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THESIS

WEB-BASED NETWORK MANAGEMENT CONFIGURATION FOR THE INDONESIAN EASTERN FLEET WIDE AREA NETWORK

by

Halomoan Sipahutar

March 2001

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This thesis presents a model of an integrated wide area network using web-based network management to support fleet operations of the Indonesian Eastern Fleet. It surveys possibilities for improving the Indonesian Eastern Fleet's computer communications network systems to provide a fast, reliable, and effective way of gathering and distributing information to all fleet units. A standardized LAN infrastructure and the use of an appropriate network hardware and software was recommended to achieve connectivity of all main naval base LANs in an integrated WAN. This thesis provides a design of the Indonesian Eastern Fleet WAN that was tested using a leading edge simulation tool, EXTENDv4. A feasible sized WAN communication architecture was modeled utilizing scaling techniques, which simulated the operation of the Indonesian Eastern Fleet WAN that linked six Fast Ethernet LANs configuration in a one worksheet PC wide screen. A reliable wide area network design using ISDN 128 Kbps and T1 line 1.544 Mbps has been proved in this thesis by executing tests and simulation runs using EXTENDv4 software simulation program.

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WEB-BASED NETWORK MANAGEMENT CONFIGURATION FOR THE INDONESIAN EASTERN FLEET WIDE AREA NETWORK

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Lieutenant Colonel, Indonesian Navy
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ABSTRACT

This thesis presents a model of an integrated wide area network using web-based network management to support fleet operations of the Indonesian Eastern Fleet. It surveys possibilities for improving the Indonesian Eastern Fleet's computer communications network systems to provide a fast, reliable, and effective way of gathering and distributing information to all fleet units. A standardized LAN infrastructure and the use of an appropriate network hardware and software was recommended to achieve connectivity of all main naval base LANs in an integrated WAN. This thesis provides a design of the Indonesian Eastern Fleet WAN that was tested using a leading edge simulation tool, EXTENDv4. A feasible sized WAN communication architecture was modeled utilizing scaling techniques, which simulated the operation of the Indonesian Eastern Fleet WAN that linked six Fast Ethernet LANs configuration in a one worksheet PC wide screen. A reliable wide area network design using ISDN 128 Kbps and T1 line 1.544 Mbps has been proved in this thesis by executing tests and simulation runs using EXTENDv4 software simulation program.

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I. INTRODUCTION

A. BACKGROUND

The Indonesian Navy consists of integrated weapon systems that include warships, aircraft, naval bases and Marines. The responsibility of the Indonesian Navy is vast, and encompasses 17,506 Indonesian islands widely scattered from west to east. Indonesia has 1,222,466 square miles of sea area and 782,665 square miles of land area inside the unified archipelago country. The Indonesian Navy has two fleets: the Indonesian Western Fleet, responsible for the western region of Indonesia's sea territory, and the Indonesian Eastern Fleet, responsible for the eastern region of Indonesia's sea territory.

Computer communication network in the Indonesian Eastern Fleet are supported from the four main naval bases: Surabaya, Ujung Pandang, Bitung, and Jayapura, which are designed to connect remote naval bases and all naval units dispersed through the entire eastern region. Information systems play an important role in enabling the Indonesian Navy to execute fleet operations all over the country. The Indonesian Eastern Fleet has identified that improvements in its information systems especially its network infrastructure and connectivity are required in order to obtain an effective and efficient naval fleet. The Indonesian Eastern Fleet Network has communication system resources such as telephone, radio-link, microwave-link and satellite systems. Those existing communication system resources are still not linked for optimal data communication exchange to computer systems in local area networks (LANs) or in an integrated wide area network (WAN). This thesis will recommend a method for implementing an

integrated wide area network using web-based network management to utilize the existing computer communication systems in the Indonesian Eastern Fleet.

The arrival of the information age has led to an explosion of distributed users, databases and communications networks in the military sector as well as in the commercial sector. Computer networks today have evolved into complex and often tangled systems. The primary reasons for networking computers are to share information, to share hardware and software, and to centralize administration and support. Effective local area networks (LANs) and an integrated wide area network (WAN) are required to achieve connectivity of the Indonesian Eastern Fleet Network.

Organizations adopting LANs and WANs must also adopt clear techniques and tools to tame these beasts. The organizations that become over reliant on their networks could experience devastating results if down time were encountered. The network administrator's job has become increasingly critical to manage and control the operation of the network. Network management can be defined as the processes and techniques that ensure an organization's network is operating properly and efficiently. The Indonesian Eastern fleet requires the appropriate system to manage and control its network. The implementation of a web-based network management appears to be well suited to support the Indonesian Eastern Fleet's missions and operations. There is a wealth of knowledge that can be effectively captured and transferred wherever needed within the Indonesian Eastern Fleet Network.

B. PURPOSE

The objective of this thesis is to present a model of an integrated wide area network using web-based network management to support fleet operations of the

Indonesian Eastern Fleet. It surveys possibilities for improving computer communications systems to provide a fast, reliable, and effective way of gathering and distributing information to all fleet units. This thesis recommends a standardized LAN infrastructure and the use of common network hardware and software to support web-based network management of the Indonesian Eastern Fleet Network. It reviews current technologies and provides an assessment for future use.

C. SCOPE AND THE ORGANIZATION OF THE STUDY

The scope of this thesis is limited to the following:

- A review of computer and communications networks, and a study research in designing the Indonesian Eastern Fleet Wide Area Network
- An in-depth review of web-server-based technology and Internet Information Server (IIS) 5.0
- An in-depth review of network management and security
- An evaluation of how computer and communications networks using web-based network management can be used effectively to support successful fleet operations
- Web-Based Wide Area Network design using the EXTEND-4 simulation software program

D. METHODOLOGY

The methodology used in this research consists of the following steps:

- Conduct an in-depth search and review of available books, magazine articles, documents, and other library information resources regarding computer networking, web-server technology, network management, and information technology management to acquire the ability to propose a successful information technology strategy
- Develop and administer a user requirements study
- Conduct a search of the Internet and websites for information from military and commercial sources

E. THESIS OUTLINE

This section provides an outline of the different parts of this thesis that explores the general concept of web-based network management and the specific client application

for improving the computer communication network systems in the Indonesian Eastern Fleet.

Chapter I: Introduction – provides a brief description of the development of computer communication systems in the Indonesian Eastern Fleet, the object of this thesis, and the organization of the study.

Chapter II: Problem Definition - describes the need for connectivity in the Indonesian Eastern Fleet Network to support successful fleet missions and operations.

Chapter III: Computer Communication Network - provides an introduction to the fundamental concepts of networks that is needed as a framework for understanding the concepts of network infrastructure, design and implementation.

Chapter IV: Designing Local Area Networks Infrastructure - provides the fundamental guide lines for designing LANs infrastructure, recommends a standardized LAN architecture, LAN connection options, and the selection of a network operating system.

Chapter V: Web-Based Wide Area Network Design - discusses WAN connection services, linking the network, and implementing an integrated WAN. Recommends the appropriate choice of WAN links service, WAN Hardware and Software. The last part of this chapter discusses managing the WAN using web-based technology.

Chapter VI: Describes the proposed WAN design using the EXTEND-4 simulation software program.

Chapter VII: Conclusion.

F. EXPECTED BENEFITS OF THIS THESIS

This thesis will become the foundation of web-based technology studies in the Indonesian Eastern Fleet to achieve the needed network management improvement. The integrated wide area network is expected to support the Indonesian Eastern fleet in making critical changes in how they do business, and ultimately result in increased readiness, contributory support, and overall effectiveness. Central to these benefits is the establishment of a standardized network infrastructure and making significant changes to business practices that will fully utilize the available technology.

The overall benefit of implementing a web-based wide area network is improved fleet readiness through a better computer communications network, real-time fleet support, training and information exchange, and a more responsive method of managing requests for support from the Fleet. Implementing a web-based network management enables the improvement of the organization through more efficiently sharing and gathering information. It enables users to combine knowledge and experience of the entire organization and to fully exploit information technology systems for strategic purposes.

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II. PROBLEM DEFINITION

A. MISSION

The mission and operation of the fleet can be conducted successfully if there is sufficient support from its existing system. The mission of the Indonesian Eastern fleet is to conduct daily sea operations to enforce the law at sea and to maintain sovereignty in the entire eastern sea territory of Indonesia. Coordination and communications systems are crucial to successful operation and to accomplishing the mission. An integrated decision making system and real time access to all relevant data and information are essential to successful fleet operations. This is the point at which information technology infrastructure becomes important; especially the establishment of the Indonesian Eastern fleet wide area network.

A reliable computer communication system is expected to provide an effective method to accomplish the fleet's missions and provide contributory support. It is an essential tool for carrying out the Indonesian Eastern fleet's mission given the complexities of coordinating the fleet. Naval base and naval unit location, unit placement and composition, and communication systems operations are among the factors affecting the fleet operations strategy. All of these components could be better administered with an integrated wide area network computer communications system.

B. THE REQUIREMENTS OF THE INDONESIAN EASTERN FLEET INFORMATION SYSTEMS

1. The Need for Connectivity

The Indonesian Eastern Fleet requires connectivity as a central concept in computer and communications networks. A military organization such as the Indonesian

Eastern Fleet relies on applications like database management systems, electronic mail, and integrated decision-making systems for supporting fleet operation. Any collection of independent computers in all office units in the Indonesian Eastern Fleet need to be able to communicate with one another over a shared network medium. Connectivity provides a means to individually address any device on a network. One aspect of information technology enhancements for the Indonesian Eastern fleet has been the implementation of a plan to establish a wide area network (WAN).

2. Effective Local Area Networks (LANs) and an Integrated Wide Area Network (WAN)

The Indonesian Eastern fleet needs a global, high-speed, interactive computer-network with adequate capacity for voice, video, and a wide range of data communication among its operational units including naval bases, warships, and aircraft. The suitable network would facilitate "just in time" transmission of Indonesian navy policies and positions as well as statements by navy leaders.

The Indonesian Eastern Fleet needs a network system that provides quick access to information via real time databases no matter what the time differences between fleet headquarters in Surabaya and all units in the entire eastern fleet operational area. This wide area network would enhance collaboration on regional strategies and policies across geographic boundaries at no additional cost.

3. Improved Access to the Internet and Other Information Services

The Indonesian Eastern fleet needs the link of computer communication systems that provides improved access to the Internet and other information services. The network would also result in substantial savings. This rapid, interactive network would

provide fast and cost-effective services that will improve the Indonesian Eastern Fleet's information system technology.

4. Minimize Costs

The improvement of Information Technology systems needs a lot of budget available. However, we need to minimize cost that will be spent on designing and building the network, so it will meet the Indonesian Eastern Fleet's budget allocation.

C. THE INDONESIAN EASTERN FLEET NETWORK

Local area networks (LANs) are currently being established in Surabaya main Naval base. The Indonesian Eastern Fleet headquarters is located here from where the communications systems for the entire eastern fleet area are managed and controlled. There are three LANs that are being established in Surabaya: the Indonesian Navy Eastern Fleet headquarters LAN, Surabaya main Naval base LAN, and Juanda Naval air base LAN. In the near future, local area networks are planned to be established in Ujung Pandang, Bitung and Jayapura. These local area networks will be connected together as an integrated wide area network. The improved Indonesian Eastern Fleet network system is required to effectively communicate within the Indonesian Eastern Fleet organization as well as with their Navy counterparts.

The use of computer systems in gathering and distributing information is essential to the daily operations of fleet units. Most operational and administrative offices in the Indonesian Eastern Fleet are equipped with computer systems. The fleet's four main naval bases and their remote naval bases are widely dispersed geographically. This wide dispersion has made it difficult and costly to integrate all the bases into a wide area network, whether by cable, satellite, or dial-up phone.

Computer communication networks are supported from the four main Naval bases in an integrated WAN and are designed to connect remote naval bases dispersed through the entire eastern region. The problem regarding long distance among those widely dispersed naval bases could be solved using web-based technology. An integrated WAN would be able to efficiently connect computer and communication systems in those diversified main naval bases and their remote naval bases. Fleet contributory support to the Navy gaining commands, administrative requirements, and training and exercises will be fulfilled more efficiently using an improved Indonesian Eastern Fleet Network.

D. DESIGN GOALS

The goal of this thesis is to recommend standardized local area network and wide area network configuration that will meet the requirements of the Indonesian Eastern Fleet. The primary goals for the new systems are efficiency, speed and high reliability. By interconnecting all of the Indonesian Eastern fleet's computer communication systems in an integrated web-based wide area network, we gain several advantages, such as improved efficiency, increased productivity, saving effort, seizing opportunities and reduced costs.

The integrated web-based wide area network should be able to take advantage of information systems support by linking all the existing computer and communication systems resources in all of the Indonesian Eastern Fleet units. It should also be managed by a proper network management system to ensure the network operation always run properly. With improvements in information systems technology, the Indonesian Eastern fleet can have effective and rapid access to various strategic planning systems. This

includes force structure and the development of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) capabilities.

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III. COMPUTER COMMUNICATION NETWORK

This chapter introduces the fundamental concepts of networks as a framework for understanding the concepts of network infrastructure, design and implementation. Networking deals with the technology and architecture of the communications networks used to interconnect communicating devices. A network consists of computers and other devices, the physical connection between them, and the additional hardware and software required to enable them to communicate with each other. Why are computer networks important? What motivates people to connect computers together? Sharing is the chief motivation for networking computers. A network enables us to share resources such as files, software application, and devices (hard disks, printers, modems, and so forth). Having a computer communication network enables our organization to work, cooperate and communicate with great efficiency.

