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# **An Investigation into Multimedia Local Area Networks**

A Thesis presented in partial fulfillment of the requirements for the degree of Master of Technology in Information Engineering at Massey University

SUSARLA UDAYA KUMAR

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## **Abstract**

In this thesis the performance of the Multimedia Local Asynchronous Transfer Mode Network (MLAN) protocol is evaluated by a computer simulation method using voice and data source models. SIMSCRIPT II.5, a discrete event simulation language is used for the simulation. In addition, Fiber Distributed Data Interface (FDDI) and Fast Ethernet networks were simulated for data traffic and their performance is evaluated using COMNET III, a communication network simulation package. The main aim of this work is to evaluate the performance of the MLAN and to analyse the suitability of MLAN for Multimedia Traffic. The work is further extended by comparing the performance of MLAN with FDDI and Fast Ethernet LANs. Simulation results show that MLAN protocol has some potential to operate as a Multimedia LAN. However, analysis shows that some modification of the protocol is required to increase the bandwidth utilisation.

## Acronyms

AAL	ATM Adaptation Layer
ABR	Available Bit Rate
ARP	Address Resolution Protocol
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband ISDN
BT	Burst Tolerance
CAC	Connection Admission Control
CBR	Constant Bit Rate
CDV	Cell Delay Variation
CDVT	Cell Delay Variation Tolerance
CLR	Cell Loss Ratio
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
DLPI	Data Link Provider Interface
DVI	Digital Video Interactive
ELAN	Emulated LAN
FDDI	Fiber Distributed Data Interface
GFC	Generic Flow Control
HDTV	High-Definition TV
IEEE	Institute of Electrical and Electronic Engineers
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPX	Internet Packet Exchange
ISO	International Organization for Standardization
ITU-T	International Telecommunications Union – Telecommunications
JPEG	Joint Photographic Expert Group
LANE	LAN Emulation
LAN	Local-Area Network
LEC	LAN Emulation Client

LECS	LAN Emulation Configuration Server
LES	LAN Emulation Server
LE_ARP	LAN Emulation ARP
LLC	Logical Link Control
LUNI	LAN Emulation User to Network Interface
MAC	Medium Access Control
MCDV	Maximum Cell Delay Variation
MCLR	Maximum Cell Loss Ratio
MCR	Minimum Cell Rate
MCTD	Maximum Cell Transfer Delay
MII	Media-Independent Interface
MPEG	Motion Pictures Expert Group
NDIS	Network Driver Interface Specification
NetBIOS	Network Basic I/O System
NNI	Network Node Interface
NTSC	National Television Standards Committee
ODI	Open Data Link Interface
P-NNI	Private NNI
P-UNI	Private UNI
PCI	Protocol Control Information
PCR	Peak Cell Rate
PHY	Physical layer
PMI	Physical Medium Independent
PMD	Physical Mmedium Dependent
PVC	Permanent Virtual Circuit
PVP	Permanent Virtual Path
QOS	Quality Of Service
SHD	Super High Definition TV
SVC	Switched Virtual Connection
TCP	Transmission Control Protocol
UBR	Unspecified Bit Rate

UNI	User-Network Interface
VBR	Variable Bit Rate
VCI	Virtual Channel Identifier
VC	Virtual Circuit
VF	Variance Factor
VPI	Virtual Path Identifier
VP	Virtual Path

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# Chapter 1

## Introduction

### 1.0 General Introduction

Until mid 80's, network traffic was almost entirely comprised of voice and data traffic. With the advancement of computer technology, there is an increasing demand for multimedia traffic that comprises of audio, video, image, graphics, text and data. Generally, multimedia traffic requires medium to high data transfer rate or bandwidth. Different compression techniques are used to reduce transmission bandwidth requirements. For example, an MPEG-2 session requires a bandwidth between 4-10Mbps, to transmit audio and video signals, while the projected required bandwidth for HDTV is between 5-30Mbps [1]. The multimedia traffic requirements are low latency, low jitter, lower packet loss etc.

Different high speed network structures have been proposed to support multimedia traffic in Wide Area and Local Area Network environments. Broadband Integrated Services Digital Network (B-ISDN) [2] standard has been developed to integrate various types of traffic. It can offer very high data transmission rate using optical fiber link. B-ISDN is a logical extension of the narrow band ISDN. The B-ISDN will be able to integrate all existing network technologies. In addition to that it will be able to support all future teleservices like video-on demand, video conferencing, high speed data transfer, videophony, home shopping etc. The need for a flexible network and advances in technology and systems led to the definition of the Asynchronous Transfer Mode (ATM) protocol. The ATM [3] protocol is the standard protocol for the B-ISDN and is standardised by the International Telecommunication Union-Telecommunications (ITU-T). ATM is also accepted as the technology to interconnect computers over ATM Local Area Networks by the computer industry in the ATM forum.

