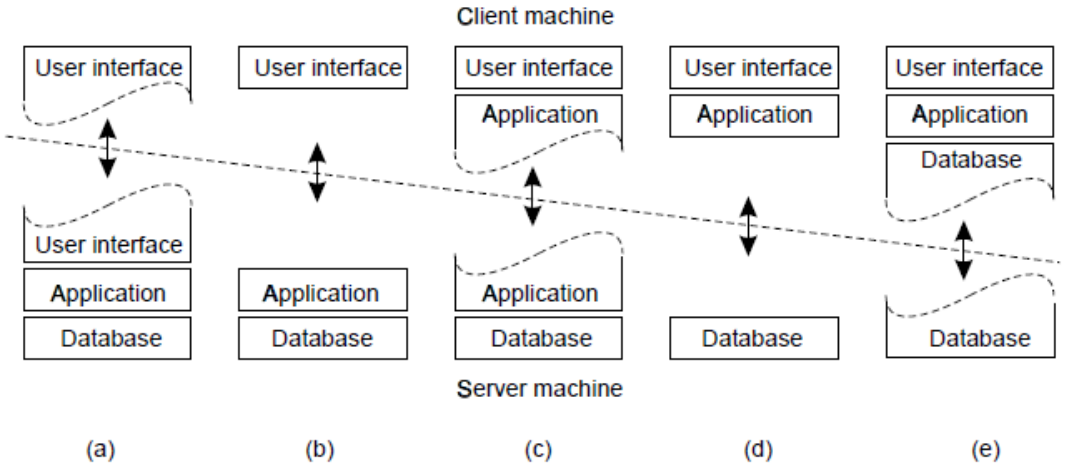


Figure 3.2. Traditional Two-Tiered Configurations

b) Basic Client–Server Model Characteristics:

There are processes offering services (servers)

There are processes that utilize services (clients)

Clients and servers can be distributed across dissimilar machines

Clients follow request/reply model with respect to utilizing services

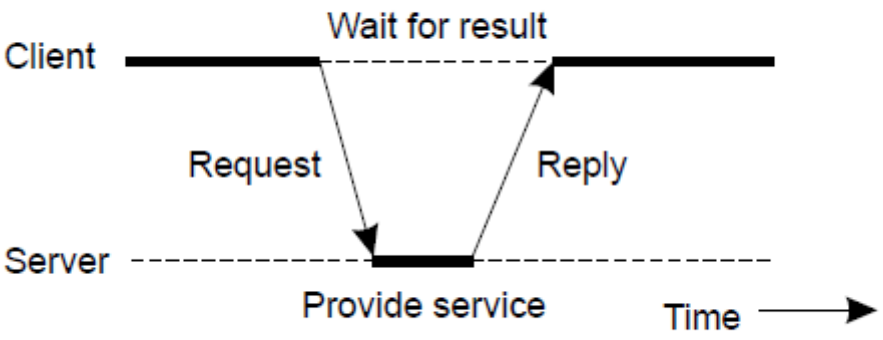


Figure 3.3. Server-Client

Servers: Generally give services related to a shared resource:

• Servers for file systems, databases, application repositories, etc.
• Servers for shared, linked documents (Web, Lotus Notes)
• Servers for shared applications
• Servers for shared distributed objects

Clients**:** permit remote service access

Programming interface transforming client's local service calls to request/reply messages Devices with relatively simple digital components (barcode readers, teller machines, hand-held phones Computers giving independent client interfaces for specific services Computers giving an integrated user interface for related services compound documents.

3.4 System Requirements Interface

Each electronic system needs prerequisite of both of programming and hardware parts. It is preferred to have two different types of computers; the servers-side PCs must be more powerful than those of clients-side however if the client hosts are powerful too, it is not an issue. In this way, it is needed to describe all software and applications utilized for designing the proposed system. Likewise, all hardware equipment features depended for the proposed system machinery must be described. The system is implemented utilizing

hosts with various features in order to give more practical applications and to be close to the real situation.

a) Software required for windows:

- Development server: WAMP(W: Windows platform, A: Apache HTTP server,
- Operating System: Windows-7
- Applications : Text Editor sublime, Almost any web browser,
- OPNET Modeler.

b) Host's features depended in implementing**:**

- CPU: Core(TM) i3-CPU M350 @ 2.27GHz (4 CPU), 2.3GHz
- Architecture: 32 bits (6.1, Build 7601)
- Memory: 2048MB RAM
- HD: 500GB

3.4.1 Applying for the license of OPNET

The test depends on the network simulation software OPNET. However, unlike other competitors for example NS and OMNET++, OPNET is commercial programming requires license authentication. Luckily, it gives free license to universities and tertiary institutions for educational purpose of utilizing their products that is called OPNET University Program. The free academic license could be applied from the OPNET University Program webpage. To apply it, the applicant has to fill in an application form online to give their personal information and academic information. In addition, if the applicant is willing to utilize OPNET for particular research project, it likewise requires brief description of the project. The application takes around 5 working days to process. Once it is approved, OPNET emails the login name and password to the applicant. The first time user's login to the It support center, it is required to accept the agreement of utilizing the permit and sign it digitally and it takes one business day to be approved. After that, the permit is activated.

3.4.2 Download Software

The most recent version of OPNET Modeler It can be run on Windows this project utilizes the Windows version running on Windows 7 Professional. The installation file of OPNET Modeler is obtainable on the It website with logging into the OPNET support center. The compiler for Windows platform is Visual Studio 2005 or above. There is an express version of Visual Studio 2010 that can be freely downloaded from Microsoft website.

3.4.3 Evaluation Platform

Presented by OPNET Technologies is a business simulator where the kernel source code is not open [2]. Notwithstanding it has a rich and include development features built in, which facilitates the process of designing the real world scenario and simulating the network models [3]. It adds inclusive options as being both an object oriented and separate Event System (DES) based network simulator. In our studies, we utilized OPNET modeler for its dependable and proficiency for simulation. The motivation of choosing OPNET will discuss in below part. It models the system behavior by every event in the system effectively. Its proficiency can be measured from the below mentioned features, Gives more features than any other simulator in practice:

- Permit modelers to straightforwardly comprise models in it with a wide range of available standard and vendor specific communication networks. It likewise assists to reduce the development time greatly.
- Has a dynamic development environment with rich features that support both distributed systems and modeling of communication networks.
- Has a large and client friendly documentation to guide client.
- Give easy graphical interface to work and view the outcome.

- OPNET results are adaptably interpretable (i.e. exported to spreadsheets), and have inclusive tools to support show, plot and analyze time series, histograms, probability, parametric curves, and certainty intervals.

3.5 Network Model Configuration

3.5.1 Network Components

This section briefly describes about the following network elements used in our study network models running on OPNET [36]. The main components of this model are the following:

The application_Config comprises a name and a description table which is specified different parameters for the various applications (i.e. Data Base, HTTP, voice and FTP applications). Each application defines a service that can be executed in a workstation or in a server. It likewise defines the load of the system. To emulate the behavior of the Campus application Web-based front-end with file transfer and email support-, we defined two OPNET applications: Data Base (Heavy Browsing) and HTTP (Heavy Browsing).

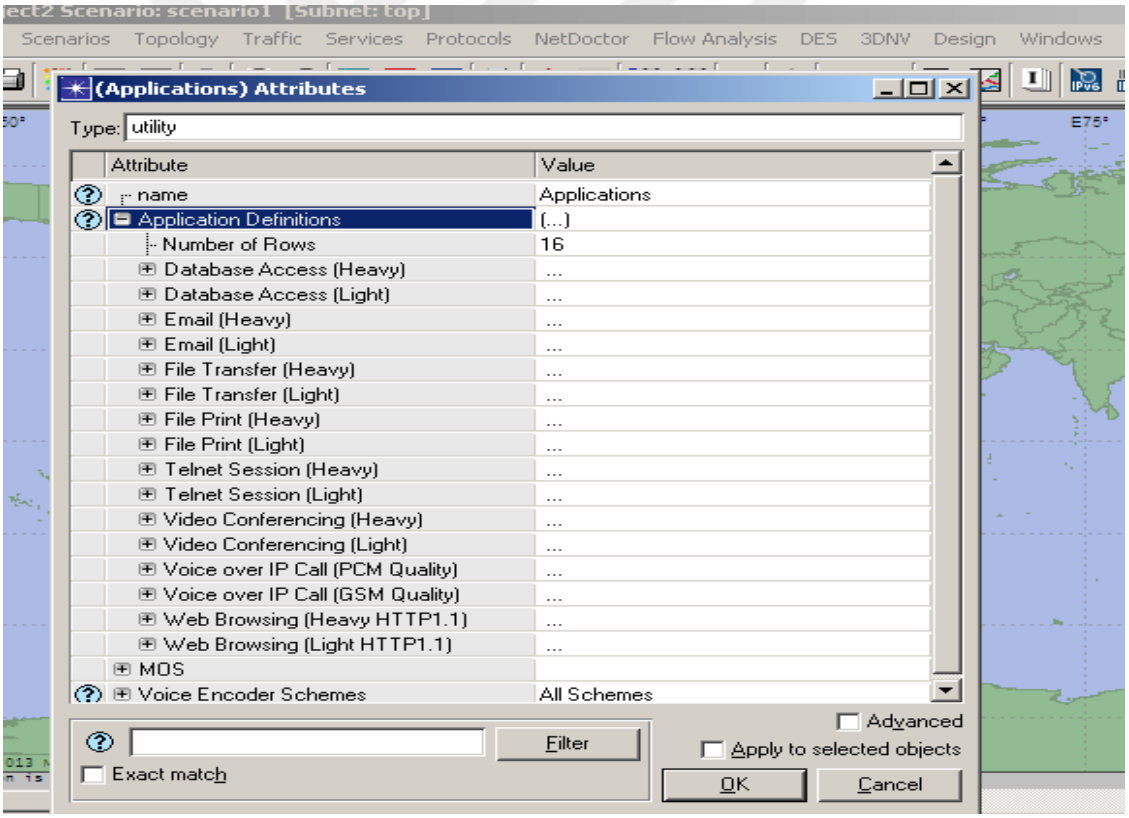


Figure 3.4. Application Definition

The individual application name is used while inventing user profile on “Profile_Config” object. The Profile_Config node can be used to create user profiles. These user profiles can be precise on various nodes in the network to generate application layer traffic. The

applications distinct in the Application_Config are applied by this object to configure profiles. Traffic patterns can be precise followed by the application as well as the configured profiles. A profile is a group of applications to be used by some type of users such as students, managers, visitors, etc. Each profile likewise defines the statistical distributions for the simulation engine. In this first model, only one general profile -with support for all applications- was defined.