A. DATA COMMUNICATION NETWORKING

The fundamental purpose of a communications system is the exchange of data between two or more parties. Electronic communications provide the means for the transmission, reception and processing of information between two or more locations using electronic circuits [Tomasi, 1998].

Many problems appear when multiple communicating devices are directly connected point-to-point. It is very expensive to string a dedicated link between two devices that are separated by thousands of kilometers. The other problem occurs when each node requires a link to many of the others at various times. The solution to this problem is to attach it to a communication network. A network is a group of computers

and various devices (such as printers and routers) that are joined together in a common network medium.

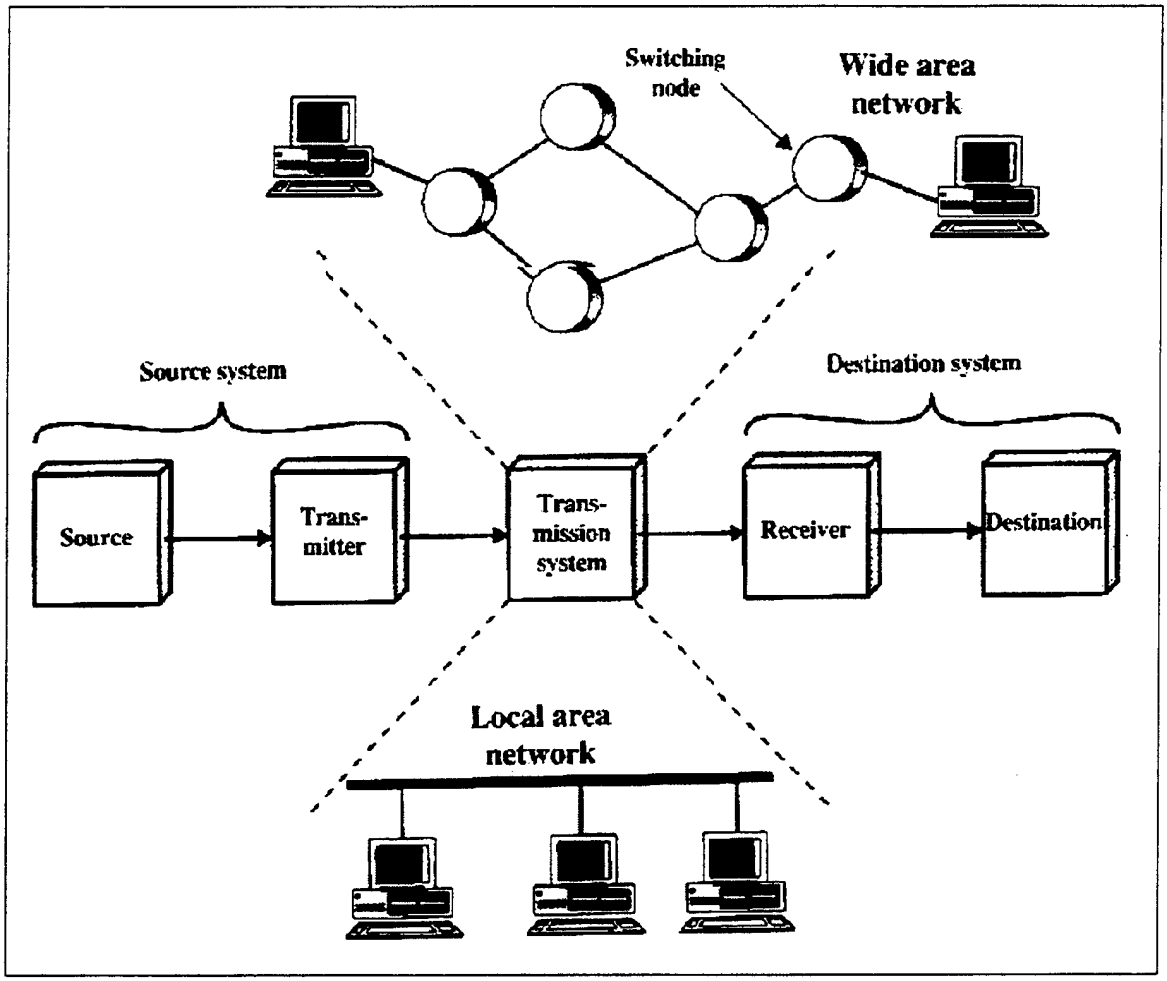

Figure 1. Simplified Network Model. [From Stallings, 2000, p.10]

Figure 1 illustrates the two major types of computer communication networks distinguished by their size and location, as a local area network (LAN) and a wide area network (WAN). A local area network (LAN) is the basic building block of any computer network. It is a group of interconnected computers located relatively close to each other which permits users to share information and resources. A LAN can range from a simple network with two computers connected by a cable, to a complex network

with hundreds of connected computers and peripherals throughout a major corporation. Within a building or campus-style corporate complex, a LAN would be used for:

- ***Interactive Computing:*** The LAN supports flexible database access and resource sharing among groups of users
- ***Switching among multiple host computers:*** LANs allow virtual circuits from a user to several computers
- ***Broadcast and flexible addressing:*** A LAN allows messages to be received by some or all users in a system

A wide area network (WAN) has no geographical limit. It can connect computers and other devices on opposite sides of the world. A WAN is made up of two or more LANs connected together. LANs support transmission over relatively short distances, while WAN's packet-switching technology support transmission in a large geographical area.

B. PEER-TO-PEER AND SERVER BASED NETWORK

Both peer-to-peer and server based exist as the configuration of the end systems of the networks. A peer-to-peer network is where each computer on the network is both a client and a server. All computers are equal, and each workstation functions independently in its administration and operation. A client on the network can access any other client's files, no single person is assigned to administer the resources of the entire network. Users are responsible for making shared resources available, maintaining applications and data on their own computers, installing and upgrading applications, and deciding who gets access to their shared resources.

In a server-based network, one or more computers act as servers and provide the resources to the network. The other computers are the clients and use the resources provided by the servers. A server-based network has a network administrator responsible

for managing the network. Shared data files, programs, and resources are centralized to one or more specially configured computers called a server. All network administration, security, and maintenance are managed by the network administrator. Client/server computing uses a powerful server to store data. The client workstation can process some or all of the requested data. The data is secure and easy to maintain because the file services are in one location on the server.

Centralization provides reliability and consistency in network administration. One advantage of server-based network is better performance, several computers can process applications in parallel. We can distribute application programs to the client computers and the database is processed by the server computer.

C. NETWORK TOPOLOGY

Network topology has an important role in designing a network. A topology is the physical layout of computers on a network. Topologies can be physical (actual wiring) or logical (the way they work). A network's topology is a map of the arrangement of its nodes and connections between them. There are several network topologies that we can choose among for the Indonesian Eastern Fleet network:

1. Bus Topology

In the bus network topology, we connect each node to the network along a single piece of network cable, called a bus. The bus provides the path for the data, and devices tap into the bus along its length to communicate with other devices. Data travels from a node out onto the bus until it reaches the ends of the cable. At each end of the bus, a device called a terminator is installed to prevent data signals from reflecting back onto the bus and causing errors. When the transmitted data hits the terminator, it does not go

any farther. The disadvantage of this topology is that if the single cable acting as the bus is severed at any point, the entire network goes down. Bus topology is used in the Ethernet LANs configuration.

2. Star Topology

In the star network topology, the computers network nodes are connected to a central device called a hub. Small LANs with less than eight nodes usually need only one hub. Larger networks may require many hubs, and hubs can be connected to each other to tie all the nodes together into a single network. Hubs are used to centralize the data traffic and localize failures. If one cable breaks, it will not shut down the entire network.

3. Ring Topology

The ring network topology is made up of an unbroken circle of network nodes. Each node is directly connected to its two immediate neighbors. The data is passed from one computer to another around the circle. If the ring is broken at any point along the way, the entire network stops functioning. This problem is solved in FDDI LANs configuration by using double-linked rings. Token Ring LANs and FDDI LANs configuration use the ring network topology.

4. Star Bus Topology

The star bus is a combination of the bus and star topologies by linking several star topology networks with linear bus trunks. It will not affect the rest of the network if one computer goes down. However if a hub goes down, all computers on that hub are unable to communicate, and if this hub is linked to other hubs those connections also will be broken.

5. Star Ring Topology

The star ring topology is a combination of the star and the ring topology. Both the star ring and the star bus are centered in a hub that contains the actual ring or bus. Linear-bus trunks connect the hub in a star bus, while the hubs in a star ring are connected in a star pattern by the main hub.

D. PASSING DATA ACROSS A NETWORK

Windows 95/98/ME, Windows NT 4.0, Windows 2000, and other network operating systems have implemented a layered, modular networking architecture. That architecture is based on an industry standard called the Open System Interconnect (OSI) Reference Model.

The OSI model defines an approach to networking in which each layer is responsible for a very specific portion of the networking function. It provides a framework for understanding the software and hardware components of networks and how they interact with each other.

Figure 2 depicts the OSI reference model that passes the data from one layer to the next in its journey from source to destination. It describes the flow of data in a network from the lowest layer, representing the physical network connection, to the highest layer, representing the services used directly by applications.

The data begins its journey at the highest layer on Node A and travels down until it reaches the physical network. The information travels over the physical network and arrives at the lowest layer on Node B. It then travels up on Node B until it reaches the application layer. On its way up through the Node B layers, the control information that

was added on Node A is stripped off, layer by layer, until the application receives the original data that was sent by the application on Node A.

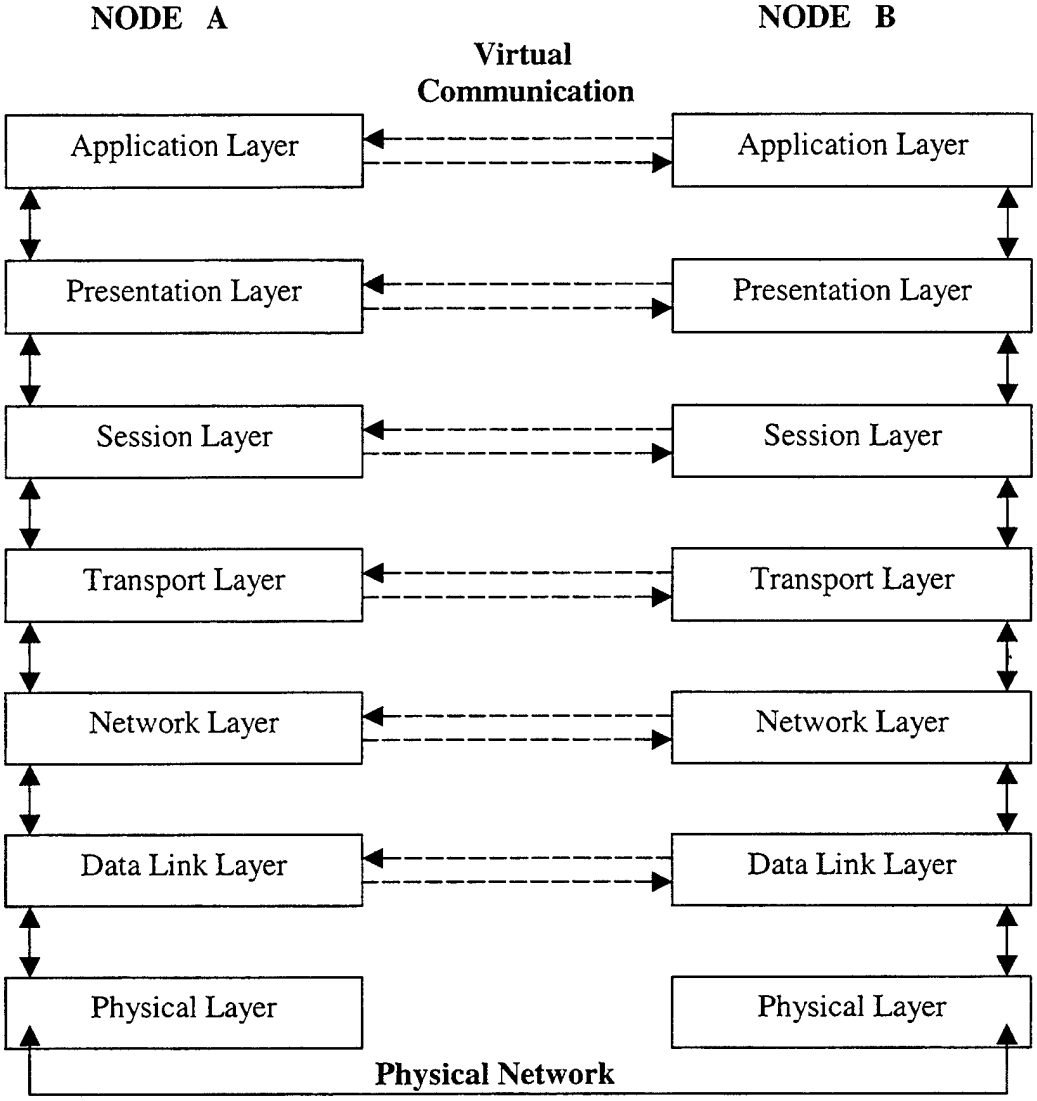

Figure 2. The OSI Reference Model.

