AIN SHAMS UNIVERSITY

LOCAL AREA NETWORKS PERFORMANCE EVALUATION

A THESIS

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BY

YASSER HESHAM DAKROURY

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PROF. HUSSEIN I. SHAHEIN

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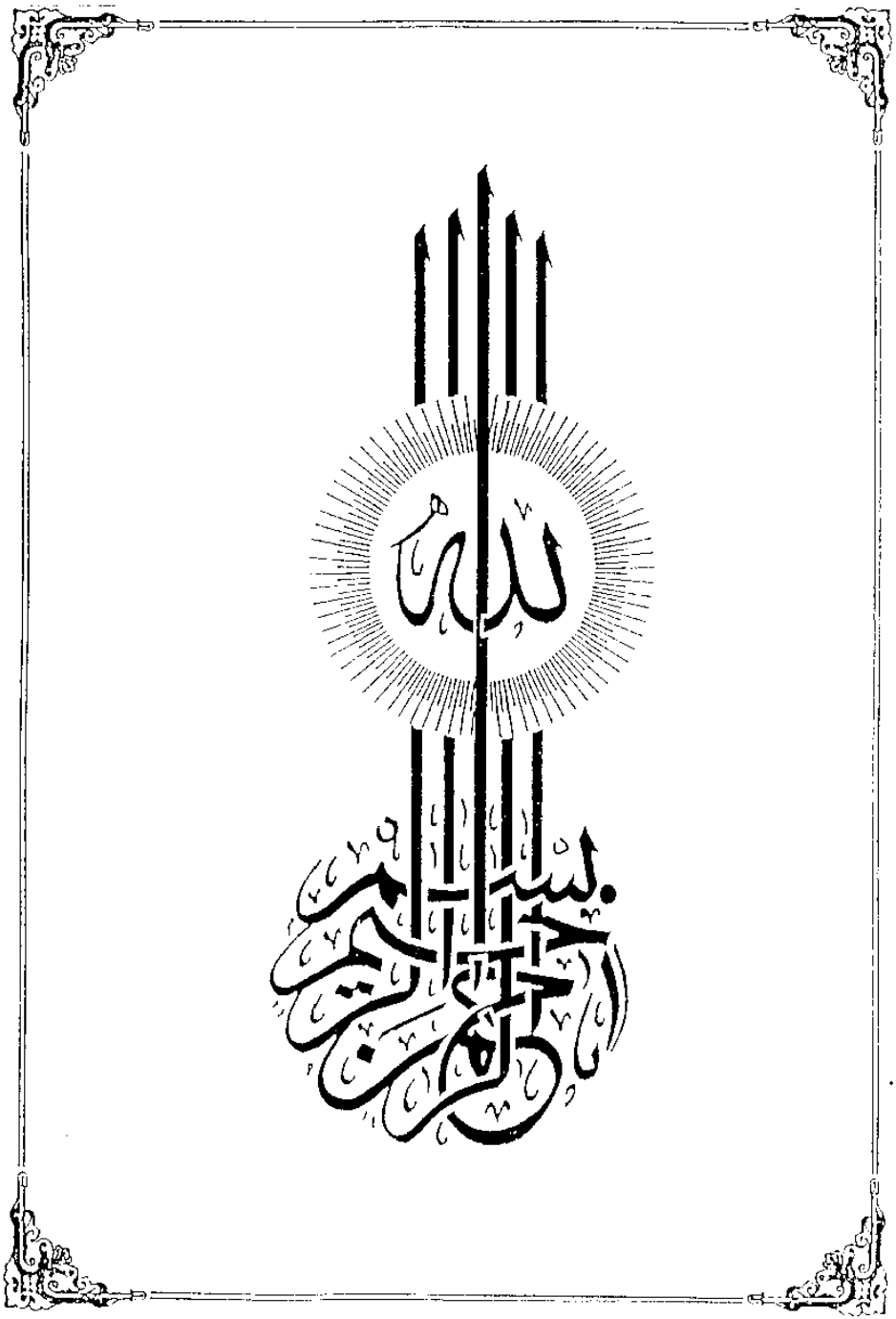
To my parents



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ABSTRACT

A comparative performance evaluation study for Local Area Networks (LANs) is presented in this thesis. Three major LAN protocols, namely Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Token Ring and Token Bus are considered in the comparative study. The medium access control of the three protocols is determined by the IEEE 802 standard specifications.