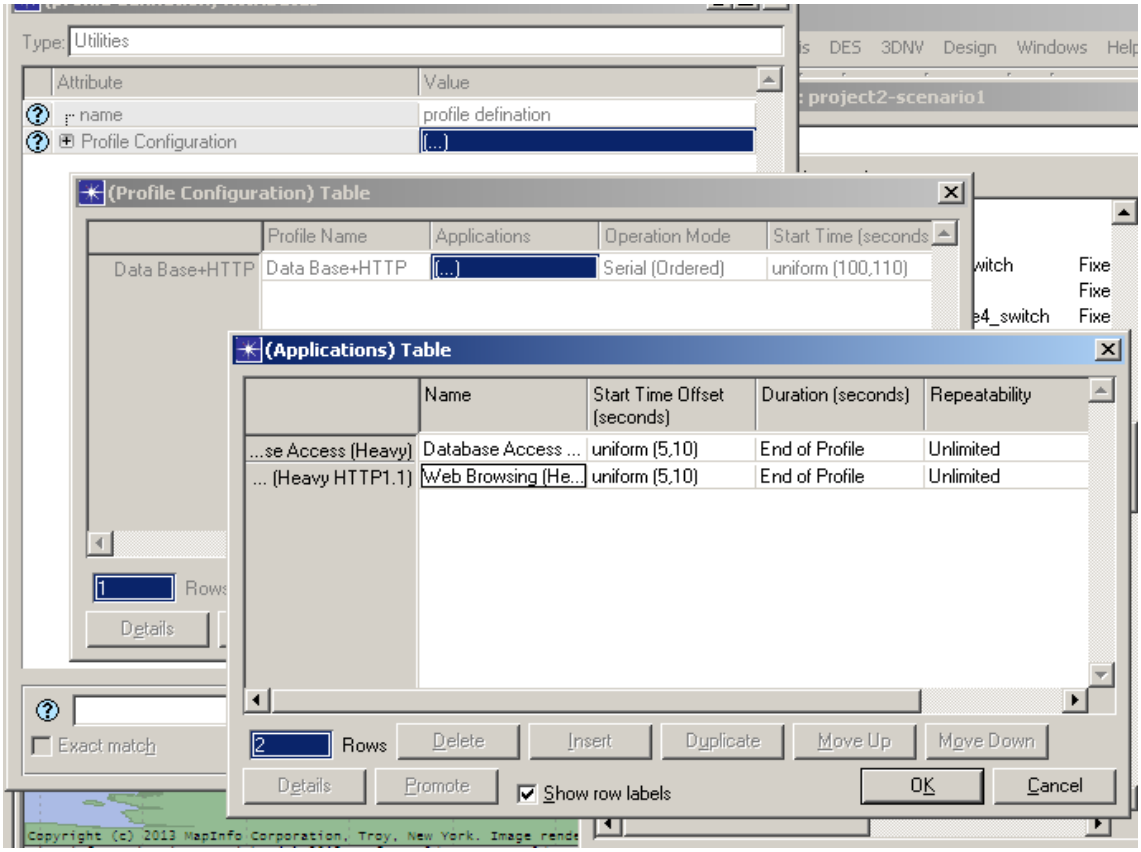


Figure 3.5. Profile Definition

Servers: Continually running programs that serve information to the web. It there were several servers to execute applications: servers to emulate the basic Campus activity using Data Base and HTTP servers. All servers were directly connected to the load and delay.

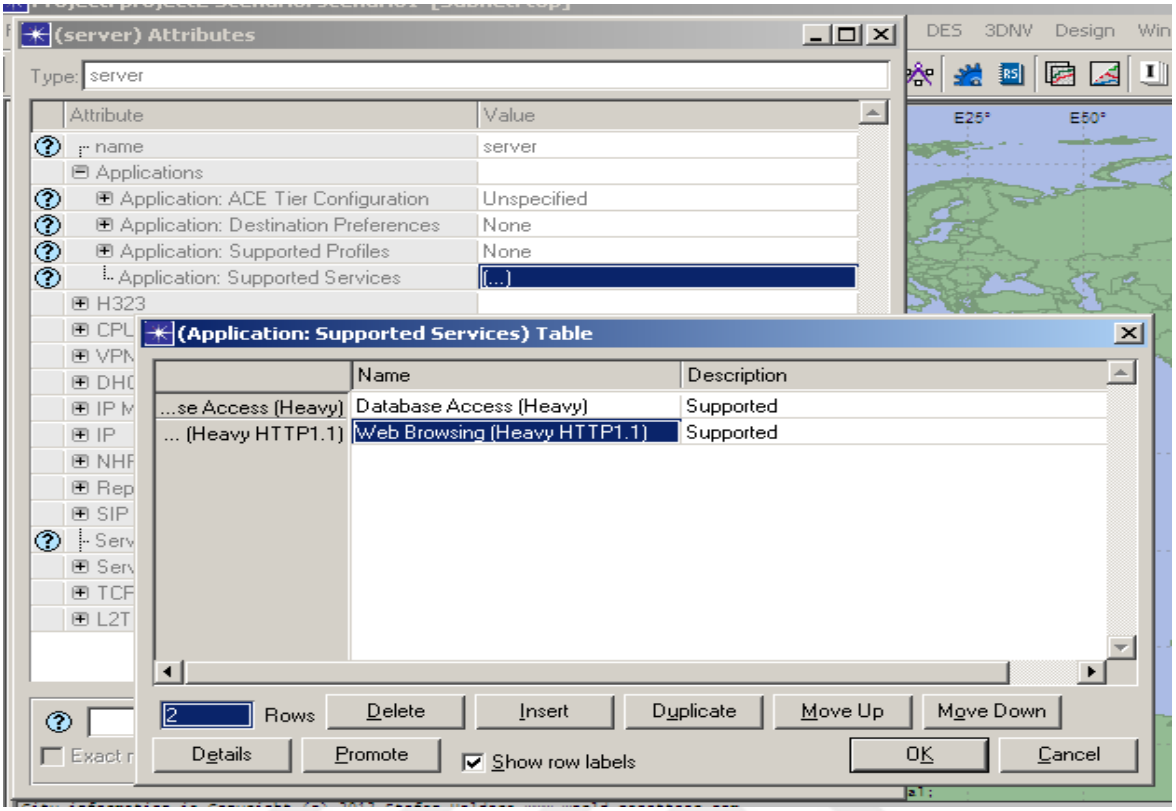


Figure 3.6. Example of Server.

3.5.2 Evaluation Parameters

The assessment parameters used in performance network are as follows:

Load: It represents all control packets sent by the nodes in the network for discovery and keeping up the server during the emulation. Loading capacity can be used to compare the scalability and proficiency as well as the capacity to configure network congestion in different networks. Server protocols with extensive loading capacity have more probability of packet collision and delay.

Average delay: This parameter refers to average delay time of the packet going from the source node to the aim node. It consists of the buffer lag in the server finding process, the transmission lag in the MAC layer and the transmission time.

Load balancer: It is a mechanism that decides which server will attend the next client request. Servers are assigned to balanced applications. Every application is balanced utilizing its own policy: Round-Robin for Data Base and HTTP, and Number of

Connections for Email. All former devices were connected to a router through a firewall, which restricts the supported applications. The router was the single connection to the Internet.

3.5.3 Simulation

There are several techniques to assess the execution of network architecture for example, statistical analysis, network monitoring or simulation. In this work, computer simulation was chosen as the assessment tool since it has the great advantage of being less expensive than building up a network and performing the monitoring assessment on it. Simulators are accessible, for example, OPNET. It is usually up to the designer to select the modeler that best fulfills his/her specific needs. In this thesis, OPNET modeler was utilized as simulator for the following reasons. Firstly, OPNET is a very user-friendly tool with a library that contains wide choices of components. This can help in creating the implementation phase easier for the designer. Secondly, with OPNET, dissimilar simulations can be run at the same time, which makes the analysis of the outcomes more comparable and easier to comprehend [37]. We have developed two diverse case studies to test in OPNET, based on the theoretical features that we have clarified in the previous chapters 4. For the starting, we utilized a real scenario to study the similarity of Ethernet and Internet traffic. The Ethernet traffic is generated by several conglomeration sources while Internet traffic is generated by client requisition to online applications [9].

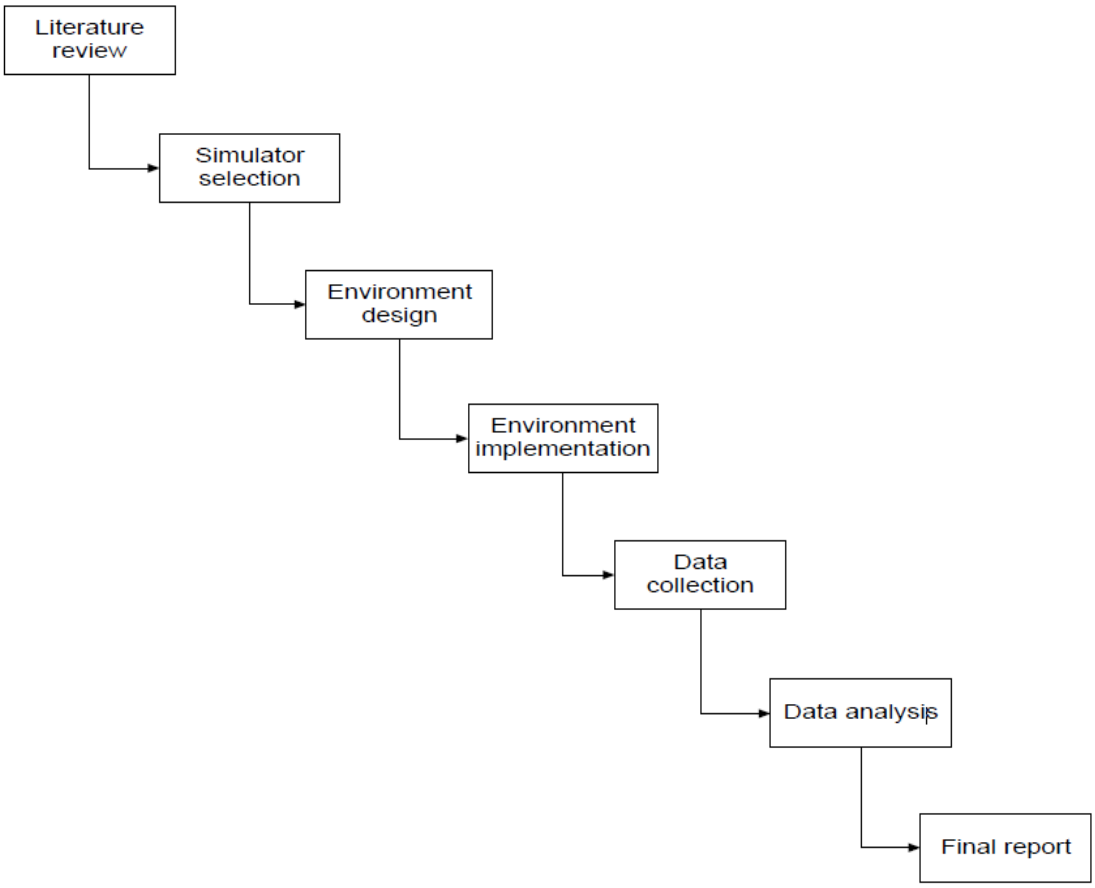


Figure 3.7. General Steps for Waterfall Approach.