The explanation below shows the roles and responsibilities of each layer in the OSI reference model:

1. Layer 1 - Physical Layer

The physical layer is responsible for transmitting raw binary data on the network cable. This layer is the closest to the network hardware and includes both the physical

specifications of how network nodes are connected, and the electrical details of how raw data bits are transmitted and received over the connection medium. It defines how data bits are represented when they are transmitted on the cable. A repeater operates exclusively at the physical layer of the OSI model. The data packets handled by the repeater are exactly the same coming in as they are going out. All other network devices that transmit or receive information on the network also operate at this layer.

2. Layer 2 - Data Link Layer

The Data Link layer packages the raw stream of data into data frames for transmission. A frame is a manageable, logical chunk of information that includes the data to be transmitted as well as information about its source and destination. It also includes information that helps the recipient of the transmission detect whether the data arrived intact. The data link is responsible for preparing data frames for transmission, receiving data frames, managing the network access method, and assuring error-free node-to-node communication.

The Data Link layer is divided into two sublayers: *Logical Link Control (LLC)* and *Media Access Control (MAC).* The LLC manages connections between network nodes and controls the flow of data frames. The MAC sublayer manages the network's access method. In an Ethernet environment, the MAC sublayer implements the CSMA/CD access method. The MAC sublayer isolates the access method management functions from the other functions of the data link layer. It also ensures an error-free communication path between nodes by retransmitting data frames and throwing away duplicate frames when necessary. ATM, Frame relay and X25 are designed to

interconnect point-to-point links. They do not have any MAC protocols and this is one of the reasons that terrestrial WAN protocols are suited to radio WANs.

3. Layer 3 - Network Layer

The network layer is concerned with packet switching. It addresses data transmissions and translates logical into physical addresses. The network layer determines the route of each packet from the sender to the receiver. The Internet Protocol (IP) operates at the network layer and it is stateless and connectionless.

Routers also operate at the network layer and they can route packets across several networks. A router can reach into a data packet, reading and interpreting its embedded addressing information. It uses this information to update its routing tables for the next packet that comes along.

4. Layer 4 - Transport Layer

Transport layer provides transparent transfer of data between end points. Transport Control Protocol (TCP) and User Datagram Protocol (UDP) operate at transport layer. All state of connections resides in the transport protocol. TCP is a transport protocol that does error checking and ensures all packets are delivered efficiently, without error, and processed in the same sequence in which they were sent. UDP is a transport protocol that provides application programs with connectionless communication service but does not error checking.

5. Layer 5 - Session Layer

The session layer is concerned with network management by handling password recognition, logon and logoff procedures, and network monitoring and reporting. The session layer enables application processes on two different nodes to establish,

communicate over, and terminate an end-to-end connection called a session. The session layer focuses on managing the entire dialog between the two processes by controlling who transmits when and for how long. Just as the transport layer ensures in-sequence delivery of packets, the session layer ensures in-sequence delivery of messages.

6. Layer 6 - Presentation Layer

The presentation layer controls the formats used to exchange data between network nodes. It translates application data into a commonly recognized form at the sending node, and translates the data from the common form to an application-specific form at the receiving node. It controls how the network presents itself to applications which is include character set conversion, data compression/expansion, encryption and decryption, file format translation, and graphics command expansion.

7. Layer 7 - Application Layer

Network programs found at the Application layer include electronic mail, database managers, file-server software, and printer-server software. The application layer handles messages, remote logons, and network management statistics.

E. NETWORK SHARED MEDIUM

Network shared medium is used to transmit data over the network and this is an essential element of a computer communication network. Nowadays, transmission media can take the form of cabling system and wireless system. The main types of media available for use in implementing a LAN is as follows:

1. Cabling System

The vast majority of networks today are connected by some sort of wiring that act as a network transmission medium that carries signals between computers. Many cable types are available to meet the varying needs and sizes of networks. The majority of

networks are connected by one of two major classes of cable: twisted-pair (unshielded and shielded) cable or fiber-optic cable.

a. Twisted-Pair Cable

Twisted-pair cable consists of two insulated strands of copper wire twisted around each other: unshielded twisted-pair (UTP) and shielded twisted-pair (STP) cable.

(1) Unshielded Twisted-Pair (UTP) Cable. UTP cable consists of two insulated copper wires, and it has four individually twisted pairs of wires in a common sheath. There are five standard categories of UTP to ensure consistency of products for customers:

- **Category 1 UTP** can carry voice but not data transmissions
- **Category 2 UTP** is rated for signals of 4 MHz with a data rate of 4 Mbps
- **Category 3 UTP** is rated for signals of 16 MHz with a data rate of 16 Mbps. It supports 10 Mbps Ethernet, 16 Mbps Token ring, and 100VGAnyLAN with a maximum length of 100 m per segment.
- **Category 4 UTP** is rated for signals of 20 MHz with a data rate of 20 Mbps. It consists of four twisted pairs of copper wire.
- **Category 5 UTP** is rated for signals 100 MHz or less and supports 100 Mbps Fast Ethernet. Individual cable runs should not exceed 100 meters, including the patch panel and patch cable.
- **Category 5 Enhanced UTP** is rated for 200 MHz with a data rate of 200 Mbps. Category 5 Enhance UTP is now being used in most new constructed LANs.

(2) Shielded Twisted-Pair (STP) Cable. STP cable uses a woven copper-braid jacket that is more protective and of a higher quality than the jacket used by UTP. STP also uses a foil wrap around each of the wire pairs. This gives STP excellent shielding to protect the transmitted data from outside interference, which in turn allows it to support higher transmission rates over longer distances than UTP.

b. Fiber-Optic Cable

Fiber-optic cable is the best choice when the network needs to transmit data at very high speeds over long distances in a very secure media. At the present time, fiber is commonly used in campus networks at all levels above the desktop computer communications.

The Fiber-optic cable principles of operation are different than a copper cable. Copper cable transfers information in the form of transverse electromagnetic waves while optical fibers carry digital data signals in the form of modulated pulses of light. This is a relatively safe way to send data because no electrical impulses are carried over the fiber-optic cable. This means that fiber-optic cable cannot be tapped as easily, and its data cannot be stolen as easily. Fiber-optic cable is good for very high-speed, high-capacity data transmission because of the purity of the signal and lack of signal attenuation. Currently industries are using OC-192 (10 Gbps) for their network transmission. However, because fiber is point to point it cannot be used for bus topologies.

2. Wireless System

Wireless technology uses either optical or radio techniques to transmit data. Computers operating on a wireless network function similar to cable networks, except that the network interface card (NIC) is connected to a wireless transceiver instead of a cable. A wireless bridge can connect buildings that are situated as much as 40 kilometers (about 25 miles) apart. Cellular communication, satellite stations, and packet-radio communications are adding mobility to networks. Wireless LANs use four techniques for transmitting data:

a. Infrared Transmission

Infrared networks transmit and receive data using a high-intensity infrared light beam. Infrared transmission has a line-of-sight limitation. If someone walks between the two computers, the wireless connection is broken until there is a clear path again.

b. Laser Transmission

Laser networking technology is similar in concept to infrared. It requires an unbroken direct line of sight between sender and receiver. People or objects that get in the way will block transmission. Laser technology is more expensive than infrared.

c. Narrowband Radio Transmission

Narrowband radio uses an approach similar to a radio station. The sender and receiver use a specific radio frequency.

d. Spread-spectrum Radio Transmission

Spread-spectrum radio transmission broadcasts its transmissions over a range of radio frequency instead of just one. It divides the available frequency into channels. All the wireless nodes in the network synchronize to a specific channel.

3. Cabling System versus Wireless System

A wireless system is convenient, does not require wiring, and is certainly more flexible than a traditional cable network. On the other hand, a wireless system is relatively high cost and its transmission systems relatively slower than CAT-5 UTP cable or fiber optic cable. The fastest data transmission speed over a wireless LAN at the present time is 23.5 Mbps [Computer Magazine, Oct. 2000], while a cabling system LAN using CAT-5 UTP transmits at 100 Mbps; and fiber optic cable in a Gigabit Ethernet is even faster.

So, if our network investment is measured in terms of the cost and bandwidth, wireless networking offers the lowest value. Due to its high cost and transmission speed, wireless is a good alternative only if we have a real need for it. A cabling system is more appropriate for use in the Indonesian Eastern Fleet network as its LAN shared medium.

IV. DESIGNING THE INDONESIAN EASTERN FLEET LANS INFRASTRUCTURE

This chapter forms the foundational guidelines for designing and implementing the Indonesian Eastern Fleet LAN's infrastructure. In designing LAN infrastructure, it is necessary to know the concepts associated with designing the logical layout of our network, as well as the issues involved with creating the physical network infrastructure. Understanding the end user requirements is important because end users will interact with the application running on their network. We must learn what the end user needs, determine which software will best provide that functionality, and finally build software distributions of public domain programs that meet all user requirements for network-based operations. The Indonesian Eastern Fleet network's most important end users are computer operators, naval units personnel, and fleet support facilities personnel. Defining an appropriate technology design and selecting a useful network operating system will determine the performance and the capability of the network.

A. NETWORK ANALYSIS

Network analysis is needed in designing the Indonesian Eastern Fleet network in order to fully understand our design environment. This involves identifying, gathering, understanding system requirements, and developing performance thresholds to determine specified services for the network. The computer network designed must meet the needs of the organization. The Indonesian Eastern Fleet's network goals are to:

- Network the existing computers so that they can more efficiently share information and network resources
- Provide a full access Internet connection
- Provide video conferencing facility

- Provide hypermedia technology including: text, graphics, image, audio, and archive
- Improved fleet readiness through an improvement in information systems technology
- Minimize cost

The network analysis process begins by defining the requirements of our network. Next these requirements will be matched to the existing telecommunication features available and then determine what steps are needed to develop the network. At a minimum, we should consider requirements of the network that consists of:

- The number of users
- The size of the facility
- The environment (office, manufacturing, out-of-doors)
- Performance Characteristic, which include:
  - Storage (disk drive) performance
  - Processor (CPU) performance
  - Memory performance (access time)
  - Bus performance (bus capacity and arbitration mechanisms)
  - Operating system performance

  Information about any of these components can be helpful in estimating the overall performance of computer network as seen in figure 3 below.

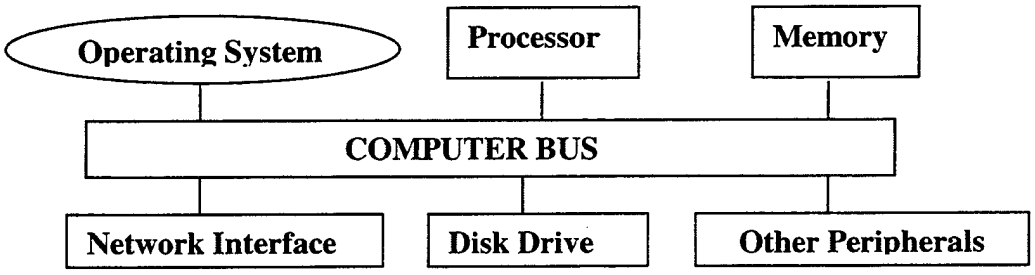

Figure 3. Computer Network Performance Components.

- Location information. It helps to determine the relationships between components of the system.

B. THE STANDARD LAN ARCHITECTURE: ETHERNET TECHNOLOGY

A network's architecture specifies the desired structure of the network. Its purpose is to provide an organization with a framework for more informed decision-making and a guide for ongoing planning. It includes some specification of standards, distribution of system functions and how the components relate to one another.

A standard architecture is critical to the establishment of the Indonesian Eastern Fleet Network. The architecture's main purpose is to provide guidance and structure for implementing the network. It helps to define the information technology strategy. A uniform strategy is needed to insure that all LANs are implemented similarly. This will help to insure that the LANs will function effectively when incorporated into the Indonesian Eastern Fleet Network. The LAN architecture is one part of the overall WAN network architecture. Without a standard LAN architecture, it will be difficult to manage and connect the collection of disparate systems. A uniform approach that conforms to published guidance on standardization will result in a more viable network.

The network architecture can be selected based on its topology, access method, signaling method, or support of a particular type of transmission medium. Although there is no one best network for users, Ethernet represents a diverse mixture of technological characteristics. In the 1980s the IEEE published Project 802. This project generated standards for design and compatibility for hardware components that operated within the OSI physical and data-link layers. The standard that pertains to Ethernet is the IEEE 802.3 specification. Ethernet network architecture strikes a good balance between speed, cost and ease of installation.

1. THE IEEE 802.3 ETHERNET NETWORK

a. The Features

Talking about the Ethernet features begins with the topology. The traditional topology such as a linear bus or another topology such as a Star Bus can be used. The IEEE 802.3 Ethernet Network relies on Carrier Sense Multiple Access/Collision Detection (CSMA/CD) as its access method to regulate traffic on the main cable segment. If two or more computers happen to send data at exactly the same time, there will be a data collision. When that happens, the two computers involved stop transmitting for a random period of time and then attempt to retransmit. Each computer determines its own waiting period; this reduces the chance that the computers will once again transmit simultaneously. Commonly, many computers on the network attempt to transmit data (multiple access); each one first listens to detect any possible collisions. If a computer detects a possible collision, it waits for a random period of time before retransmitting (collision detection). CSMA/CD is known as a contention method because computers on the network compete for an opportunity to send data. Nowadays users should not aware when they are using a contention access method because current implementations are very fast. CAT-5 UTP cable transmits at 100 Mbps and this problem was solved. Table 1 below describes the features of Ethernet technology that we can use to determine our plan in building the local area network infrastructure.