The performance is measured in terms of the delay-throughput characteristics. The thesis includes a comprehensive discussion about how the performance of the different LANs protocols is affected by the network parameters such as, the transmission rate, the number of nodes, the network distance and the packet length.

The work presents a novel algorithm for improving the performance of local area networks, which uses the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol under high traffic conditions. The basic features of this algorithm when compared with other techniques are : its simplicity and that it requires no hardware modification, hence no extra cost is required.

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A performance evaluation simulator is developed to evaluate the performance of the protocols under investigations. The simulator follows the IEEE 802 standard specifications. This simulator was built to help as a design aid for designers of LANs. Since, for a given network configuration, the simulator will display the throughput - delay curves, so that the designer can select the protocol with the best characteristics for his operating conditions.

Extensive simulation scenarios on the different LAN parameters ;namely , channel capacity , number of stations , network distance ,and packet length ,were carried out. The results obtained from these scenarios supports our claim.

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CHAPTER 1

INTRODUCTION

1.1. Introduction

The old model of a single computer serving all of the computational needs is rapidly being replaced by another in which a large number of separate , but interconnected computers , do the job . These systems are called Computer Networks .

Tanenbaum (1981) stated that :"A Computer Network is an interconnected collection of autonomous computers ". Two computers are said to be interconnected if they are capable of exchanging information . The connection need not be via a copper wire ;lasers , microwave , and earth satellites can also be used . From the above definition , the term autonomous computers means that the master/slave relation between computers is excluded .

1.1.1. Network Goals

There are three important goals for the computer network over the centralized computer system , which cause the centralized computer systems to give way to computer networks . The first goal comes from that many organizations already have a substantial number of computers in operation , often located apart . Interconnecting them

will make all programs , data and other resources available to any one on the network without regard to the physical location of the resource and the user .The second goal is that , a computer network can provide a powerful communication medium among widely separated people . The third goal is to provide high reliability by having alternative source.

Another important reason for distributing the computer power is the relatively low price of computers compared to communication facilities . In some applications data is generated at widely scattered locations . Instead of transmitting all the data to a central computer center somewhere, a computer can analyze the data at the place where it is captured , and only send occasional summaries back to the computer center to reduce the communication cost , which now represents the largest percentage of the total cost . This approach results in a Computer Network [1] .

1.2. Local Area Network Definition

A Local Area Network (LAN) is a data communication network , typically a packet communication network , that provides interconnection of a variety of data communicating devices within a small area . In other words it is a resource sharing data communication network , which is limited in geographic scope . There are three elements of significance in this definition.

First , a local area network is a communication

network , not a computer network.

Second , the data communication over devices can include any device that communicates over a transmission medium such as : Computers - Terminals - Peripheral Devices - Telephones- Television Transmitter and Receiver - Sensors (temperature , humidity , flow , etc.). Of course , not all types of local area networks are capable of handling all of these devices.

Third, the geographic scope of a local network is small. Generally , this is limited to a single building , a single work site or several buildings such as in a college campus [2,3,4] .

A Local Area Network is characterized by a numder of aspects:

1- High bandwidth in the range 0.1 Mb/s - 100 Mb/s .

2- Limited geographical scope in the range 0.1 - 25 Km .

3- Low error rate in the range 10^{-8} - 10^{-11} .

4- Low utilization .

5- Inexpensive transmission medium .

1.3. Local Area Network Benefits and Pitfalls

The desire to connect existing computer systems is not only the driving force for computer networking . The other main force is the superior price/performance ratio of small computers over large ones . Mainframes are roughly a factor of 10 faster than the largest single chip microprocessor , but they cost a thousand times more . This imbalance leads to the trials of replacing a large mainframe by a collection

of microcomputers to outperform them at a lower cost . This goal leads to design a system that consists of many processors located close together , called a local network . In addition to a favorable price/performance ratio , local networks have many benefits that make people interested in building a local network .