4. SYSTEM IMPLEMENTATION AND RESULTS

4.1 Introduction

Effectuation analysis of the proposed is described in this chapter web Browser over both category of 2TA and 3TA. Three connection-LAN networks are addressed for testing the proposed on both of 2TA and 3TA. The two procedures of testing are manually tested. At last, different organizations are addressed which proposed for this system of 2TA and 3TA with various scenarios utilizing OPNET-tool.

4.2 Performance Analysis Implementation Criteria

Effectuation analysis is implemented by OPNET tools. A duplicate is run on the server side of the four category of PC -LAB namely; LAN-1, LAN-2, LAN-3 and LAN4 for the reason of testing and to discover out the optimal time-consume by response time. 2TA and 3TA has been depended. The outcome of the system is assessed by comparing them with professional tools called OPNET as well as (response time). The tests depended (5, 10, 15, and 20) hosts for the user-side and server/servers side with (2TA and 3TA). The test is to discover out which architecture is best when dealing with databases takes less time to load data from the database or into the database. The investigation tests of the advanced criteria records are shown in detail in the coming segments. Time-Consume Analysis approaches**.** There are ways to test the reaction time for the Performance Measurement for Distributed Systems utilizing OPNET Principles. On the other hand, the OPNET tool is a professional one that can helps for designing and implementing huge networks, particularly those depending on the principles of the Client/Server. The average delay time for the total network or related with some portion of it can be measured. Likewise, the amount of dataflow can be measured for small or huge numbers of utilized hosts. This tool provides for the configuration of the designed network.

- **Windows-7 with 2TA**

Four discrete groups of client tests have been depended to acquire an excellent and accurate outcome, these groups rely on the number of client-hosts in the LAN. Test -1 is just a client

that is directly connected to the server, test -2 contains five clients connected to the server, test -3 contains ten clients that connected to the server and test -4 contains twenty clients connected to the server. The proposed framework application runs on the server and the clients just with browsers. The utilization of one-client or two-clients for implementation in a LAN is very difficult to get an acceptable outcomes, however utilizing of up to ten-clients achieves better outcomes. The system has no problems when utilizing more than two clients at the like time, consequently, group tests -1- and group tests -2- are not very accurate compared with those of group tests - 3 and 4.

- **Windows-7 with 3TA**

The similar test in 2TA, with the same stages, is reiterated for 3TA. The 3TA components are separately connected in three computers (two servers and a number of clients). Server-1 and the client's computer (web browser), while server-2 is the database server All application required to achieve the proposed system are be installed on the server side in both tier architecture 2TA and 3TA.

4.3 Additional Test Using OPNET Tool

In order to have a wide view of the proposed framework, it is important to apply simulation-tests to the system for various loads during certain periods. Subsequently, as an extra test applied to the proposed system, the OPNET tool has been depended that gives simulation tests to such these systems. Diverse organizations have been proposed for this system of 2TA and 3TA with various scenarios utilizing OPNET-tool. There are two principle of the assessment, firstly, the similar scenarios applied for 2TA and 3TA utilize Windows 7 OS is adopted here utilizing (five, ten, fifteen and twenty) clients. The consumed-time and the dataflow for the general network and the server(s) have been resolved utilizing OPNET tool. At last, other scenarios have been proposed utilizing large numbers of clients to be as greatest as possibly close to the real conditions. The kind of the OS is not significant here because in real applications will be treated with the distributed systems that have diverse kind of OS and there should be transparency for the utilized OS. The first part of the simulation was run for thirty minute, and HTTP-server was supposition to be a heavy browsing server, while the database

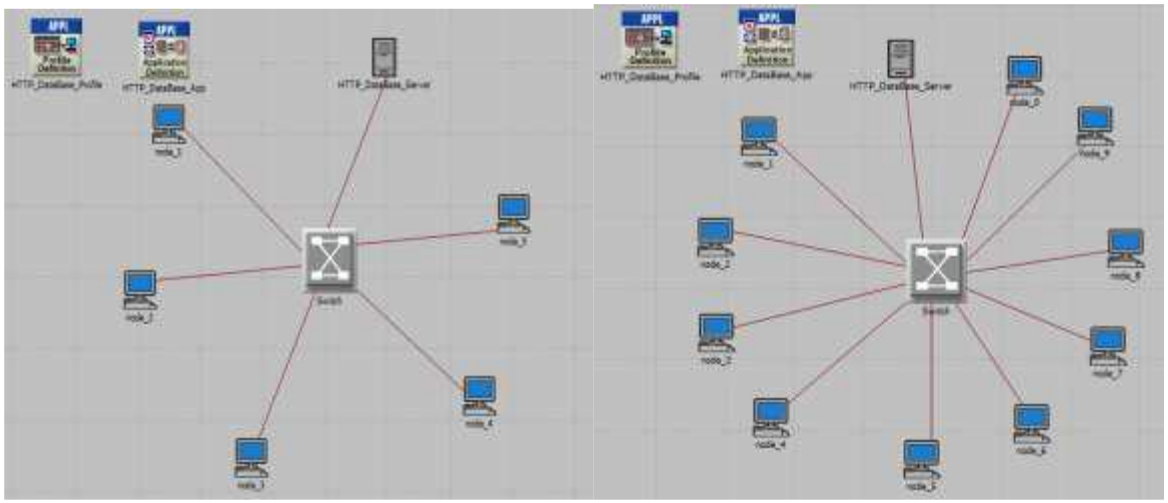
server was supposition to be a medium load database server, while for the second portion of the simulation was run for few minutes. The supposition prototypes have been simulated relying on the mechanism represented in Appendix. Only the general diagrams of the proposed scenarios will be displayed in this chapter, and there is no requirement for detailed description-steps.

4.4 Implementation and Results

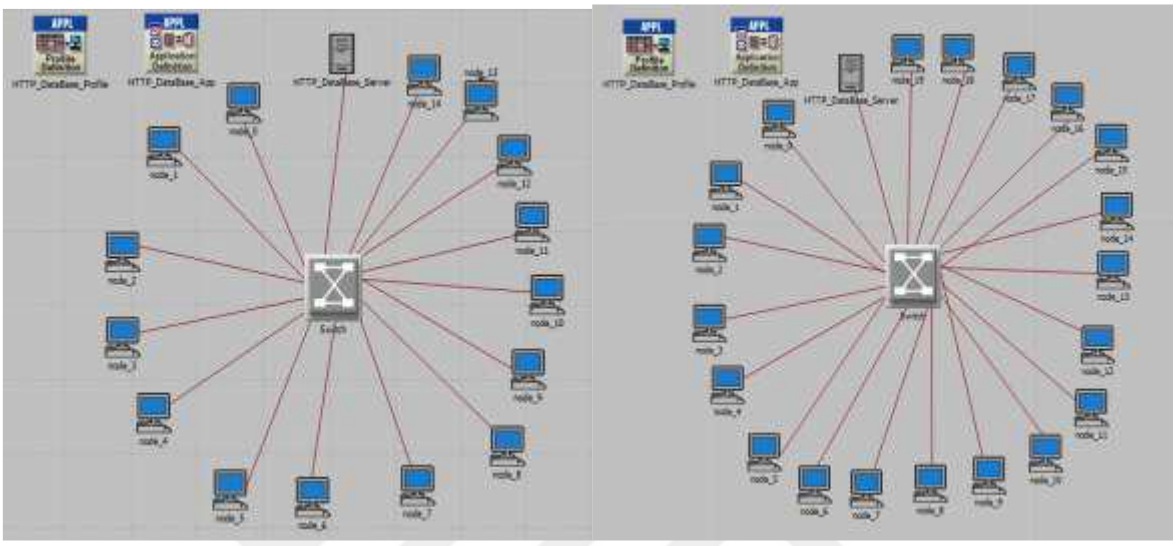
System implementation and results introduction implemented results discussion evaluation and comparison. Is entitled Performance Analysis the performance with different architectures using a standard tool named OPNET Tools Likewise, a professional evaluation and designing tool called OPNET has been addressed.

4.4.1 Results Obtained for Four-Evaluation-Scenarios Using OPNET Tool

The similar four scenarios declared in dot (4.2) are adopted here to be tested utilizing OPNET-tool. Figure 4.1.Represents the four assessment-scenarios for 2TA utilizing OPNET-tool utilizing five, ten, fifteen and twenty clients. Table 4.1. Represents Total-Network-Delay (TND), Server Delay (SD) and Server- Load (SL). Figure 4.2. Figure 4.3 Figure and 4.4. Represent TND, SD and SL comparisons of the four assessments -scenarios for 2TA utilizing OPNET-tool.



(A) (B)



(C) (D)

Figure 4.1. Four Evaluation-Scenarios for 2TA Using OPNET-Tool (A) Using 5 Clients. (B) Using 10 Clients (C) Using 15 Clients. (D) Using 20 Clients

OPNET tool has the capacity of determining many features for the depended network, but just these features (i.e. TND, SD and SL) considered here that are related to the system execution measurements. From this table and figures it is clear that the general delay of the network is greater than that of the server-host (which is normal and expected outcomes). In general, because of that both of web application program and database system are put at one server-host (for 2TA), so the server load can be noticed obviously.

Table 4.1. Total-Network-Delay and Server-Load for 2TA Using OPNET-Tool.