Feature	Description
Traditional topology	Linear bus
Other topologies	Star bus
Type of architecture	Base band
Access method	CSMA/CD
Specification	IEEE 802.3
Transfer speed	10 Mbps or 100 Mbps
Cable type	Cat-5 UTP

Table 1. The Features of Ethernet Technology.

b. Constructing the Ethernet Network

In constructing an IEEE 802.3 Ethernet network either the 10-Mbps IEEE Standards or the 100-Mbps IEEE Standards can be used. A 10 Base-T and a 100 Base-T network can be constructed with network interface cards (NICs), UTP cable, and one or more hubs. Each is installed in the expansion slot of a computer and wired on a point-to-point basis to a hub port. When all the ports on a hub are used, one hub can be connected to another to expand the network, resulting in a physical star, logical bus network structure.

In the definition process of standardization development, both the Ethernet media access control (MAC) and the physical layer require adjustments to permit 100 Mbps operational support. The 10 BASE-T and 100 BASE-T standard supports an operating rate of 10 Mbps at a distance of up to 100 meters (328 feet) over UTP cable without the use of a repeater. The wiring hub in an Ethernet network functions as a multiport repeater: it receives, retimes, and regenerates signals received from any attached station. The hub also functions as a filter; it discards severely distorted frames.

All hubs that conform to IEEE 10/100 BASE-T specifications perform a core set of tasks in addition to receiving and regenerating signals. 10/100 BASE-T hubs test each port connection, detect and handle excessive collisions, and ignore data that exceeds the maximum 802.3 frame size.

Hubs can monitor, record, and count consecutive collisions that occur on each individual station link by using a management agent. Since an excessive number of consecutive collisions will prevent data transfer on all of the attached links, hubs are required to cut off or partition any link on which too many collisions have occurred. This

partitioning enables the remainder of the network to operate in situations where a faulty NIC transmits continuously.

c. The Ethernet Frame Operations

Ethernet breaks data down into frames. A frame is a package of information transmitted as a single unit. It is used to deliver data between computers. An Ethernet frame can be between 64 and 1518 bytes long, but the Ethernet frame header uses at least 18 bytes. Every frame contains control information and follows the same basic organization.

PREAMBLE	**DESTINATION ADDRESS**	**SOURCE ADDRESS**	**TYPE**	**DATA**	**FRAME CHECK SEQUENCE**
8 bytes	6 bytes	6 bytes	2 bytes	46-1500 bytes	4 bytes

Header Payload

Figure 4. The Ethernet Frame Format.

The Ethernet packets begin with a Preamble that consists of eight bytes and is used for synchronization. The first two fields in the frame carry 48-bit addresses, called the destination and source addresses. The IEEE controls the assignment of these addresses by administering a portion of the address field. The IEEE does this by providing 24-bit identifiers called "Organizationally Unique Identifiers" (OUIs), since a unique 24-bit identifier is assigned to each manufacturer that wishes to build Ethernet interfaces. This 48-bit address is also known as the physical address, hardware address, or MAC address. The destination address can be a single workstation's address, a group of

workstations, or even several groups of workstations. The source address tells the workstation receiving the message where it came from.

As each Ethernet frame is sent onto the shared signal channel, all Ethernet interfaces look at the first 48-bit field of the frame, which contains the destination address. The interfaces compare the destination address of the frame with their own address. The Ethernet interface with the same address as the destination address in the frame will read in the entire frame and deliver it to the networking software running on that computer. All other network interfaces will stop reading the frame when they discover that the destination address does not match their own address.

The Type field designates which type of format the data is using. Without this information, it is impossible to decipher the packet when it arrives. The Data field is strictly limited; it can hold only a minimum of 46 bytes and a maximum of 1,500 bytes. Frame-Check Sequence provides a mechanism of error detection. It contains a check system of the rest of the frames which allow receiver to detect error.

Computers attached to an Ethernet can send application data to one another using high-level protocol software, such as the TCP/IP protocol suite used on the worldwide Internet. The high-level protocol packets are carried between computers in the data field of Ethernet frames. The system of high-level protocols carrying application data and the Ethernet system are independent entities that cooperate to deliver data between computers.

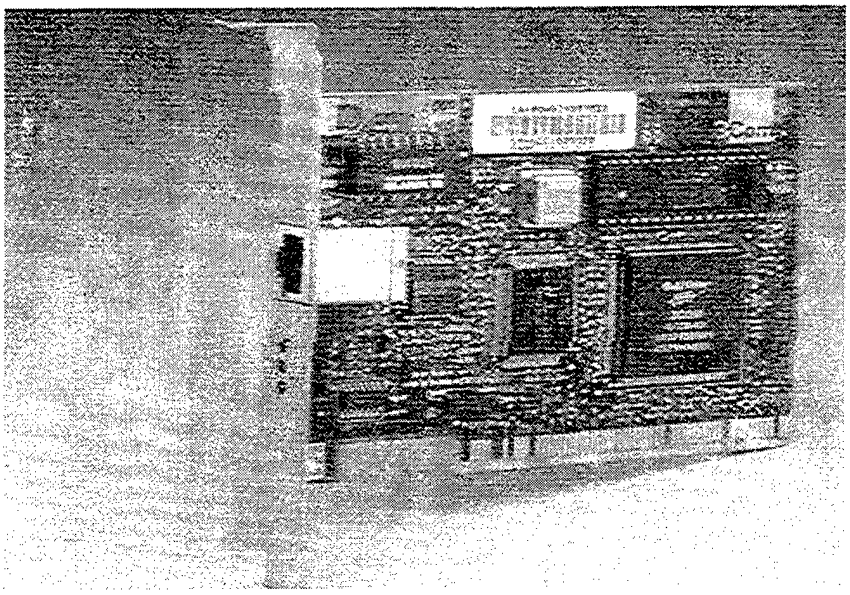

Figure 5. Fast Etherlink 100 BASE-T XLK NIC.

2. Fast Ethernet (100 Mbps) Network

One version of Ethernet technology that widely used is the 10 Mbps twisted-pair category. Fast Ethernet (100 Mbps) is a more recent Ethernet standard which operates over twisted-pair and fiber optic media and has become the accepted standard. Fast Ethernet transmits data much faster than Ethernet, and it also has some other advantages when used in the LAN architecture. These include moderate throughput, numerous vendors, strong commercial support, reliable multi-vendor interoperability and availability in a fiber version.

Fast Ethernet LAN specifications include 100 BASE-TX and 100 BASE-FX. Each specification maintains the use of the MAC protocol used by earlier Ethernet/IEEE 802.3 standards, CSMA/CD. 100BASE-T specifies 100-Mbps operations using the CSMA/CD protocol over two pairs of category 5 UTP cable. 100BASE-FX changes the LAN transport media to fiber optic cable.

IEEE Media Specifications	Cable Support	Connector Support	Coding Scheme
100BASE-TX	Category 5 UTP (2-pair wire)	RJ-45	4B/5B
100BASE-FX	62.5/125-micron fiber-optic cable	RJ-45	4B/5B

Table 2. Fast Ethernet Functionality.

Fast Ethernet 100BASE-TX is inexpensive compared to 100Base-FX because category 5 UTP cable is cheaper than fiber-optic cable. Even though data transmitted over fiber-optic cable is very fast and secure, data transmitted using category 5 UTP cable is already fast enough and good enough to meet the Indonesian Eastern Fleet Network requirements. The Ethernet specifications (IEEE 802.3) of the 10Base2, 10BaseT, and 100BaseTX are explored in Table 3.

	10Base2	**10BaseT**	**100BaseTX**
Topology	Bus	Star bus	Star bus
Cable type	RG-58 (thinnet coaxial cable)	Category 3, 4, or 5 unshielded twisted-pair cable	2-pair Category 5 UTP or STP
Connection to NIC	BNC T connector	RJ-45	RJ-45
Distance	0.5 meters between computers (Max 185 m)	100 meters (328 feet) between the computer and the hub	100 meters (328 feet)
Maximum cable segment length	185 meters (607 feet)	500 meters (1640 feet)	100 meters (328 feet)
Maximum computers per segment	30 (There can be a maximum of 1024 computers per network.)	1 (Each station has its own cable to the hub. There can be a maximum of 12 computers per hub and a maximum of 1024 transceivers per LAN without some type of connectivity.)	N/A

Table 3. Ethernet Specifications (IEEE 802.3).

3. GIGABIT ETHERNET (1000 Mbps) NETWORK

Gigabit Ethernet provides a data transmission capability of 1000 Mbps and supports the CSMA/CD access protocol. Similar to 10 Base-T and Fast Ethernet, Gigabit Ethernet can be used as a shared network through the attachment of network devices to a 1-Gbps repeater hub. It provides 1-Gbps ports to accommodate high-speed access to servers. Gigabit Ethernet operations require workstations, bridges, and routers to use a network interface card to connect to a 1-Gbps network. The maximum distance obtainable for Gigabit Ethernet when transmission occurs using a 1330-nanometer (nm) frequency on single-mode fiber is 3000 meters [Ref. : Held, 1998]. Data transmission on 1000BASE-T Gigabit Ethernet using category 5 UTP cable has a maximum distance of 100 meters, as does 100 BASE-T Fast Ethernet.

There are presently only a very few organizations that can be expected to require the use of a 1-Gbps shared media network. However, the use of Gigabit Ethernet can be expected to play an important role in providing a high-speed network in the future.

4. Making the Technology Choice for the Design

Based upon the need to have good results in network performance, all LANs in the Indonesian Eastern Fleet Network should be implemented as a Fast Ethernet (100 Base-T). This will provide a consistent approach and ensure that the network meets current needs while supporting future growth. Fast Ethernet has sufficient bandwidth to support an increase in network traffic and advances in network technology.

High-Speed Gigabit Ethernet 1000 Mbps is still not widely accepted and is too expensive to be implemented. Fast Ethernet is at the leading edge of Ethernet technology and offers significant advantages over 10 Mbps Ethernet. Fast Ethernet, operating at 100

Mbps, which is ten times faster than 10Base-T Ethernet, is a reliable LAN technology designed to meet high demands for network bandwidth. Network managers also benefit from Fast Ethernet by leveraging the familiarity of the underlying Ethernet technology and the protection offered for investments in applications, cabling, and management expertise.

Fast Ethernet delivers high performance and familiar technology. Another benefit arises from the fact that Fast Ethernet products are becoming increasingly inexpensive. For all of those reasons, Fast Ethernet 100 Base-T LAN is the most appropriate choice for the standard LANs architecture for the Indonesian Eastern Fleet Network. Implementation of Fast Ethernet 100 Base-T will provide a responsive and uniform network environment.

C. DEFINING THE LAN CONNECTION SYSTEM

The local area network (LAN) is a communication network that interconnects a variety of devices for information exchange. Network nodes can consist of workstations with network interface cards (NICs), hubs, bridges, routers and servers. The idea of a shared medium is a key concept when planning a LAN. The infrastructure is the physical wiring of the LAN, over which all network devices communicate. A properly designed infrastructure can be flexible enough to support current and future networking needs. Cable and hardware infrastructure quickly become the primary limiting factors in most LANs.

Connections in the older networks were mainly 10Base2 (Thinnet), 10Base5 (Thicknet), category 3 (CAT- 3), unshielded twisted pair (UTP) and shielded twisted pair (STP). Modern local area networks use mainly category 5 (CAT-5) UTP cable. The

CAT-5 UTP cable is installed point to point between the workstation and the electronics that make up the network, such as a hub or a switch. The CAT-5 UTP cable terminates to an IDF, and an individual cable should not exceed 100 meters long. The CAT-5 UTP cable has four pairs of wires with a lay length of eight twists per foot. It is rated for signals of 100 MHz or less and supports 100 Mbps Fast Ethernet.

The fiber-optic cable connects all the electronic devices throughout the campus to an MDF. The MDF houses the enterprise category network equipment, such as switches capable of switching packets and routers with multiple ports connecting the enterprise together. Fiber-optic cable uses reflected photon (light) energy instead of an electromagnetic charge to transmit its signal. This makes it resistant to electromagnetic interference.

Since efficiency and cost are the main issues in implementing an effective local area network, it is recommended that any new cable installations use CAT-5 UTP cable for future growth. Installation of CAT-5 UTP where new cabling is required allows maximum flexibility for future expected requirements.

D. DEFINING NETWORK PROTOCOL

Protocols are the system of rules and procedures that govern communication between two or more devices. Many varieties of protocols exist at all layers of the OSI model. Not all protocols are compatible, but as long as two devices are using the same protocol, they can exchange data. A network protocol is a set of language and set of rules that nodes agree to use to communicate over the network [Gregg, 1999]. When several computers are networked, the rules and technical procedures governing their communication and interaction are called protocols.

NetBEUI is not a routable protocol. It does not contain enough information to send packets from one network to another. NetBEUI is a network protocol that is used in all Microsoft networking products including MS-DOS and all versions of Windows and Windows NT. The NetBEUI protocol works well on old and lower-end computers running MS-DOS.