From the network architecture point of view, computer networks can be classified into three types of networks such as Local Area Networks (LANs), Metropolitan Area Networks (MANs), and Wide Area Networks (WANs). The classification is done

depending upon the distance the corresponding network is designed to span. While LANs cover an area of a few Km, on the other hand MANs cover an area of up to several tens of Km. WANs are generally supported by public carrier services which link users separated by geographically wider distances.

Use of high-speed data and multimedia applications such as voice, video, graphics etc. have been increasing rapidly in local and wide area network environments. Such integration yields several benefits such as the economy realized by the shared usage of resources. Other benefits of integration are the ease of use of data resources such as file servers for voice applications; and the facilitation of added functionality in data applications, for example, voice annotation of text files and electronic mail [4]. As the services like voice, video, fax, graphics etc. are integrated on to the same LAN, the protocols designed primarily for data transmission may not be suitable to meet the requirements of the multimedia traffic [3]. Therefore, significant amount of research has been carried out [5,6,7,8] to integrate data, voice and video traffic on to a Local Area Network.. These new applications continue to make increasing demands on the performance of LANs. LANs are, therefore, required to provide not only high channel throughput, but also satisfy stringent delay requirements. To meet these increasing demands, it is essential that future LANs be capable of operating at much higher data rates achieving high channel efficiencies and lower delay. Operating at data rates ranging from several Mbps to several Gbps, an ATM network with its flexible traffic handling capacity and high data transmission rate could be able to support the multimedia services.

With the increasing demand for multimedia services, a shared media ATM LAN (a non-switch based) spanning relatively shorter distances of a few km and operating in native mode may be a better choice than a switch based ATM LAN for the reasons enumerated below.

In a switch based ATM LAN

- i. Each terminal in the user group requires a direct full duplex link to the ATM switch
- ii. All intra-campus traffic of an organization passes through the ATM switch, which need to relay the same message on all links resulting higher resource requirements for the ATM switch.

Hence, the cost of the ATM switch, its installation, operation, and maintenance need to be considered. Therefore, ATM LAN emulation is desirable as a backbone network connecting terminals/workstations and traditional local area networks. However, a shared media LAN based on ATM technology could be an alternative low cost choice for certain multimedia applications.

### **1.1 Aim of the Research**

The main objective of this work is to simulate the Multimedia Local Asynchronous Transfer Mode Network (MLAN) protocol [9] for voice and data traffic in order to evaluate the performance of the protocol. Performance of the MLAN is evaluated by the computer simulation technique, using Data and Voice traffic models.

The performance of MLAN was compared with two existing high-speed LANs. The existing LANs used for this study are the Fiber Distributed Data Interface (FDDI) [10,11,12,13] and Fast Ethernet (100base-T) [7,14]. The FDDI and Fast Ethernet models were simulated using the COMNET III, a communication network simulation package. These high-speed LANs' performances were evaluated in terms of throughput, end-to-end delay, channel efficiency, and ability to integrate different services. Finally, the performance of MLAN was compared with that of FDDI and Fast Ethernet using the above parameters.

## **1.2 Thesis Structure**

Chapter 2 presents an overview of ATM for multimedia communication. In this chapter, the multimedia traffic requirements are discussed. Some of the existing network technologies and protocols, which support multimedia applications, are also discussed. A brief introduction of the ATM protocol is given along with the capabilities of ATM to support multimedia applications in the context of a Local Area Network. In addition, traffic management issues in ATM networks are also discussed.

In chapter 3, the architecture of a generic LAN, along with the architectures of ATM LAN and MLAN are discussed. The requirements of ATM LAN in the context of multimedia communication are also briefly discussed. The MLAN protocol is discussed in detail and a comparison of the architecture of MLAN is made with that of ATM LAN, FDDI, and Fast Ethernet.

In chapter 4, the simulation models of the traffic generators (data and voice) along with the simulation model of MLAN protocol is discussed. The salient features of the discrete event simulation language are explained. An overview of FDDI and Fast Ethernet protocols is also given. The simulation results of FDDI and Fast Ethernet using COMNET III are discussed. Finally, a comparison of MLAN is made with that of FDDI and Fast Ethernet using the simulation results.

In chapter 5, the conclusions drawn from the simulation of MLAN is presented along with that of FDDI and Fast Ethernet. Finally, the scope for future work in MLAN is discussed.