No. of Clients	Total Network Delay(sec.)	Server Delay (Sec.)	Server Load (bit/sec.)
5	0.0035	0.000018	264,5
10	0.0035	0.000018	452,3
15	0.0034	0.000018	739,4
20	0.0035	0.000018	946,4

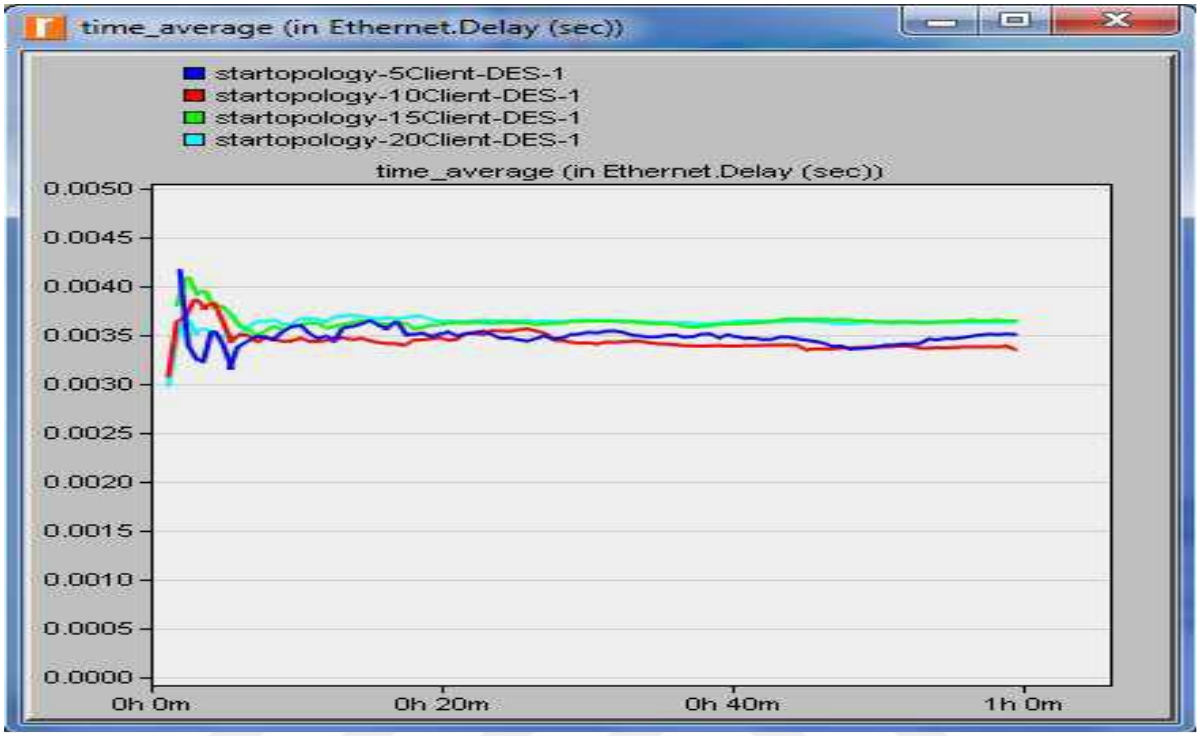


Figure 4.2. Total-Network-Delay Comparison of the Four Evaluation-Scenarios for 2TA Using OPNET-Tool

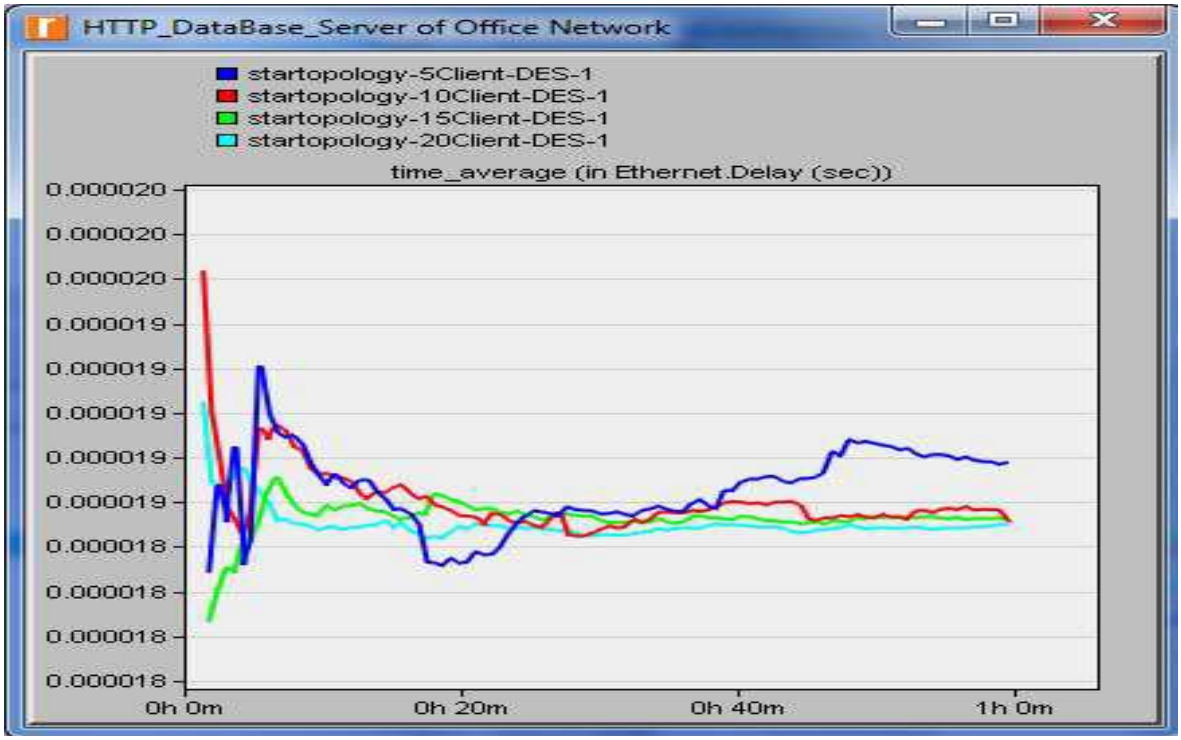


Figure 4.3. Server-Delay Comparison of the Four Evaluation-Scenarios for 2TA Using OPNET-Tool

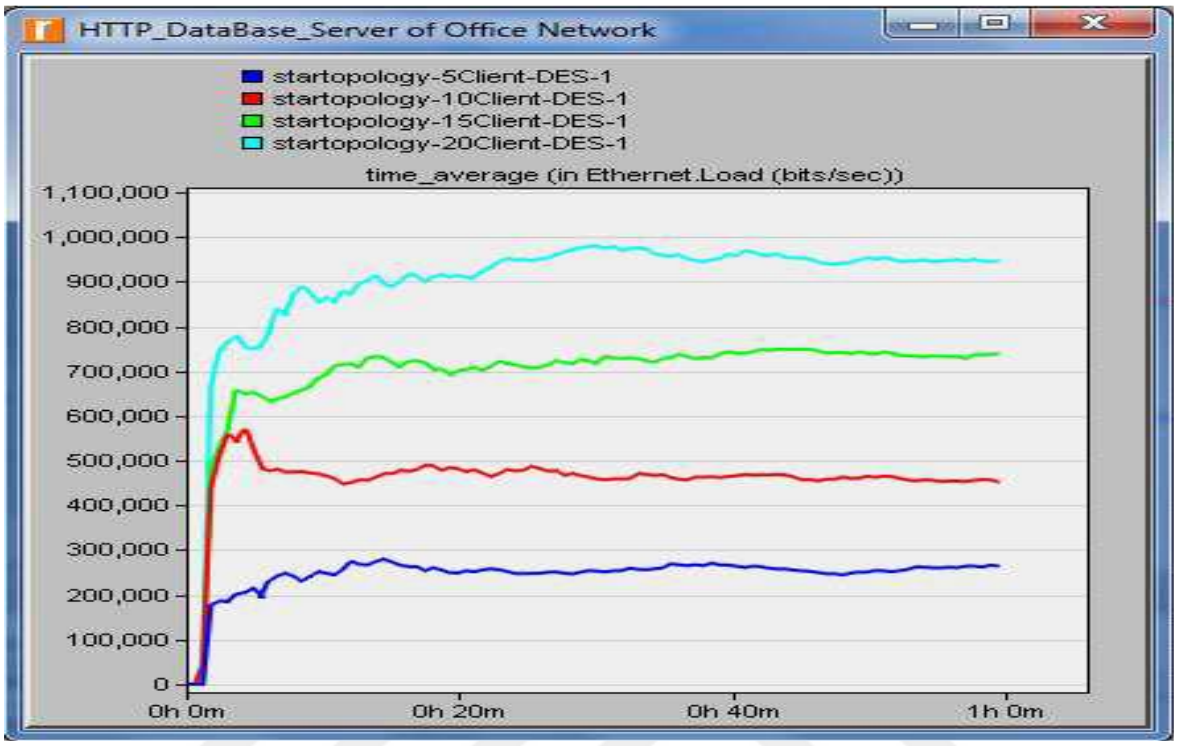
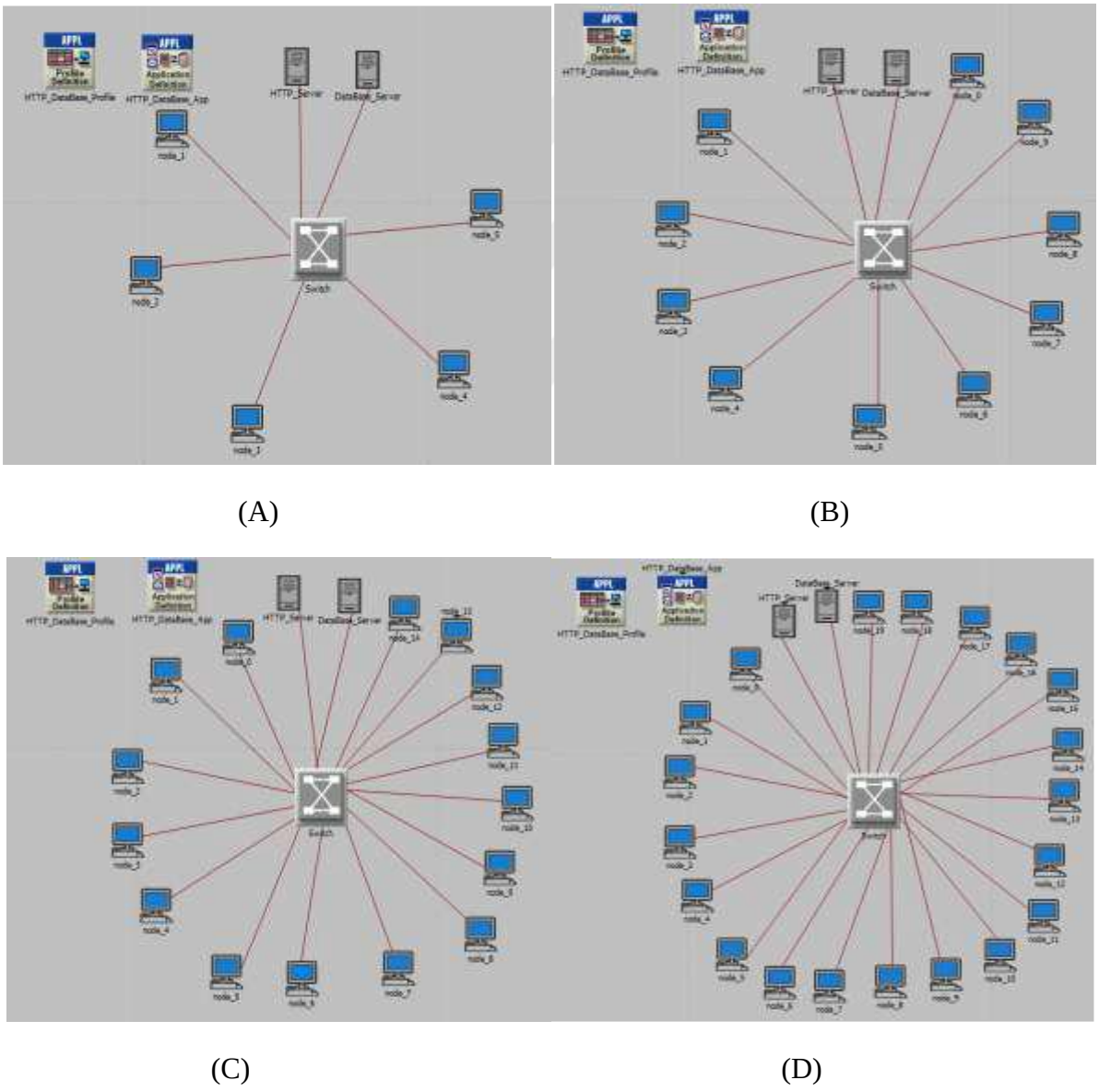