Internetwork packet exchange/sequenced packet exchange (IPX/SPX) is the network protocol that is usually used on Novell NetWare networks. However, it can also be used as the main protocol in a pure Microsoft network. IPX/SPX is not routable. It operates at the application and session layers of the OSI model.

Transmission control protocol/internet protocol (TCP/IP) is routable. It enables users to connect and communicate across networks that use different hardware architectures and run different operating systems. TCP/IP can be used to communicate on pure Microsoft networks, or on mixed networks with products such as IntranetWare and UNIX. TCP/IP provides reliable data delivery service by setting up end-to-end connections between two systems that need to exchange data. To do this, it establishes a virtual network between the two computers across all routers in the affected network. TCP uses the Internet Protocol (IP) as the transport to deliver information across the network. The main advantage of TCP/IP is its flexibility. Every operating system platform now supports it. TCP/IP is the default protocol for Unix and the preferred protocol for the NetWare and Windows operating system.

CRITERIA FOR SELECTING NETWORK PROTOCOLS

Characteristics	NetBEUI	IPX/SPX	TCP/IP
Capability to transmit across routers	No	Yes	Yes
Best for corporate intranet	No	No	Yes
Best for large networks	No	No	Yes
Best for pure Microsoft networks (no routing)	Yes	No	Yes
Best for pure Microsoft networks (with routing)	No	No	Yes
Best for small LANs	Yes	Yes	Yes
Best for WANs	No	No	Yes
Ease of client configuration	High	Low	Low
Ease of network administration	High	High	Low
Interoperability with NetWare	No	Yes	No
Interoperability with the Internet	No	No	Yes
Interoperability with UNIX	No	No	Yes
Performance for application server (client/server)	Low	Low	High
Performance for file and printer sharing	Medium	High	Medium
Performance on small networks	High	Medium	Medium

Table 4. Criteria for Selecting Network Protocol [Gregg, 1999]

The Data Link Control (DLC) network protocol enables the network to communicate with certain network printers. The DLC protocol operates in the data link layer and corresponds to the logical link control (LLC) sublayer. When using DLC to communicate with a network printer, the DLC protocol need to be installed on the computer that is acting as the print server for the network printer. Other nodes that send jobs to the print server can use any standard protocol, and do not need to have DLC installed.

User Datagram Protocol (UDP) is a transport layer component that provides data delivery service in the TCP/IP protocol stack. UDP is a connectionless protocol and does not check to see if the packet arrived at its destination. This protocol is used to transmit packets that are time sensitive, or when it is not important to know if they have arrived at their destination. UDP is commonly used in audio and video applications.

E. CONFIGURING NETWORK COMPONENTS

In the following sections, many of the key networking components are discussed that are likely to be considered in our network design process. Small and simple networks use only cables and network adapters attached to the computers and other devices. However, as the network grows in size and complexity, it needs other networking devices to tie everything together correctly.

1. Network Interface Card (NIC)

The network interface card (NIC) is a layer 1 device and is the only device on the network that is actually installed inside the machine. Workstations, servers, print servers, and gateways all have NICs. NICs provide the connection point to a network. Each type of NIC is specially designed for a specific type of network such as Ethernet, Token ring, FDDI, or ARCNET. Newer NICs usually have RJ-45 connectors on them. A standard NIC would be a 10/100 Mbps PCI Ethernet card with an RJ-45 connector. Windows 95/98/ME and Windows NT 4.0 will auto detect most NICs. Before installing the card it is important to ensure that the latest driver is installed on the machine.

2. Hubs

A hub is a layer 1 device that repeats a signal to all the hub ports that can connect to network segments or devices. A hub may have as few as 4 ports, 8 ports, 12, or 24 port models. The unit has female RJ-45 connectors on the front that may attach directly

to a computer by means of CAT 5 cable or it can attach to a patch panel with an RJ-45 patch cable. The connectivity with other devices is indicated by a link light at the front panel of the hub. A popular 10/100 autosensing Ethernet hub supports legacy systems and provides growth for greater speed. Hubs are a critical component in most networks, so we need to safeguard them to avoid network down time. In networks containing more than a couple of nodes, it is best to install the hub devices out of the way, preferably in a wiring cabinet or closet.

3. Switches

A switch is a layer 2 device that separates a network into segments. It is essential for large Ethernet networks because it eliminates the collisions that are frequent with shared networks. Switches support hierarchical network designs and can connect different architectures. A switch repeats data but, unlike a hub, only to the recipient/port specified by the MAC address.

In a campus area networks, each device (end system) connects to a workgroup switch over a point-to-point CAT-5 UTP cable and shares the media with any other device. This allows for a full-duplex connection between the switch and the device. Workgroup switches are hierarchical in design. They are connected to individual workstations and also to a large enterprise switch. This large enterprise switch connects to Servers and to the WAN via the router. A switch can segment a network into its ports, and forward the packets between those ports at the same time (simultaneously).

4. Routers

The router is used to connect to remote offices or the Internet and is installed as a device on the network. An Internet router is usually the gateway address in the TCP/IP

protocol parameters. It is an OSI layer 3 device that routes packets to the proper destination on the basis of the destination network address in the packet. A router will have one or more serial ports with a Channel Service Unit/Data Service Unit (CSU/DSU) connected to it and one or more LAN ports connected to a switch or hub. A router is configured with the local subnet address information and the address information of the router to which it is connected on the WAN port.

F. SELECTING A NETWORK OPERATING SYSTEM

There are several network operating system servers available, such as Windows NT 4.0 Server, Windows 2000 Server, Novell NetWare, and Windows 98/ME. Due to geographic separation of the organizational units and the high cost of training administrators, the capability to centrally manage the network is an important aspect of limiting the total cost of ownership. The advantages of using a Windows 2000 Server include increased flexibility, scalability, reliability, management capabilities and security. Migration to Windows 2000 provides a common operating system environment and meets the Indonesian Eastern Fleet recommendation on standardization.

Below are the features of network operating systems that are commonly used at the present time:

1. Windows NT 4.0 Server

Windows NT 4.0 Server is a full scale network operating system. Its robust security and management features make it a good candidate for medium and large size network environments, but it also requires the knowledge and the management of a network administrator.

Windows NT 4.0 Server is a genuine network operating system. Its services are especially optimized to give the best service for its clients and the Windows NT 4.0 Workstation can be used as a client side operating system. Windows NT 4.0 Server was designed from scratch to perform the roles of a real network operating system with features like preemptive multitasking, multiprocessing, multiplatform support, secure file systems and fault tolerance. A window NT 4.0 Server machine can play many roles in a network. It can be a file server, a database server, or a web server. It performs all of these duties with great success. Windows NT 4.0 Server's minimum hardware requirements are Intel Microprocessor 80486 or higher, 120 MB disk storage, 16 MB memory, and a VGA display or higher resolution. It also can support three kinds of Reduced Instruction Set Chips (RISC) microprocessors. These are MIPS, Digital Alpha, and Power PC Alpha with 150 MB minimum disk storage, 16 MB memory, and a VGA display or higher resolution.

2. Novell NetWare

Novell NetWare is a widely accepted network operating system that has started to lose market share against the Windows NT Server. Novell NetWare 5.1 is specially designed for organizations that need a cost effective and reliable network operating system. In the file server role, it is accepted as the fastest server available for medium to large networks, but it only runs programs written for Netware.

The minimum hardware requirements for Novell NetWare are a 486 Based PC or above, 64 MB RAM, and at least 200 MB of free hard disk space.

3. Windows 98/ME

Windows 98/ME is not designed to perform a server role but its rich network features make it very suitable for small-scale network environments. It also can handle 32-bit applications. Unfortunately, however, features like overhauling system security, multi-user environment support, and secured file system structures are weaker than the other operating systems. Windows 98/ME minimum requirements are 486/66 MHz based Computer/Processor, 16 MB of memory (RAM), 225 MB of available hard disk space, and a VGA or higher-resolution display.

4. Windows 2000 Server

Windows 2000 Server is the newest version of Windows NT. Windows 2000 Server delivers powerful, comprehensive management services for managing the servers, networks, and client systems. Windows 2000 Server has an interoperability with existing systems by providing migration paths from any number of existing systems, devices, and applications. The minimum system requirements for Windows 2000 Server are as follows:

- 133-Mhz Pentium or higher central processing unit (CPU)
- A maximum of four CPUs per computer are supported
- 256 MB of RAM recommended minimum
- 128 MB of RAM minimum supported
- A hard disk partition with enough free space to accommodate the Setup process. The minimum amount of space required is 1 GB'

Windows 2000 Server comes along with Active Directory, an Internet standards-based directory service that uniquely enables flexible policy-based management of systems. Active Directory is a directory service that is scalable, built from the ground up using Internet-standard technologies, and fully integrated at the operating-system level.

It allows a single point of administration for all published resources, which include files, peripheral devices, host connections, databases, web access, users, other arbitrary objects, services, etc [Microsoft, 1997]

Active Directory simplifies administration and makes it easier for users to find resources. Using Active Directory, hierarchical information structures can be built that make it easier to control such things as administrative privileges and also make it easier for users to locate network resources such as files and printers. Hierarchical information structures form a tree structure that reflects all organizational resources. Compared to Windows NT 4.0 that scales quite well up to 100,000 users, Active Directory can scale up to over one million users in a single domain by using indexing technology and advanced replication techniques to speed performance.

G. DATA BACKUP SYSTEM

The network administrator is responsible for creating a backup plan which assures that the organization can easily recover data if data security is breached. There are three methods used for backing up data and files on a network. These are differential backup or incremental backup, copy, and full backup. A differential backup, also known as incremental backup or daily backup, is used to backup selected files when the content of a file has changed. The backup system reviews the date and time of the file, which indicates the last time the file was updated and compares it with the file. If they differ, then the backup system copies the file. Otherwise, the file is not backed up. A copy backup is used to back up selected files. A full backup copies all the files on a server regardless of whether they changed or not since the last backup. The network

administrator chooses the backup method based upon the efficiency of the backup schedule and the capacity of the backup medium.

All backup software modules must be installed on a server to guarantee the quality of backed-up data. The magnetic tape backup can be used as a common type to provide an effective backup system for our network. A magnetic tape backup is reliable, inexpensive, and has enough capacity to backup the entire network on a single tape.

H. IMPLEMENTING THE NETWORK

1. Standardization

One of the most important aspects of implementing our LAN infrastructure is planning. It is necessary to ensure that every aspect of the implementation has been addressed. Implementation of the Indonesian Eastern Fleet LANs infrastructure begins by establishing standard network architecture to achieve compliance with the Indonesian Eastern Fleet network requirements, compatibility with the naval main bases and fleet units, and to establish an effective and highly reliable network. A standard architecture is needed to provide direction for information technology managers and to define the Indonesian Eastern Fleet information technology strategy.

The IEEE 802.3 Ethernet Network architecture, using Fast Ethernet (100 Mbps) technology, is designed to be implemented on the Indonesian Eastern Fleet's LANs infrastructure. The standardization of network architecture is a critical aspect to implementing an integrated network that is interoperable with other Indonesian Navy networks or with other branch services networks.

Ensuring hardware compatibility is important because each piece of hardware on the network must be able to communicate with other hardware on the network.

Minimum hardware requirements represent values that are sufficient only to allow the system to start. To obtain the best performance out of our network, the appropriate hardware compatibility that meets the Indonesian Eastern network's requirements and allocated budget needs to be determined.

2. System Administration

There are three parts of IT support that make our information technology systems success: network operations, system administration, and install/configure/troubleshoot categories. IT support for information systems is a large part of the life cycle costs.

System administration in the Indonesian Eastern Fleet network should conduct a network operations center for monitoring and controlling the operation of our wide area network, and providing reports for a distributed system. A network operations center is responsible for day-to-day operation of the WAN. This accomplished through the monitoring of online statistics including traffic patterns, congestion reports and data from SNMP clients. Many software packages exist which aid in the recognition of network problem areas.

The right choice in selecting a network operating system determine how well the network operation supports distribution and gathering information all fleet units. The implementation of centralized management by using Windows 2000 network operating system is key to improving the Indonesian Eastern Fleet network system. This one step forward in computer communication systems by implementing effective LANs will improve the Indonesian Eastern Fleet information technology systems.

For effectiveness and efficiency, the network operations center (NOC) should be established in the Indonesian Eastern Fleet headquarters LAN in Surabaya.

Centralization is a good strategy to support information systems to all fleet units. The network operations center manages the Indonesian Eastern Fleet wide area network to ensure its up and run properly. However, all other LANs should also have their own network administration unit in each LAN that managed by a local network administrator. We still need decentralization to manage and maintaining the network locally in each LAN. The synchronization between all LANs and the Indonesian Fleet NOC would provide good result in network traffic management as we will prove and evaluate in our network design using EXTENDv4 simulation software program.

The Indonesian Eastern Fleet NOC responsible for communication with the Internet Service Provider, telecommunication carrier company, and contractors in order to obtain and maintain the good quality of the network. By default the role of the NOC falls to the information technology unit coordinated with command, control and communication unit to always provide good service and network maintenance to the network users.

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V. WEB-BASED WIDE AREA NETWORK DESIGN

Local area network (LAN) is a convenient way to connect machines in a building or in a close proximity. Each location might have its own LAN, but these were isolated from the rest of the organization until someone figured out a way to connect them together into a wide area network (WAN). There are several transmission techniques that can be used, but the simplest is with a modem and a telephone line.

