CHAPTER 1
INTRODUCTION

1.1 NEED FOR THE THESIS

Computer Networks, an interconnected collection of autonomous computers, are commonly classified into Wide Area Network (WAN), Metropolitan Area Network (MAN), and Local Area Network (LAN). A Local Area Network allows for the interconnection of a number of terminals which are typically not co-located and which may often require rearrangeable connectivity.

The main motivations behind the development of LANs are:

# The declining cost and consequent increased use of computers;

# Rapid improvements in communication technology which have led to the merging of the disciplines of Computers and Communications resulting in a better utilisation of the resources;

# Network architecture is such that total connectivity is achieved and complex routing algorithms are not needed;
# Availability of standard protocols as per IEEE specifications;

# Better price/performances ratio than main frames;

# New resources can be added as they are needed or become available;

# Ability to share resources both hardware and software between users of the network.

The LAN topologies presently adopted include the bus, star, ring, tree and a hybrid of star and ring. Among the commonly used transmission media for LAN's, the twisted pairs are limited to low speed transmission, because they are susceptible to noise and interference including cross-talk. Coaxial cables provide higher throughput and support a large number of devices and span greater distances. Optical fibers, as transmission medium, provide still higher performance [1,5], characterised by the following attributes:

* Larger bandwidth/data rate
* Very low bit error rate
* Low attenuation
* Immunity to EMI and RFI
* No ground loops and cross-talk
* High security
* Light weight and small size.

Although LAN applications encompass mainly office automation, the present trends are towards heterogeneous computer integrated manufacturing applications such as university laboratory research, and public administration. These applications involve constraints in throughput, number of access points, spanned area, offered services and reliability on the existing communication systems. To meet these demands, a new high speed communication system capable of integrating all these services is needed. Such networks with optical subsystems form the subject matter of several publications, e.g. [1] - [5].

Schmidt et al developed an Optical LAN [6], that uses Carrier-Sense Multiple Access (CSMA/CD) protocol for medium access. In this network, called FIBERNET-II, an active star repeater is used to create the equivalent of baseband coaxial cable. Another version of an Optical LAN, reported by Lee et al [7], termed as HUBNET, employs a simple routed tree network structure. The Optical Local Area Network (OSLAN) developed in this Thesis is an enhanced version of FIBERNET-II [6], incorporating some of the features of HUBNET [7].
1.2 OBJECTIVES

The main objectives of the Thesis work are summarised below:

i) To analyse critically the features of important types of Fiber-Optic LAN's, vis-a-vis their implementations and performances;

ii) To develop and implement an OPTICAL STAR LOCAL AREA NETWORK which uses CSMA/CD protocol for medium access employing plastic fiber as medium;

iii) To realise an enhanced OPTICAL STAR LAN with glass fiber as link, along with Network Interface Software and Application Software;

iv) To develop mathematical models for throughput analysis and delay analysis; and

v) To compare the performance of OSLAN with existing BUS LAN, with experimental evaluation and verification.
1.3 AN OUTLINE OF THE THESIS

Following a review of the features of Fiber-Optic LAN's in Chapter 2, their implementations and performance are analysed, identifying their limitations and justifying the need for a new type of Optical LAN.

Chapter 3 gives an account of the design and development of Network Interface Card, Central Hub, Optical Transceivers, and Optical Link together with the software required for the networking. The enhanced version of OSLAN with intelligent hub and glass fiber is investigated in Chapter 4, highlighting its merits over the simple OSLAN. Mathematical models for throughput and delay analysis of the Optical Star LAN for CSMA/CD protocol as a medium access are developed in Chapter 5.

In Chapter 6, discussions on performance evaluation in terms of throughput and delay for various values of offered traffic are included and a comparison made with the BUS LAN. Also the throughput and delay characteristics of Optical Star LAN, are studied on an experimental set up, and the results compared with the mathematical models of LAN.
The major findings and contributions of the Thesis work are summarised in Chapter 7 along with suggestions for further work in the areas of Fiber-Optic Local Area Networks. Appendices included (Appendix A through I) cover parameters of an Optical Star LAN, features of 82588 LAN controller, and procedure for designing Network Interface Card with PAL. Also included are details of a 5 m Fiber-Optic Link, specifications of plastic optical components, so also the design details for 500 m Fiber-Optic Link, PAL implementation for collision detection and signal retiming in Hub are also appended.