Figure 4.4. Server-Load Comparison of the Four Evaluation-Scenarios for 2TA Using OPNET-Tool

Figure 4.4.Shows the impact of increasing number of clients on the amount of server load in term of (bit/sec). Thus, there is an immediate proportion between number of client and server load. The similar four scenarios declared in section (4.2) are relied here to be simple utilizing OPNET-tool. Figure 4.5.Represents the assessment -scenarios for 3TA utilizing OPNET-tool utilizing five, ten, fifteen and twenty clients. Table 4.2.Represents Total-Network-Delay (TND), Server Delay (SD) and Server-Load (SL). Figure 4.6. Figure 4.7. and Figure 4.8.Represent TND, SD and SL comparisons of the four assessments -scenarios for 3TA utilizing OPNET-tool. It can be appeared from table 4.2.That the TND is greater relatively with respect to those values of 2TA because of adding an extra server. Likewise, the SD values here are less than those of 2TA because only http-server is considered (i.e. the delay of that server that contains only the web application software).While the http-server load will has higher load than that of 2TA because the extra server in 3TA. The impact of these outcomes is showed clearly in the plotted curves in Figure 4.6.Figure 4.7.And Figure 4.8. That is extracted from Table 4.2.Figure 4.6. Shows the impact of average values of TND for 3TA, and the

distinctions can be noticed. Figure 4.7.Represents the average values of http- server-delay using (5, 10, 15 and 20) clients. It is obviously that there are no large contrasts among these values because just this server will face all received packets and the impact of communication between this server and database server can be neglected. The effect of increasing number of clients on the http-server is illustrated in Figure 4.8. And this connection is immediate proportion with increasing server load.



(A) (B)

(C) (D)

Figure 4.5. Four Evaluation-Scenarios for 3TA Using OPNET-Tool: (A) Using 5 Clients. (B) Using 10 Clients. (C) Using 15 Clients. (D) Using 20 Clients

Table 4.2. Total-Network-Delay and Server-Load for 3TA Using OPNET-Tool

No. of Clients	Total Network Delay(sec.)	Server Delay (Sec.)	Server Load (bit/sec.)
5	0.0035	0.000018	242,417
10	0.0035	0.000018	489,998
15	0.0036	0.000018	678,606
20	0.0037	0.000018	1,049,059

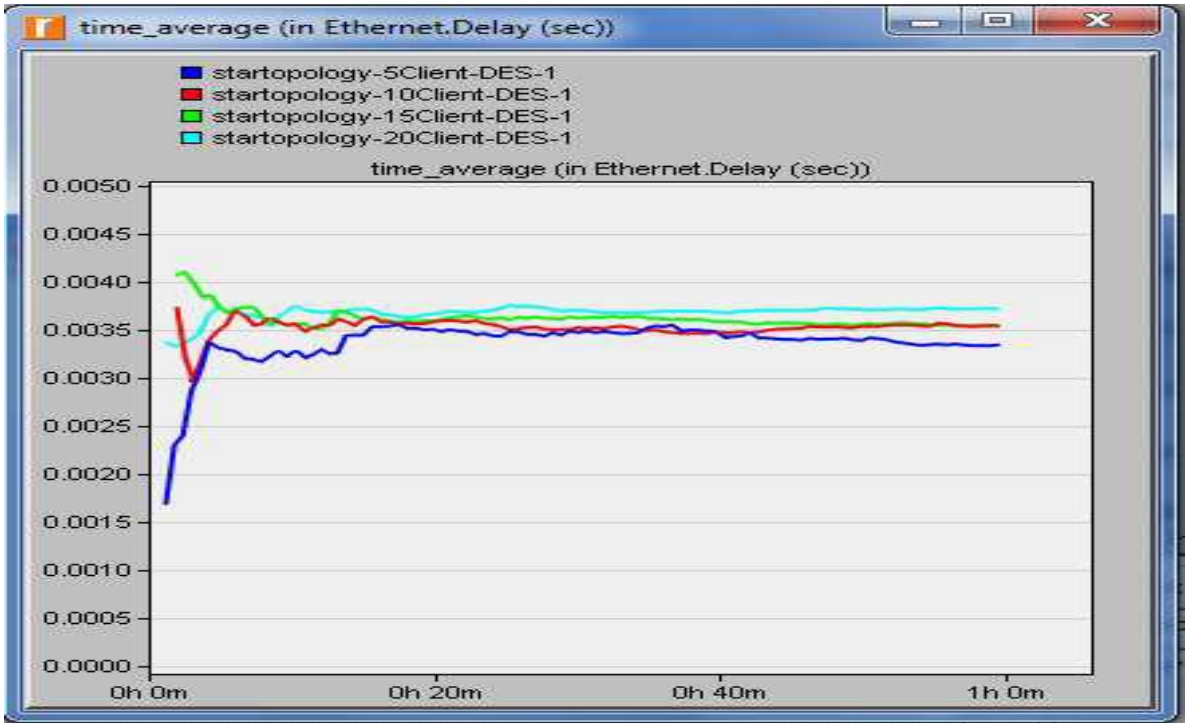


Figure 4.6. Total-Network-Delay Comparison of the Four Evaluation-Scenarios for 3TA Using OPNET-Tool

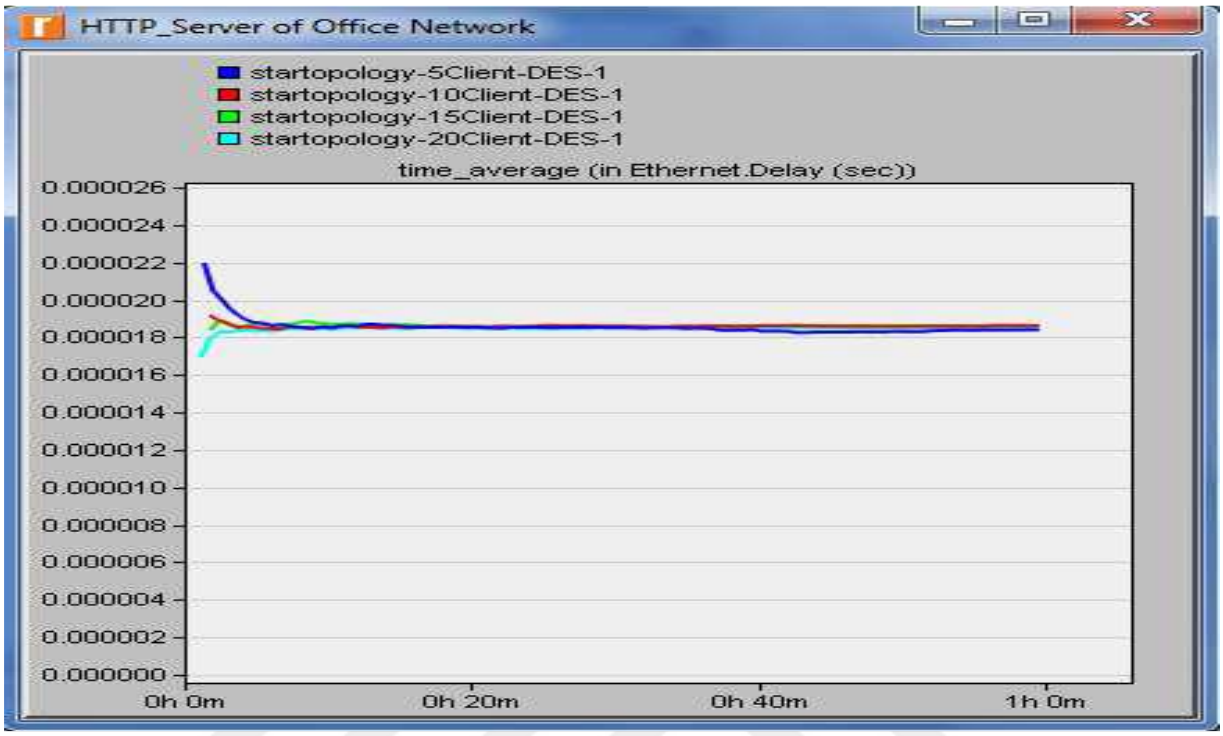


Figure 4.7. HTTP-Server-Delay Comparison of the Four Evaluation-Scenarios for 3TA Using OPNET-Tool