A WAN covers longer physical distances than a LAN. The WAN makes it possible to put the entire organization on the same network no matter how scattered its nodes. The network could be spread across a state, an island or around the whole country. Thus, it is possible for a military organization such as the Indonesian Eastern Fleet to put into operation their own wide area network tying together all naval units in the eastern territory of Indonesia. Implementing web-based technology on the WAN would greatly improve the efficiency of the Indonesian Eastern Fleet information systems.

A. REMOTE ACCESS SERVICE (RAS)

Remote Access Service (RAS) provides the capability of dialing into our network from a remote location, and acting as a remote node on the network. RAS is often referred to as Dial-up Networking, which communicates with other devices in the telecommunication system using modem at each end of the connection. Both a RAS client and a RAS server require their own modems. The RAS server modem answers a call from a RAS client modem to establish the remote network connection.

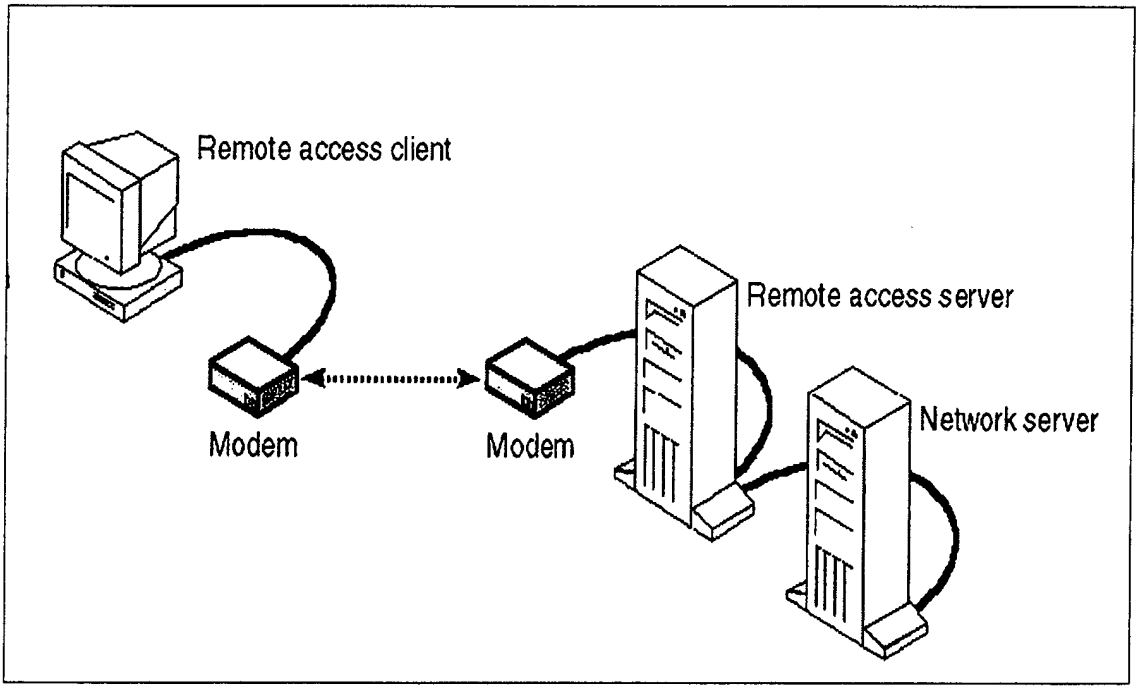

Figure 6. RAS Connection.

RAS supports three connection protocols: *Serial Line Interface Protocol (SLIP), Point-to-Point Protocol (PPP),* and *Point-to-Point Tunneling Protocol (PPTP).* SLIP does not support dynamic IP addressing or NetBEUI or IPX protocols, it cannot encrypt logon information, and it is supported only by RAS clients. PPP overcomes many of the limitations of SLIP. It supports the IPX, NetBEUI, AppleTalk, and DECnet protocols. It also supports encrypted passwords. PPTP provides a way to route IP, IPX, or NetBEUI point-to-point protocol packets over a TCP/IP network.

Using a RAS connection is not always the best choice to achieve network expansion. RAS is used if it is determined that our bandwidth requirements are not greater than 128 Kbps, if a dedicated full-time connection is not required, or if system costs must be kept down. It is not good to use RAS if a higher bandwidth is needed than

that provided by an asynchronous modem or if a dedicated full-time connection is needed.

Virtual private networking (VPN) enables us to securely access our network across the Internet. RAS is very expensive if long-distance is used for access, especially if access is needed for lengthy periods. If there is an account on the Internet using a national ISP that provides unlimited access via local phone, there is a way to securely transmit data over the Internet, and make it all seem as if our network was directly dialed into. It uses Point-to-Point Tunneling Protocol (PPTP) to encase the data in a secure tunnel and transmits it over the Internet to its destination site. Like RAS, VPN uses Dial-up Networking to establish the network connection. VPN can also be used over dedicated analog lines to maintain a permanent network connection to the Internet – and between our organization's websites.

B. CARRIERS

1. Analog Telephone lines

A modem is useless unless it can communicate with another component. All modem communication takes place over some kind of communication line. There are two types of analog telephone lines that can be installed as a modem's carriers for our network: *dial-up connection telephone lines* and *dedicated (leased) telephone lines.*

In *dial-up connections* each session requires that our modem dial a phone number to establish a new session. They are slow and can be unreliable for transmitting data. The quality (speed and reliability) of a session is only as good as the telephone network circuits connected for that particular session. The longer the distance covered by the connection, the less consistency seen in the quality from one dial-up session to the next.

However, for some organizations it may be practical to temporarily use a dial-up communication link between sites for a certain amount of time each day to transfer files and update databases.

Dedicated lines provide full-time, dedicated connections that do not use a series of switches to complete the connection. The quality of the line is often higher than the quality of a telephone line designed for voice transmission only. They typically range in speed from 56 Kbps to 45 Mbps or more. PT. TELKOM and PT. INDOSAT, Indonesian telecommunication state-owned companies, provide long distance connection across the sea to the entire country using a satellite system. A leased analog line is faster and more reliable than a dial-up connection. However, it is relatively expensive because the carrier is dedicating resources to the leased connection whether or not the line is being used.

2. Digital Lines

Organizations can turn to digital data service (DDS) lines when requiring faster and more secure transmissions than analog telephone lines provide. The primary advantage of digital lines is transmissions over them are nearly 99 percent error free. Digital lines are available in several forms, including DDS, T1, T3, and switched 56. Since DDS uses digital communication, it does not require modems. Instead, DDS sends data from a bridge or router through a device called a Channel Service Unit/Data Service Unit (CSU/DSU). This device converts the standard digital signals that the computer generates into the type of digital signals (bipolar) that are part of the synchronous communication environment. Either analog lines or digital line is a point-to-point links. We use circuit switching network (PSTN, ISDN) over these telecommunication origin

lines, and we use packet switching network (Frame relay, ATM,) over the T1 and T3 lines.

C. WIDE AREA NETWORK LINK OPTIONS

LANs are not adequate for all fleet units communications. There must be connectivity between LANs and other types of environments. Using components such as bridges and routers, along with communications service providers, a LAN can be expanded from an operation that serves a local area to encompass a wide area network. Most WANs are combinations of LANs and other communications components connected by communication links called WAN links. WAN links can include: packet-switching networks, fiber-optic cable, microwave transmitters, satellite links and cable television coaxial systems.

LAN connectivity and communications in an integrated WAN will involve one of the following transmission technologies:

1. Public Switched Telephone Network (PSTN)

Circuit Switching is used in telephone networks. In a circuit-switching network, a dedicated communication path is established between two stations through the network. Data generated by the source station are transmitted along the dedicated path as rapidly as possible. At each node, incoming data are routed or switched to the appropriate outgoing channel without delay.

The same network that our telephone uses is available to computers. One name for this network is the Public Switched Telephone Network (PSTN). PSTN is the most common communication service available in the world, including Indonesia. PSTN channel has W (bandwidth) = 4 Khz, S/N (Signal to noise ratio) = 30 dB or ratio 1000 : 1,

and C (maximum data rate) = 40 Kbps. The fact that the PSTN was designed primarily for voice-grade communication makes it slow. Dial-up analog lines require modems that can make them even slower. Since the PSTN is a circuit-switched network, the connection quality is inconsistent. Any single communication session will be only as good as the circuits linked for that particular session.

2. Integrated Services Digital Network (ISDN)

ISDN was the circuit switching that designed to be the digital successor to the existing public switched telephone network (PSTN). As a dial-up services, ISDN requires a basic monthly fee based on connect time or the volume of data transmitted. However, as computer and telecommunication systems improved, the telecommunication carrier cooperated with the Internet Service Provider (ISP) companies to provide the ISDN lease services. In that case, it is necessary to pay more than the regular dial-up ISDN service. ISDN is a standardized telecommunications network architecture providing multi-channel, integrated end-to-end connectivity. It is one of the concepts developed to answer the demands of universal services: transmission of voice, video, data, facsimile, image, and graphics information over digital channels.

Traditional data transmission uses a modem to convert data for the analog channel. With ISDN, digital data transmission does not need to be converted. An ISDN channel consists of 64 Kbps data channels (B=bearer) and 16 Kbps packet signaling channels (D=delta). Services are offered as a basic rate 2B+D (two B channels and one D channel), or a primary rate 23B+D (23 B channels and one D channel). ISDN is offer by Telkom Ltd., Lintas Arta Ltd., and Info Asia Ltd. in Indonesia using a transmission

data rate of 128 kbps, and transmitted through all over the country across the sea using satellite systems by Indosat Ltd. (state owned company).

3. T1 Line

T1 is the high-speed digital line that uses two-wire pairs (one pair for transmitting, and the other for receiving) to transmit a full-duplex signal at a rate of 1.544 Mbps. It can be used to transmit digital voice, data, and video signals. T1 line is made up of 24 distinct channels and samples each channel 8000 times per second. Using this method T1 can accommodate 24 simultaneous data transmissions. Each channel sample incorporates eight bits. Since each channel is sampled 8000 times per second, each of the 24 channels can transmit at 64 Kbps. This data rate standard is known as DS-0. The 1.544 Mbps rate is known as DS-1. DS-1 rates can be multiplexed to provide even greater transmission rates, known as DS-1C, DS-2, DS-3, and DS-4.

4. T3 Line

T3 is a digital leased line similar to T1, but it operates at much higher data rates. T 3 line is achieving data rates up to 45 Mbps. The cost of T3 line is much more expensive than T1 line. A T3 line represents a bandwidth equal to about 672 regular voice grade telephone lines, which is wide enough to transmit full motion, real-time video, and very large databases over a busy network. A T3 line is typically installed as a major networking artery for large corporations and universities with high volume network traffic.

5. OC-3 Line

OC-3 is the ideal solution for customers who seek ultra-fast connectivity for their mission-critical Internet needs. OC-3 connection line operates at 155 Mbps bandwidth

using fiber optic cable. This reliable, high-speed service is ideal for Internet Service Providers, large content providers, search engines, and Web hosting.

6. OC-12 Line

For the ultimate in high-speed connectivity, we can choose OC-12 service. Users obtain greater bandwidth flexibility with a 622 Mbps connection. OC-12 service allows customers to sustain numerous simultaneous users on their corporate Web sites and provides users shorter download times. Customers currently using OC-3 service can expand their bandwidth by simply upgrading to OC-12 service, rather than ordering multiple OC-3 lines.

7. OC-48 Line

OC-48 operates at 2.4 Gbps. OC-48 fulfills the growing need to service hand-offs in the backbone space with industry leading in-service velocity and reliability. OC-48 connection had robust reliability. It can be used to support a long distance intercity telephony trunks and as large campus backbone.

8. OC-192 Line

OC-192 delivers up to 9.6 Gbps of capacity, the highest fiber capacity commercially available in the marketplace. Having provided over 90% of the industry's 10Gbps multi-wavelength systems, OC-192 is the leading high-capacity optical networking system in the world. OC-192 delivers a virtually error free end-to-end bit error ratio of 10-15, a competitive edge for networks that carry mission-critical data traffic. OC-192 is the reliable connection line at the present time. This connection line is still not offer by network provider and telecommunication companies in Indonesia.

9. The Analysis of WAN Connection Options

The array of WAN connection choices available will be trimmed down based on our region and what services our telecommunications carrier provides. Once we know what is available, the selection boils down to our specific application and its cost. The issues behind WAN connection options are transmission data rate, capacity, and cost.

Analysis of the WAN connection options:

- PSTN. The cost of PSTN is very cheap. However, the reliability is very low compare with other services. PSTN connection service use modem communication and it is very slow.
- ISDN. This connection service operates fast enough to link all LANs in the Indonesian Eastern Fleet WAN effectively. The reliability is good; the network provider is responsible for transmission error. The cost is inexpensive and meets the network low cost requirement.
- T1 Line is more expensive compare to PSTN or ISDN but it is fast and reliable and can be used for connecting the Indonesian Eastern Fleet WAN effectively
- T3 Line is an advanced network connection technology that operates at 45 Mbps, much faster than T1 line. However, the costs is much more expensive than T1 line.
- OC-3 connection line is a high speed and secure service based-on fiber optic cabling system. High speed data transfer is possible due to the virtually unlimited bandwidth of fiber optic. However, this connection service is very expensive.
- OC-12 line is faster than OC-3. It operates on fiber optic cable at 155 Mbps. Fiber optic cable also makes our network secure and is considered to be virtually error free. The cost of this connection is more expensive.
- OC-48 line is much more expensive than OC-12 and operates at 2.4 Gbps. It is an emerging technology based on fiber optics. It is highly reliable but is very expensive.
- OC-192 is the newest connection line with a very high speed transmission. However, this connection line still not offered by the network provider in Indonesia at the present time.