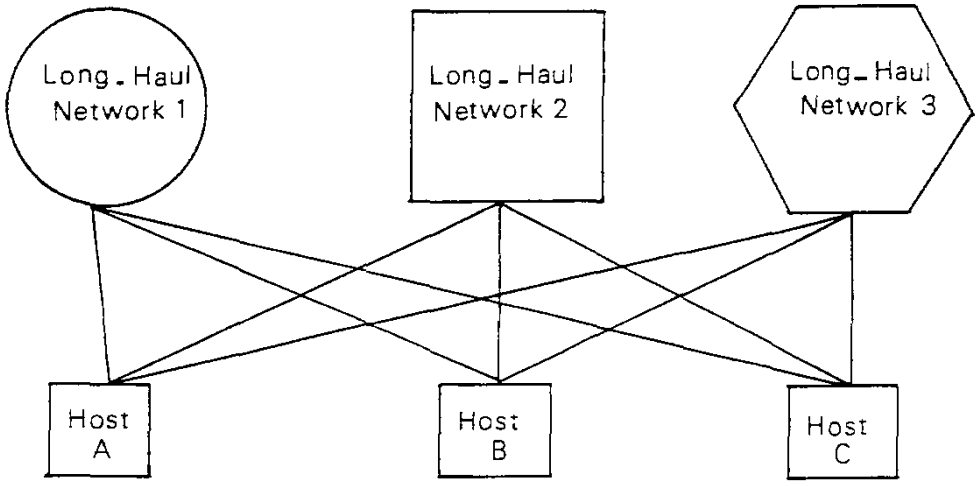
1.3.1. Local Area Network Benefits[4]

The most significant benefits for a local area network are :

1.3.1.1. Interconnection with Other Networks

Collecting together a collection of computers , terminals and peripherals located in the same building or in adjacent buildings , not only to allow them to intercommunicate but also to allow them to access a remote host or other network . In the absence of local networks , separate connections would be needed between the remote facility and each of the local machines , where as with a local area network the remote facility need only tap onto the local network in one place , as shown in figure 1-1.

In general , a local area network can provide an economical means of connecting a number of hosts within a small area to one or more long-haul networks . This cost saving can be worthwhile even in a situation in which local hosts are to be connected only to a single long-haul network, for two reasons . First , a host interface hardware for local



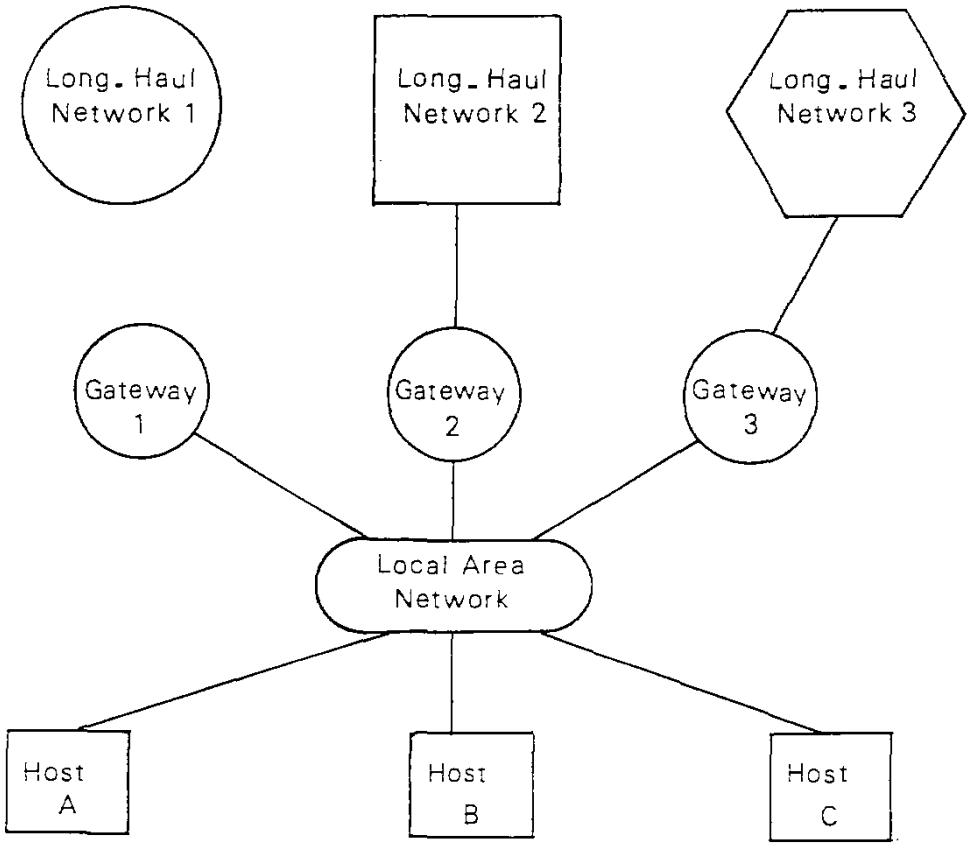


Figure 1-1 The "M*N" Problem and a LAN as one Solution to it [2].