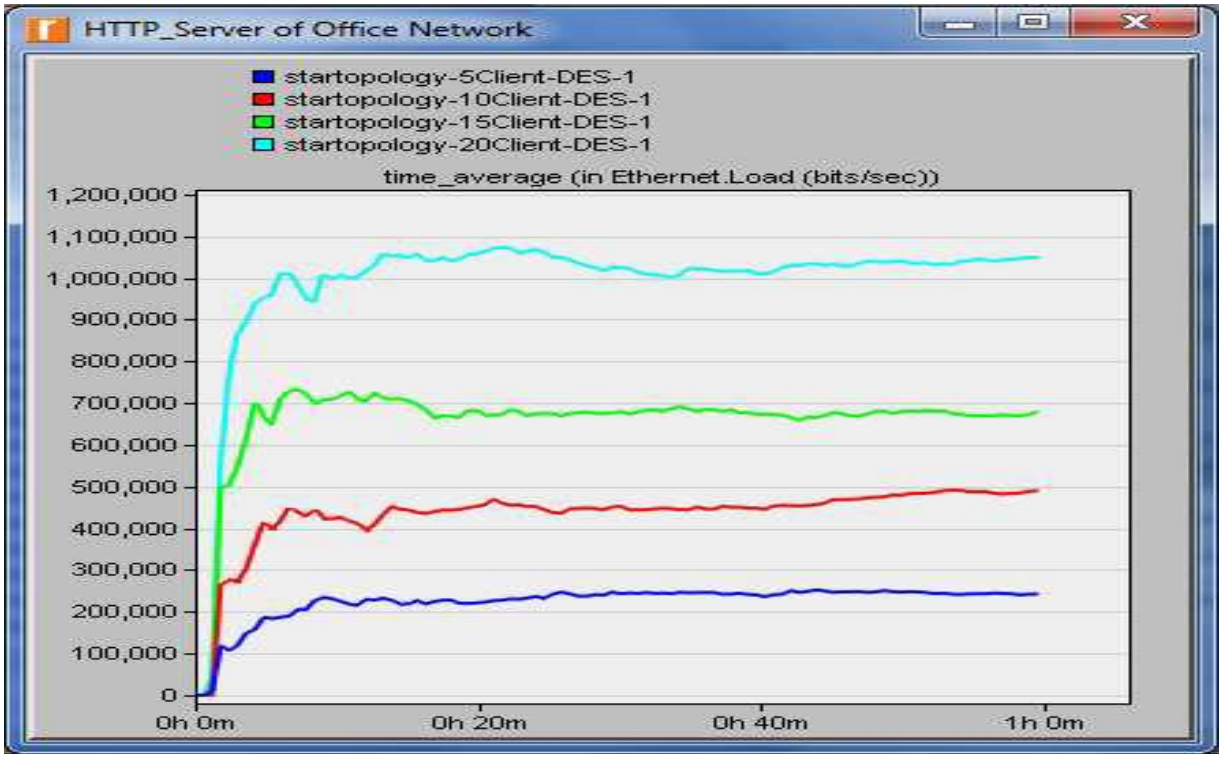


Figure 4.8. HTTP-Server-Load Comparison of the Four Evaluation-Scenarios for 3TA Using OPNET-Tool

4.4.2 Results Obtained for Large Number of Clients Using OPNET Tool

The second part is related to scenarios that have been proposed utilizing large numbers of client to as maximum as maybe close to the real conditions. Thus (100, 1000 and 10,000) clients have been proposed as prototypes to simulate three networks connected via (Router). These clients are likewise used to participate in these scenarios for both 2TA and 3TA.Figure 4.9. Represents scenario-1 organization; both of HTTP application programming and database are at the similar server. The server is connected to the three networks via a Router. This structure has been proposed when assuming that the connected three networks will be connecting in turns to the server-hosts via a router. This assumption will disregard the drawbacks and issue of the Internet. Figure 4.10. Represents the (HTTP + Database)-Server time-delay and its load measured by (bits/Sec.) for 2TA of the assessment scenario-1 showed in Figure 4.9.Utilizing OPNET-tool. While the server load that measured by (Requests/Sec.) for 2TA of the evaluation-scenario-1 is showed in Figure 4.11. Because of the large packet-traffic for this test, the simulation has been implemented for several minutes relying on the RAM-size of the utilized computer. It can be appeared from Figure 4.10. That the average time delay of the server will stay at certain level at the start and will be increased after reaching the packet-traffic within the system to the rated level While the server-load will be increased rapidly for the rated packet-traffic. There is a large hole between these outcomes comparing with those of Figure 4.3. And Figure 4.4.For the similar architecture (2TA) but utilizing (5, 10, 15 and 20) clients for both server delay and server-load individually. . As additional outcomes -field, the rate of the requests/second has been resolved at the server as appeared in Figure 4.11. It is clear that at the second 100 which is equivalent to 1min+40sec of the Figure 4.10. With begin the real packet-traffic.

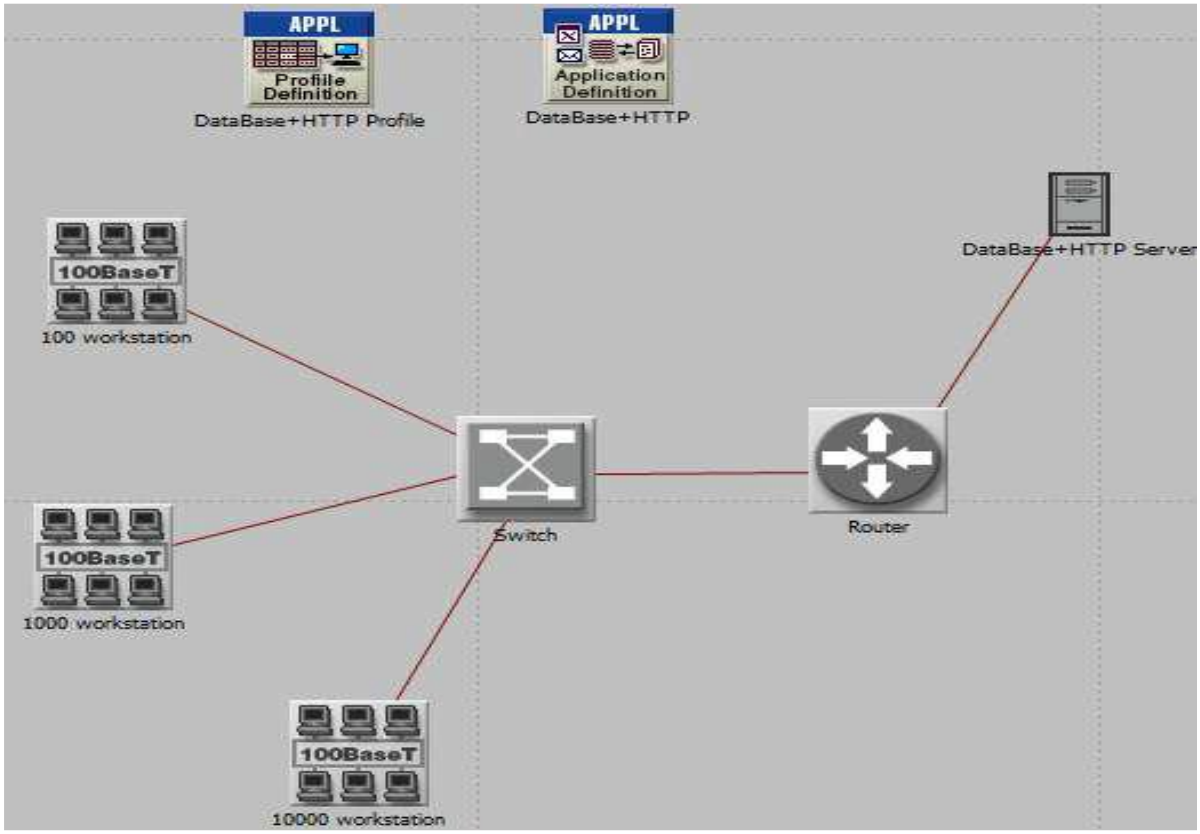


Figure 4.9. Evaluation-Scenario-1 with Three Different-Size-Networks Connected to Server via a Router for 2TA Using OPNET-Tool

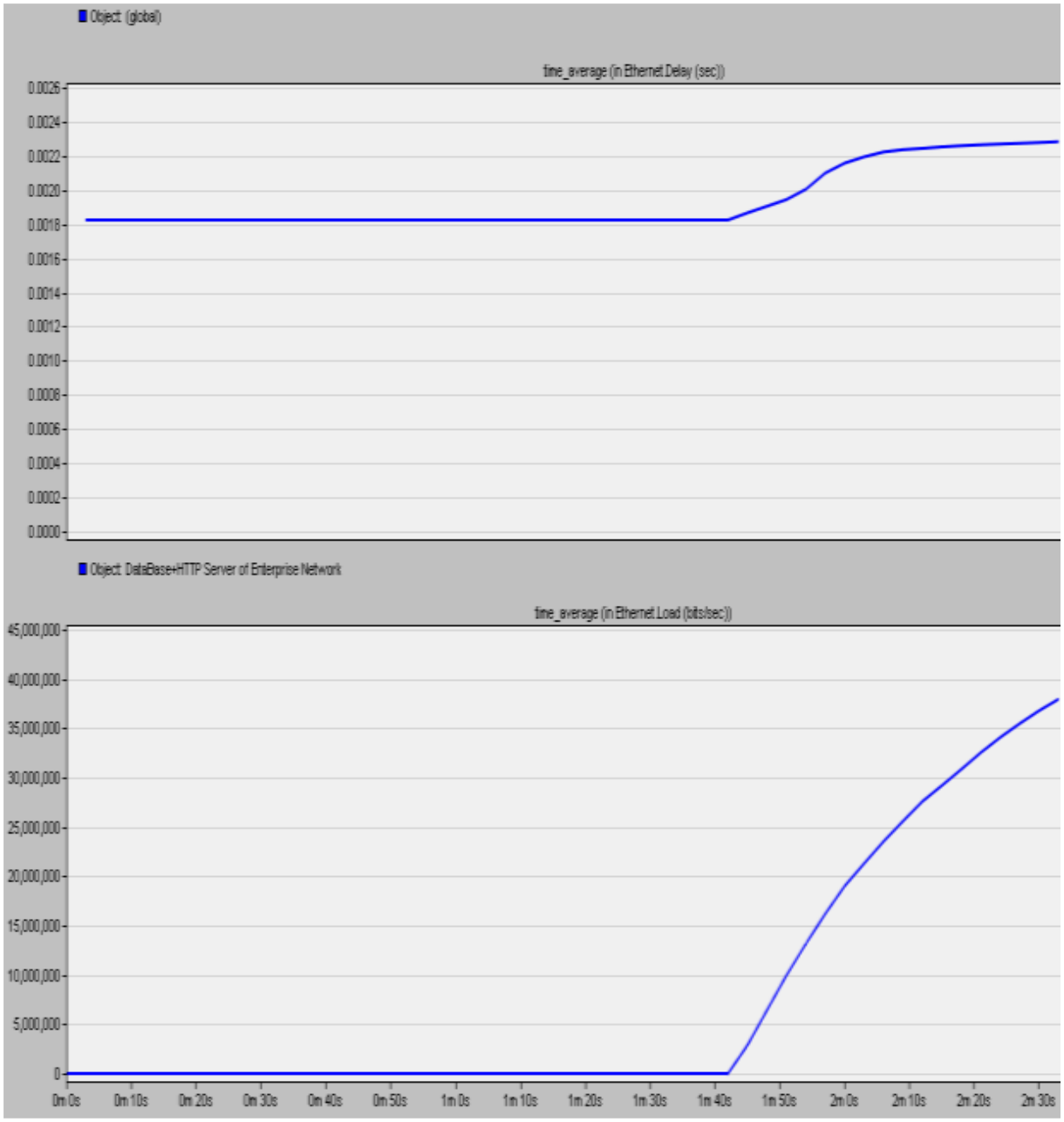


Figure 4.10. (HTTP + Database)-Server Delay and Load (Bits/Sec.) for 2TA of Figure 4.9. Using OPNET-Tool