The main goals in making technology choices for the Indonesian Eastern Fleet WAN design in this analysis are low cost, effectiveness, and efficiency. From the array

of analysis we come to conclusion that ISDN is the most appropriate choice for the Indonesian Eastern Fleet WAN design. ISDN meets the Indonesian Eastern Fleet network requirement for low cost, reliability, and capacity. We recommend that eventually, as finances permit, the Indonesian Eastern Fleet migrate to T1 Lines 1.544 Mbps for its WAN connection service. This fully digitized channel will answer the demands of multirate signal voice, data, video, image, and graphic information.

D. WAN CONNECTIVITY DESIGN

1. Connecting LANs to the Internet in a Packet Switching Network

A WAN is constructed from many switches to which individual routers connect. The initial size of a WAN is determined by the number of sites and the number of computers connected. The basic electronic switch used in a WAN is called a packet switch because it moves complete packets from one connection to another. A packet switch contains two types of input/output (I/O) connectors: one type is used for other packet switches, and the other is used to connect to computers. In packet switching, packets are relayed through stations in a computer network along the best route currently available between the source and the destination. Each packet is switched separately.

Wide area network interfaces are incorporated into remote bridges that are designed to provide an internetworking capability among all geographically dispersed LANs linked by a WAN. ISDN connection service links all LANs in the Indonesian Eastern Fleet WAN. The basic concept behind ISDN is end-to-end digital connectivity, or a completely digital signal all the way from the sender to receiver and vice versa. The Cisco 1003 ISDN router connects remote sites with Ethernet LANs to a WAN using ISDN at speeds up to 128 Kbps; with 4:1 data compression, raw throughput speeds up to 512 Kbps [Ref. Tittel, 1996]. The Cisco 1003 has a built-in ISDN Basic Rate Interface

(BRI) port, a 100Base T Ethernet port, a console port, and an external Personal Computer Memory Card International Association (PCMCIA) slot for a Flash ROM card. This plug-and-play product is designed to be installed easily by non technical personnel at remote sites. The Cisco 1003 ISDN router supports two software feature sets, based on the Cisco Internetwork Operating System (Cisco IOS). One set includes IP routing and transparent bridging. Both software sets support Point-to-Point Protocol (PPP), compression, dial-on-demand routing (DDR), and a host of other powerful features for optimizing WAN bandwidth and cost. Figure 7 illustrates the Ethernet Backbone and Internet Connection configuration for the Indonesian Eastern Fleet Network.

2. WAN Connectivity Plan

Figure 8 is a map of the eastern region of Indonesia in which all naval units of the Indonesian Eastern Fleet conduct daily sea operations to maintain sovereignty and law enforcement at sea. Figure 9 shows our "WAN connectivity plan" designed to link all Fast Ethernet LANs in the Indonesian Eastern Fleet network using ISDN connection service as an integrated web-based WAN.

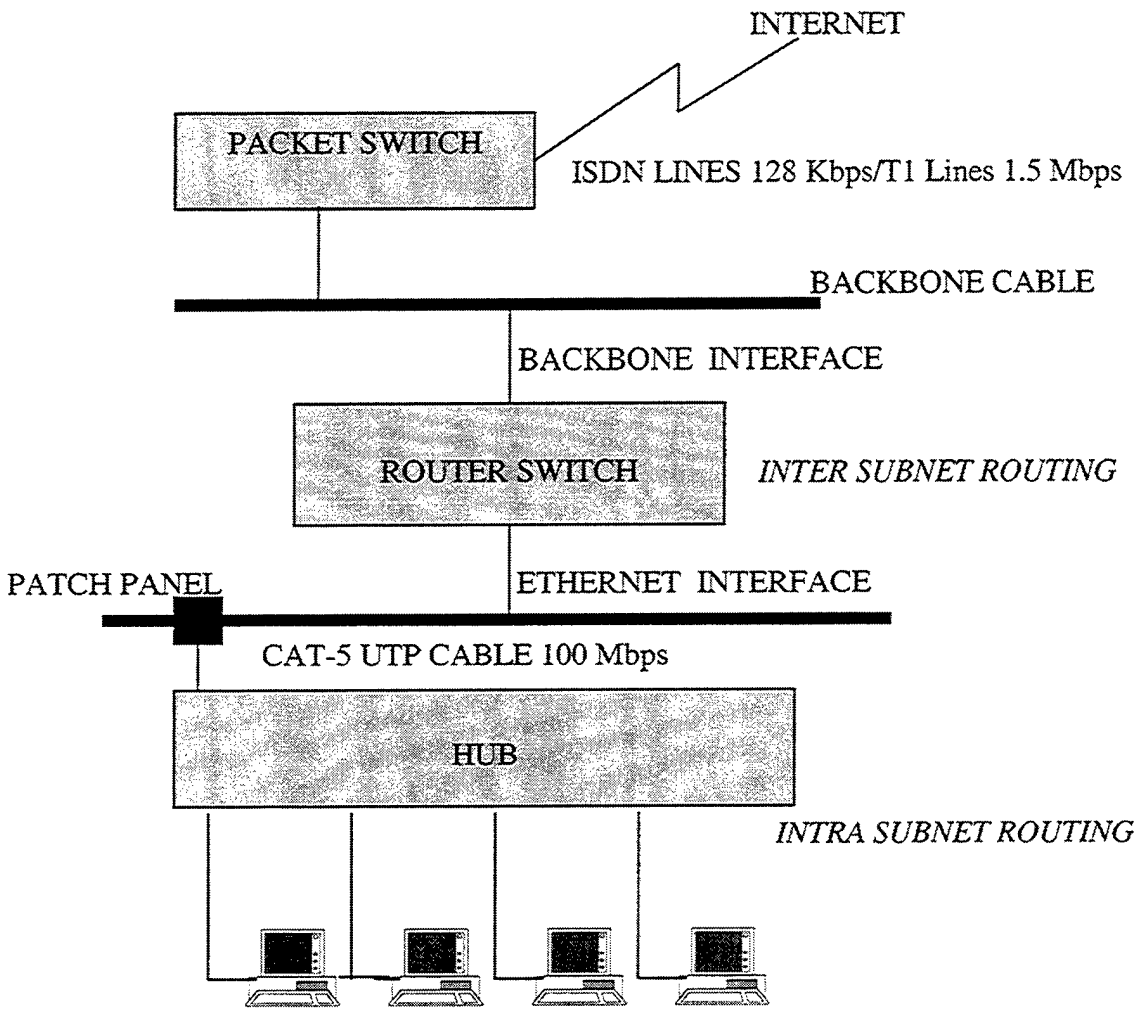

Figure 7. Ethernet Backbone and Internet Connection.

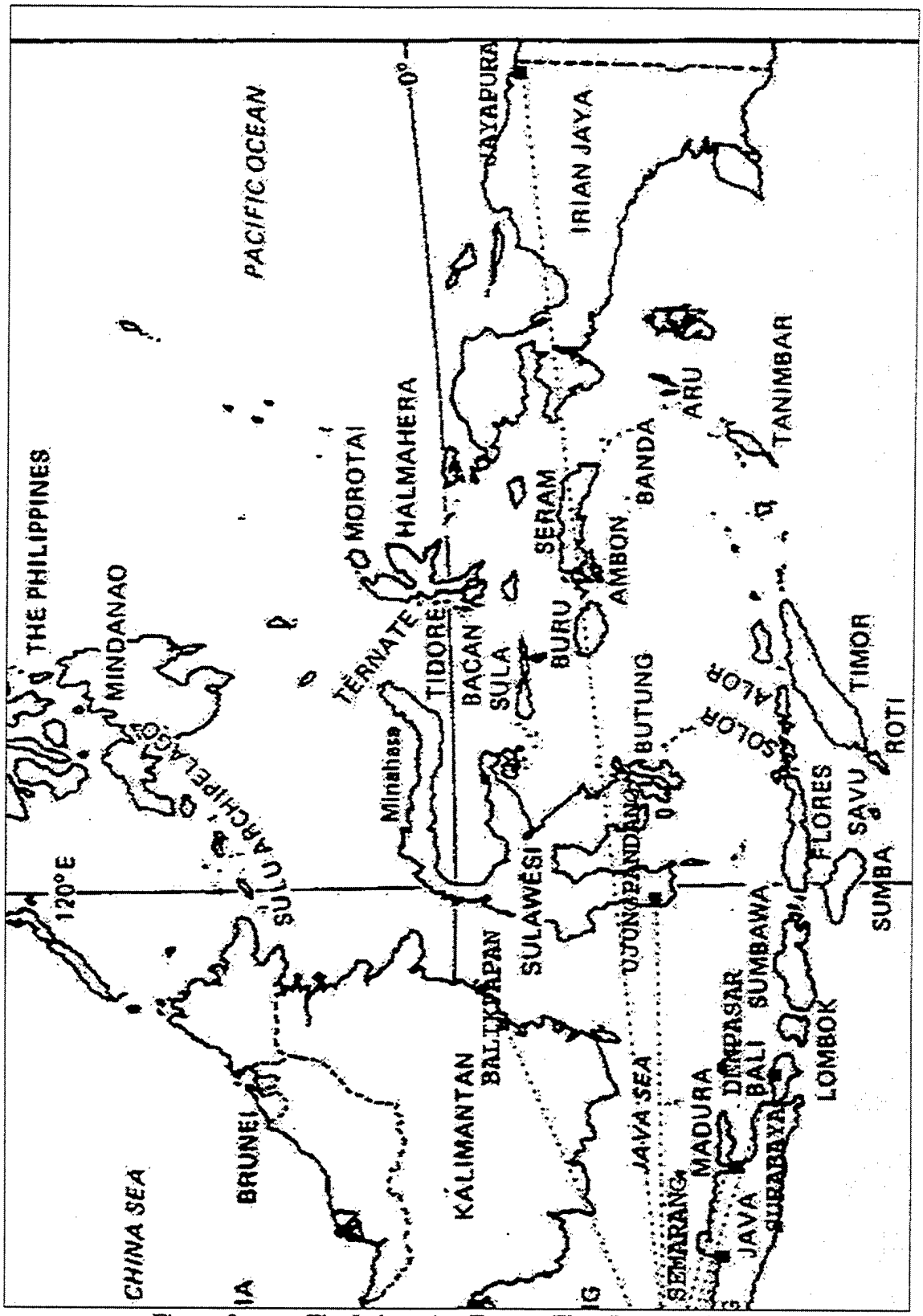

Figure 8. The Indonesian Eastern Fleet Regional Map.

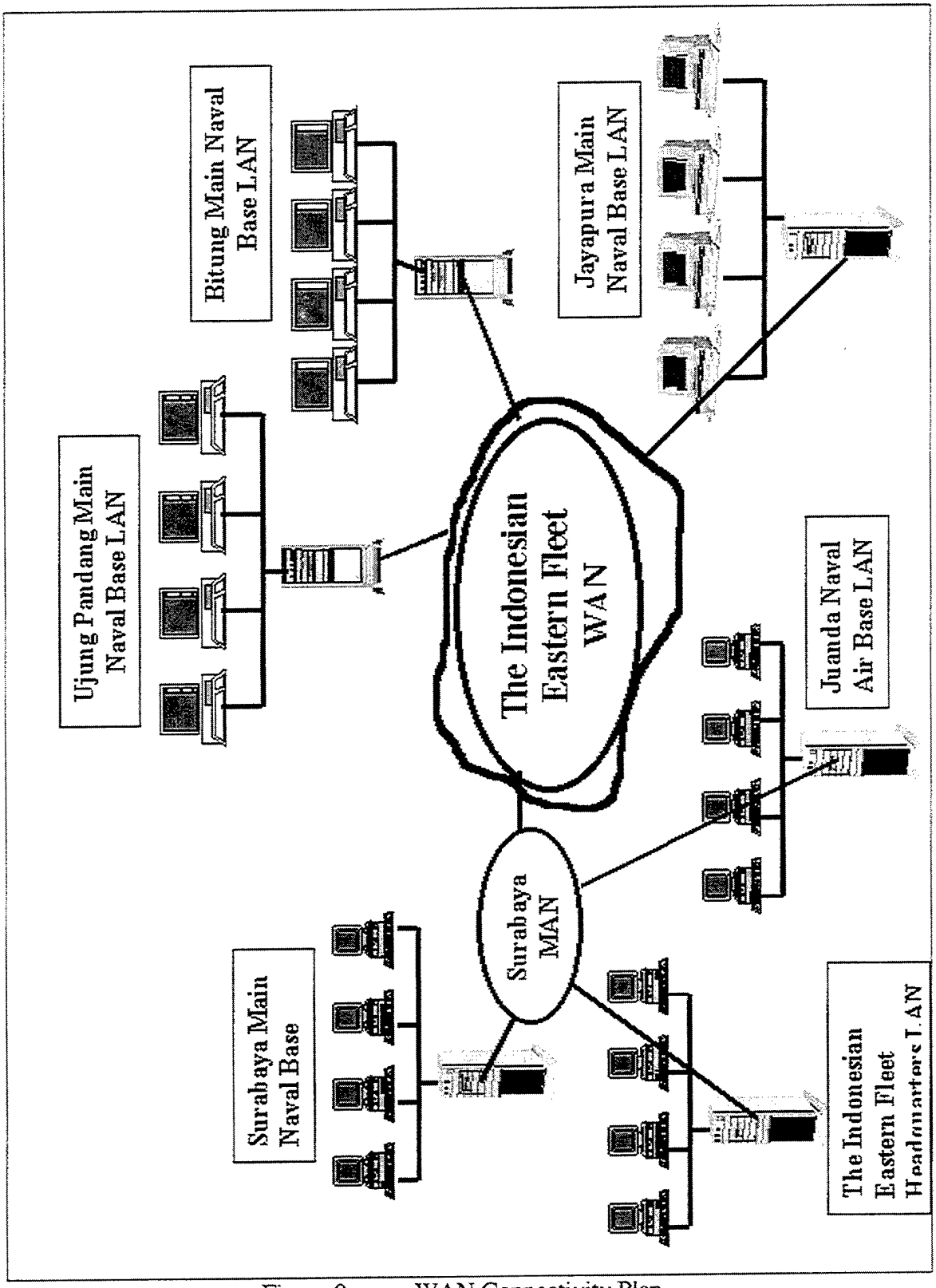

Figure 9. WAN Connectivity Plan

H. WIDE AREA NETWORK OPERATING SYSTEM

As mentioned in the previous chapter, Windows 2000 Server is the appropriate choice for the Indonesian Eastern Fleet's web-based WAN operating system. It integrates user's desktops with the Internet, thereby removing the distinction between the local computer and the Internet. Windows 2000 Server includes Microsoft Internet Information Server (IIS 5.0), a secure Web-server platform used to host Internet Web sites on network servers.