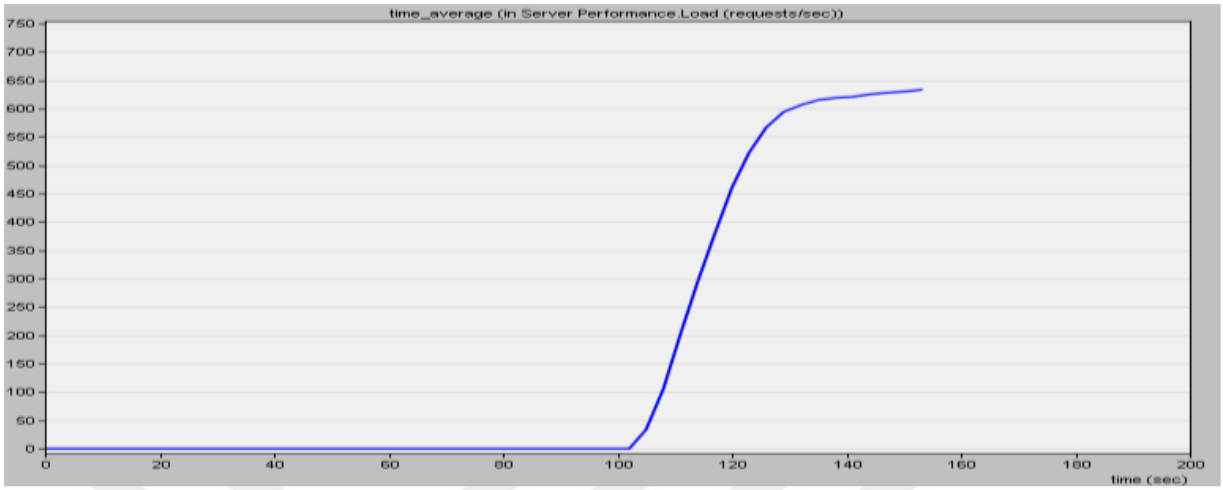


Figure 4.11. (HTTP + Database)-Server Load (Requests/Sec.) for 2TA of Figure 4.9. Using OPNET-Tool

Figure 4.13. Represents the database- server time-delay and its load measured by (bits/Sec.) for 3TA of the assessment scenario-2 as delineated in Figure 4.12.Utilizing OPNET-tool. While the HTTP-server load measured by (bit/Sec.) for this scenario is illustrated in Figure 4.14.The HTTP-server load measured by (Requests/Sec.) for this scenario is delineated in Figure 4.15.The upper curve of Figure 4.13.Shows that the average value of the data base server- delay has roughly steady-state until (100 Sec.) Then the load has been increased rapidly to reach its rate of packet-traffic changes. While, the lower curve shows that there is around no load at this server, because the really load will be done at the http-server, and the connection of the Data base-server with the clients-side is via http-server. Because of the packets-traffic, the http-server time-delay and load will begin at (100 Sec.) and increase rapidly to reach their rate values as appeared in Figure 4.14.And Figure 4.15.Respectively.

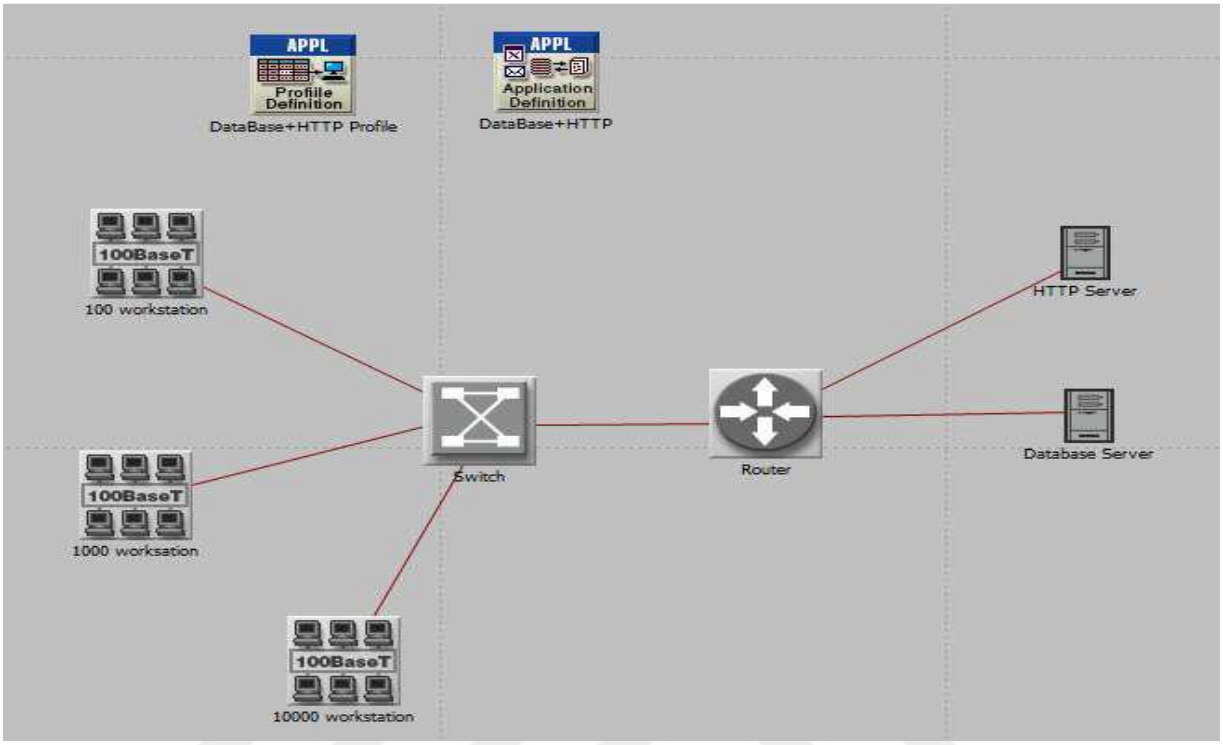


Figure 4.12. Evaluation-Scenario-2 with Three Different-Size-Networks Connected to Servers via a Router for 3TA Using OPNET-Tool

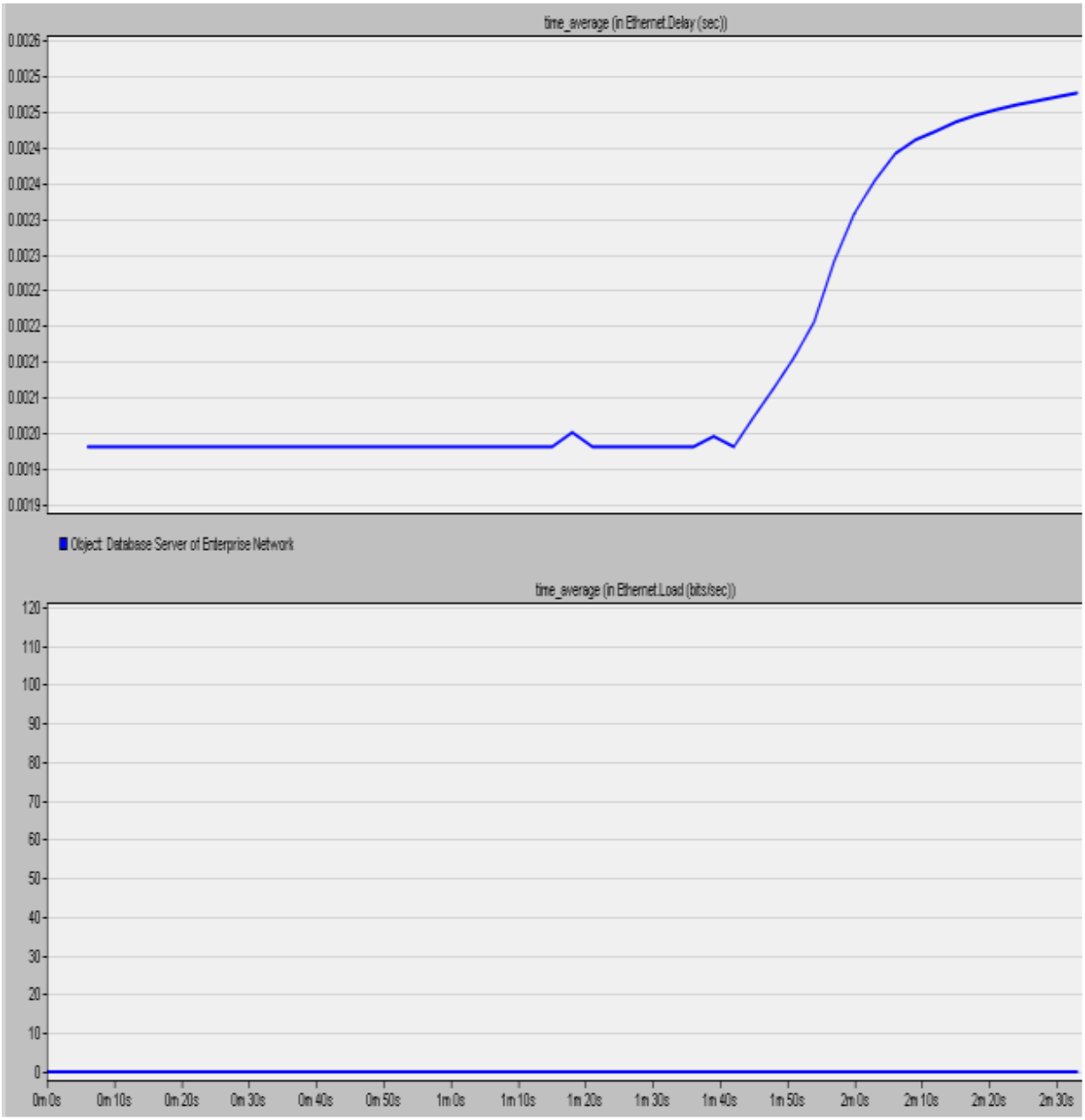


Figure 4.13. Database-Server Delay and Load (Bits/Sec.) for 3TA of Figure 4.12. Using OPNET-Tool

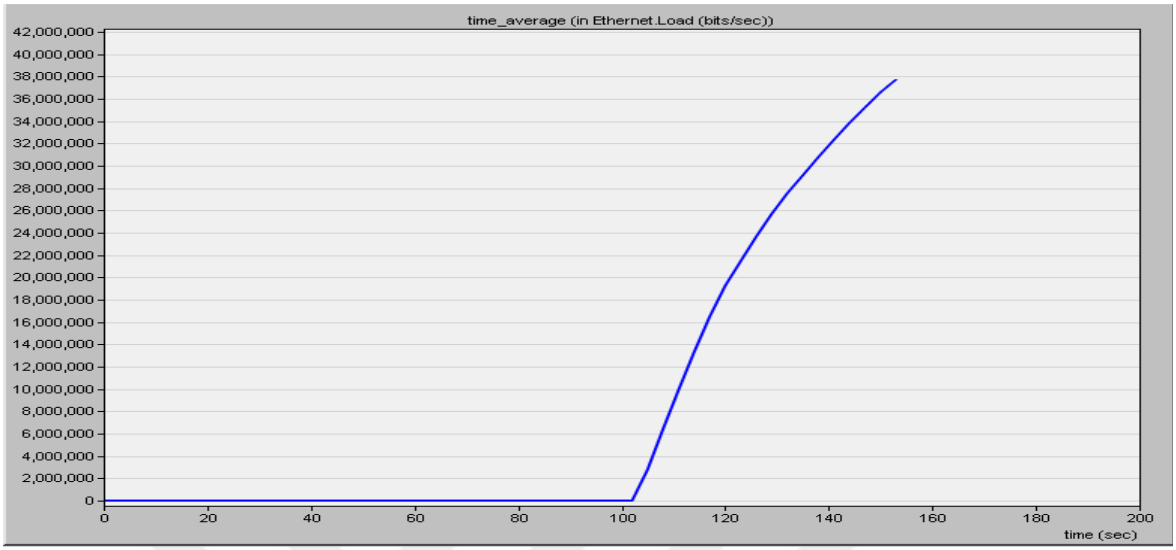


Figure 4.14. HTTP-Server Load (Bits/Sec.) for 3TA of Figure 4.12.Using OPNET-Tool

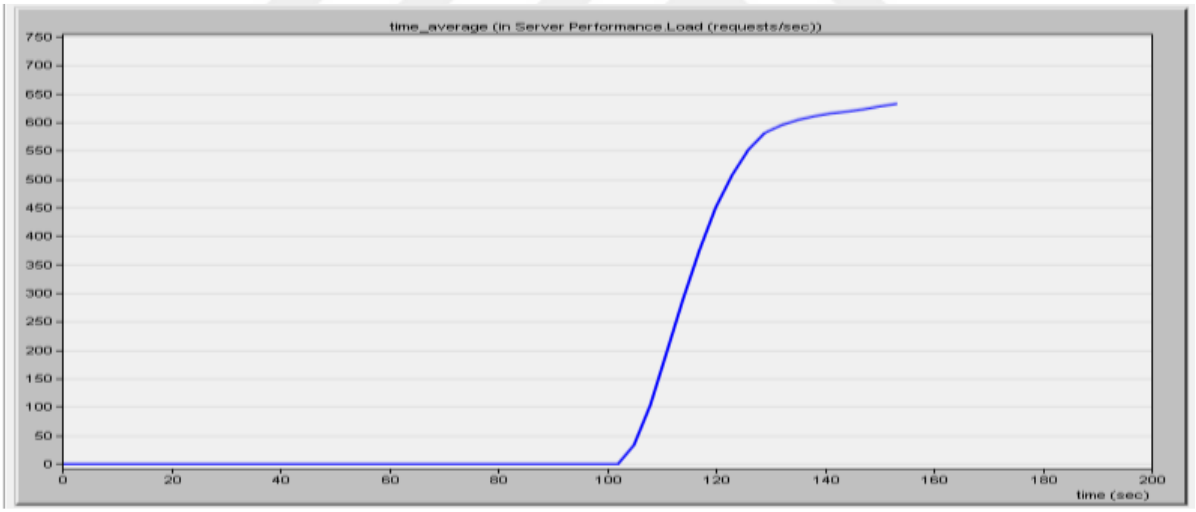


Figure 4.15. Total- HTTP-Server-Load (Requests/Sec.) for 3TA of Figure 4.12. Using OPNET-Tool

4.5 Evaluation and Comparison

The general evaluation of the proposed framework demonstrates that the 3TA is perfectly reliable with optimum outcomes for both mentioned techniques. This section deals with two main parts; the first part deals with the comparison related to both architectures of the proposed system (2TA and 3TA). There are two architectures adopted in this thesis. 2TA means that there is just one PC at the server-side, while 3TA contains two computers as a

server. Due to the lack of previous work in this field, there is no chance to compare the results of this thesis to any other previous work. Besides, professional simulation programming for measuring network-performance and network path determination namely (OPNET) is depended in this work, taking into consideration that there is no other previous work which have utilized all these assessment tools in one work. The nearest work to this thesis is Giyath [16]. Who utilized the similar tier architectures? But, still the number of clients that have been depended in this thesis is greater than those depended in his thesis who utilized just (10 clients for lab testing); this thesis, notwithstanding, depended (20 clients for lab testing). The thesis takes the lead in adopting the OPNET tool and expands the testing of up to 10,000 clients. For purposes of comparison between the features of the system developed in this thesis and those of previous related works, the bellowing points must be taken into consideration:

1. There is no previous detailed; literature tackling the architectures 2TA and 3TA as handled in this thesis, including the performance assessment methods.
2. The full statistical capacities of every service produced by the framework are presented in the present thesis. No other previous work conducted No different steps except for [40].

This investigation gave strength points to this thesis and supported additional improvements to the structure of programming the related.

5. CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK

5.1 Conclusion

The era of modern technology has could get up advanced level in many directions for the whole of society, especially with speedy system and quality assurance. Such as: without wasting time**.** Depending on the obtained results from this system that proved by evaluator software OPNET modeler, the performance of the system using 3TA was more accurate than that of 2TA. As a result of using two servers in 3TA, high security is provided by splitting both of application-HTTP-server and Database-server. Adding to that, using OPNET simulator as a professional evaluation and designing tool and an important performance evaluation tool indicated the efficiency of 3TA than that of 2TA. Evaluations to the network rely on using for (OPNET) tool so as to check up the system with both of these designs (2TA and 3TA). The result of the work could declare that the (3TA) is stronger than (2TA) to protect data and a little used time, with the way divide or classified server for two types (Http-server) and (Database-server) and this is causes to get a skillful and activism system, and it deals with a very magnificent networks with a thousand or millions users

5.2 Suggestions for Future Work

. The following suggestions can be taken into consideration for future research work:

1. Designing and implementing human resource management system related to the administration part. Applying the details proposed by this system about additional services such as: emergency section, operation rooms.

2. Depending on the proposed system that has been designed, implemented and evaluated, the next phase will be connecting the hospitals within each city together. This step can be applied after walking big steps in the direction of e-government applications. And hence, these cities can be connected together to build an efficient system.

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Appendix: Network Mechanism Using OPNET Simulator

Steps in general form to connect any network using OPNET simulator:

1. Network contains many computers work as a clients connected by each other using transmission medium and network devices such as switch, router, and hub….etc. And likewise one server or more depends on the proposed network.
2. Transmission mediums that used to connect the network were twisted pair cables with data rate equal to 100 Megabits/sec which means data are transmitted 100 mega per one second
3. The servers that connected to the network were HTTP and Database servers. The HTTP server has been assumed to be (Heavy browsing) while the Database server to be (High Load Database).
4. Many parameters such as delay (sec.) and Load (bits/sec.) are used to measure the performance of a complete network.

Steps to create a network and obtain results using OPNET Simulator Project and Scenario:
When creating a new network model, you must first create a new project and scenario.
Project:
A project is a group of related scenarios that each explores a different aspect of the network design. Projects can contain multiple scenarios. Once you have created a new project, you can use the Startup Wizard to set up a new scenario.

Adding Components:

- If it is not already open, open the object palette by clicking on the Object Palette action button (first button on the left).
- Find the Ethernet client (computers), Switches, Ethernet server and any other devices you want to used it in the network in the palette and drag it into the workspace.
- Find the 100 Base T link object in the palette, click on it and drag it to the Workspace

Finally, you need to add configuration objects to specify the application traffic that will exist on the network.

- Find the Application Config object in the palette and drag it into the workspace.

- Right-click to indicate you are finished placing this kind of object.
- Find the Profile Config object in the palette and drag it into the workspace.
- Close the object palette

Statistics:

- Now that you added the traffic, you are ready to collect some statistics.
- There are two ways to collect statistics:

A) You can collect statistics from individual nodes in your network (object statistics).

B) From the entire network as a whole (global statistics)

Global Statistics:

Global statistics can be used to gather information about the network as a whole. For example, you can find out the delay for the entire network by collecting the global Delay statistic:

- Right-click in the project workspace and select Choose Individual Statistics from the Workspace pop-up menu
- Click the plus sign next to Global Statistics in the Choose Results dialog box
- Click the plus sign next to Ethernet
- Check the box next to Delay (sec) to turn on collection
- Click OK to dismiss the Choose Results dialog box

Run the Simulation:

Now that you have specified the network, traffic, statistics to collect and saved the project, you are ready to run your simulation. To run a simulation:

- From the Simulation menu, choose Configure Simulation. Note: You can likewise open the Configure Simulation dialog box by clicking on the Configure Simulation action button.
- Type for example 30 minutes in the Duration

View Results:

To view the server Ethernet load for example of the simulation:

- Right-click on the server node chooses View Results from the server's Object pop-up menu. The node's View Results dialog box opens.
- Click on the arrow next to Ethernet under Office network
- Click on the box next to Load (bits/sec) to indicate that you want to view that result
- Click the Show button in the View Results dialog box the graph of the server load appears in the Project Editor.

CURRICULUM VITA

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WORK EXPERIENCES

1. I Lecture from primary school and preparatory school.
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PUBLICATIONS

Bishar Rasheed Ibrahim: “Performance Measurement for Distributed Systems Using OPNET Principles” International Conference on Advance and Innovations in Engineering (ICAIE) 10 – 12 May 2017/ ELAZIG.