Windows 2000 Server ensures network security by authenticating users before they gain access to resources or data on a computer or the network. It provides local auditing for files, folders, printers, and other resources.

Networking and communication services are the main goals of the Indonesian Eastern Fleet network. Windows 2000 Server provides built-in support for the most popular network protocols, including TCP/IP and IPX/SPX. It provides dial-up networking, which lets mobile users connect to a computer running Windows 2000 with the capability of 256 simultaneous sessions.

I. WEB SERVER

Web servers make information available on a computer connected to the Internet, and web browsers show us information stored on a web server over the Internet. A web server receives requests for information from a client via the Internet and after processing these requests and checking their validity, retrieves or generates the desired information and transmits it back to the client. Every computer on the Internet that contains a web site must either have a web server or upload the web site files to a computer that has a web server.

1. Web Server Software

Most large network systems use an Apache server while the smaller systems primarily use Microsoft's Internet Information Server 5.0 (IIS 5.0). The Apache server delivers the ultimate in flexibility and extensibility. Its modular design allows a Web administrator to build an application-specific binary, especially for the requirements of that installation.

Considerations in choosing a web server include how well it works with the operating system, its ability to handle server side programming and publishing, search capability, and web site construction tools that may be included. The software to be used for a web server is closely related to the hardware platform that will host the web server. Microsoft provides IIS 5.0 bundled with Windows 2000 Server, which means that we do not have to purchase it as an additional software package. IIS 5.0 is a high performance web server containing many improvements compared with the previous IIS versions. In addition, IIS 5.0 provides performance application protection security enhancements. For these reasons IIS 5.0 is the most appropriate web server for the Indonesian Eastern Fleet network.

2. Web Browser Software

A web browser is a program that is used to view and to access web pages that exist on various web sites. The web browser has the job of processing received pages, parsing HTML code, and displaying the page to the user. The browser will attempt to display graphics, database tables, forms, formatted text, or whatever the page contains. The most popular web browsers now in use are Microsoft Internet Explorer, Netscape Navigator, and Mosaic. The types of computing platforms we use can influence the

selection of an appropriate browser. So, first we have to check the operating systems that run under the respective hardware platforms and the versions we need. Another consideration is the browsers' Java-capability. It is better to test web pages using multiple browsers to ensure the final output appears as intended.

3. Middle ware Network Protocol

A necessary aspect of setting up an Internet environment in a company is to select a specific protocol for use on the corporate network. The protocol that is widely used for Internet technologies is known as the Transmission Control Protocol/Internet Protocol (TCP/IP). This protocol can operate on Ethernet local area networks, on various Wide Area Networks (WANs), and even over standard telephone lines that are connected to a modem.

4. How Web Browsers and Servers Work

The basic task of a web browser is to retrieve a web page from a specific location in cyberspace then display the page according to the rules of HTML. The Uniform Resource Locator (URL) of a web page is its address on the net. Another program, known as a web server, is waiting at this address. When a user types a URL into a web browser, the browser "travels" to the address and "asks" the web server for the desired web page. If the server has the page, it "gives" it to the web browser via a TCP connection. The web browser then displays the page to the user. In the client/server programming model a server awaits and fulfills requests from client programs in the same or other computers. A given program (application) in a computer may run as a client which requests services from other programs and as a server of requests from other programs.

J. APPLICATION SERVER

There are some choices of application server such as IBM WebSphere Application Server 3.02, Oracle*9i* Application Server, Netscape Application Server and ColdFusion that commonly used at the present time. Application servers provide the foundation for integrating browser, server, and database technologies into web applications. It gives developers a tool for creating dynamic web applications and interactive sites.

ColdFusion uses a flexible server-side markup language that seamlessly integrates with HTML called ColdFusion Markup Language (CFML). CFML gives the ability to control the behavior of applications, integrate a wide range of server technologies, and generate the content that is returned to the web browser. When a page in a ColdFusion application is requested by a Web browser, it is automatically pre-processed by the ColdFusion Application Server. Based on the CFML in the page, the Application Server executes the application logic, interacts with other server technologies, and then generates an HTML page and returns it to the web-server. The web-server returns the page to the user's web browser.

IBM WebSphere Application Server is an e-business application deployment environment built on open standards-based technology. We can use Java servlets, JavaServer Pages and XML to quickly transform static web sites into vital sources of dynamic web content. IBM WebSphere Application Server offers qualities of service such as scalability, performance, security, and availability.

We also can build and modify web-sites and applications using Oracle9*i*. We can create personalized portals, manage and secure our website infrastructure.. Once our

Web site is deployed, Oracle9*i* Application Server has built-in reporting and ad-hoc query and analysis functionality to derive business intelligence. This enables us to make rapid and accurate decisions to improve operating efficiencies.

Considerations in defining an application server include how well it works with the operating system (Windows 2000) to meet the Indonesian Eastern Fleet network requirements in effectiveness and efficiency. One advantage of Cold Fusion is that a developer does not need to know any scripting language to be able to create effective Web database applications. The tags that start with CF prefix are Cold Fusion tags. The Cold Fusion Server handles these special tags. For the purpose of this network design the author suggest the Indonesian Eastern Fleet network use ColdFusion Server 4.5 Professional running on Windows 2000 Server with Internet Information Server 5.0.

K. DATABASE SERVER

IBM DB Universal Database, Microsoft SQL Server 2000, and Oracle Database are the widely used database server software in most corporate and organizations at the present time. Databases simplify the collection and maintenance of data and facilitate querying and displaying data in a wide variety of formats. Using tables, a lot of information that is related in simple or complex ways can be organized and managed.

Since we chose Windows 2000 Server as our network operating system, we can use Microsoft SQL Server 2000 as the database server software for the Indonesian Eastern Fleet network. SQL 2000 server has good support for Web standards and systems management. Microsoft SQL 2000 is robust and can be use properly in large or medium network such as in the Indonesian Eastern Fleet network. It also offers users an

XML environment and a data mining feature in Analysis Services which can be used to discover information in OLAP cubes and relational databases.

L. MANAGING THE WIDE AREA NETWORK USING WEB-BASED TECHNOLOGY

1. The Advantages of Using Web-Based Technology

The Internet is a global grid of networks enabling computers to directly and transparently communicate and share services throughout much of the world. Using a computer and an Internet Service Provider (ISP) connection, we can get access to the entire worldwide public data network without restriction. If we have the proper equipment on our computer, we can also provide information to the rest of the world. Web based information systems help unify all forms of documents, data, sound, pictures, movies, messages and computer applications in ways we never imagined before [Ref. Harler, 1999]

An effective and efficient network will provide reliable information systems as required to support the Indonesian Eastern Fleet operations. Web-based technology gives the advantages by providing efficiency to achieve the main goal of the Indonesian Eastern Fleet. Various operating systems are used in diversified Indonesian Eastern Fleet office units, including Windows 3.1/ 95/98/ME and Windows NT 4.0/Windows 2000. Using Web-based technology, a variety operating system can be linked together. Web-based technology is designed for use in a networked environment, containing desktop computers using various operating systems. It is device-independent and works well in a cross-platform environment. The main requirement is that the network supports TCP/IP communications.

Web-based technology can be used productively for improving communications between widely separated work groups-especially those that operate on interconnected LANs spread across the sea in the entire eastern fleet region. Connectivity is the key word in using web-based technology. Its ease of access provides the ability to get to key management sites from anywhere in the eastern region. The use of web-based technology makes it possible for the Indonesian Eastern Fleet to save money and operate their units more efficiently by letting widely dispersed desktop computers share mission essential resources.

2. Network Management

The main goal in managing the WAN is to control, monitor, and run the network in such a way as to insure its proper operation. We must attain a reliable end-to end service to ensure the network users share information and transfer data. Network management system are divided by the International Organization for Standardization (OSI) into five functional areas:

- Fault management
- Performance management
- Configuration management
- Accounting management
- Security management

Fault management is the function of detecting, isolating, and correcting faults in the system. The network manager has the ability to quickly detect problems and initiate recovery procedures. Fault management is very important because time is a critical factor in supporting information systems to all naval units via the network.

Performance management is the function of monitoring and controlling the system's resources. Managers have to monitor and control that the network has the capacity to accommodate users' needs using performance management tools. Performance can be measured by error rates, percentage utilization, overall throughput, and response time.

Configuration management is the function of manipulating hardware and software while still maintaining the system. It is the process of keeping in touch with all network devices. Configuration management helps the network manager to compare the running configuration with that stored in the system.

Accounting management is the function of tracking the system's resources and charging them to users. Accounting management gathers network statistics to help the network manager makes decisions regarding the allocation of network resources.

Security management is the function of protecting the system from human error, direct probing, subversion, penetration, and abuse of authority. It adopts proper encryption techniques and security logs.

The network manager is able to communicate with element of the network and monitor and control the running network by using network management protocols. The network management protocol most commonly used to manage a WAN is Simple Network Management Protocol (SNMP). SNMP is widely used and many vendors of network components design their products to support SNMP. It provides the tools needed to gain management information from the network, and is conform to the OSI seven-layer model. SNMP combines:

- Management Information Base = MIB. It is a database of configuration and statistical information on the network device. MIB collects all the objects that SNMP can manage.
- A Management station
- A management agent. The management agent is resident in the network components such as hubs, bridges, routers, and hosts, providing the management station with important information.

SNMP exchanges network information through messages (Protocol Data Units = PDU) that can be seen as an object containing variables with both titles and values. The operation of SNMP can be broken into three basic commands: *get, set,* and *trap.* These commands utilize the MIB to obtain and manipulate data pertaining to objects. *Get* allows a manager to obtain data from an object. *Set* allows a manager to change or update data from an object. *Trap* sends data automatically from an object to a manager when certain thresholds are exceeded. Through the use of MIBs, SNMP agents can be installed that allow managers to monitor specific objects. SNMP has the advantages of its simple design and ease to implementation in large networks.

Besides SNMP there are some other network management protocols such as Remote Network Monitoring (RMON), and Switch Monitor Management Information Base (SMON).

3. Web-Based Network Management

In order to use the WWW infrastructure for network management, Hyper Text Transport Protocol (HTTP) is used as an interface layer between the devices that use SNMP. HTTP servers provide information that can be retrieved by web-browsers using HTTP protocol. HTTP is a stateless information retrieval protocol based on a TCP/IP suite. The retrieved information can be specified in several formats including graphics, text, binary, and Hyper Text Markup Language (HTML). HTTP does not replace such

network protocols as SNMP. In order to manage network resources using HTTP it is necessary to have an application which speaks both HTTP and SNMP. This can be achieved in two ways by extending standard HTTP servers and creating a proxy application which allows it the issue of SNMP protocol requests using HTTP. It is relatively easy to implement since the HTTP server transparently handles the HTTP protocol. Existing character-based network management applications can easily become Web-aware since it is straightforward to enrich the textual output with HTML tags.

Web-based network management using Java is common and widely used at the present time. The Java management application programming interface (JMAPI) supports SNMP and is based around the Java programming language. It takes the advantage of the same extensions and capabilities of Java. It consists of a manager browser in the Network Management System (NMS), and an intelligent Java engine in the agent. The manager browser monitors and controls network elements in the network. The communication between the NMS and the agent is carried out by Java classes using TCP sockets.

Web-based Enterprise Management (WBEM) is another model that merges SNMP with HTTP. WBEM is an initiative based on a set of management and Internet standard technologies developed to unify the management of enterprise computing environments. It provides the ability for the industry to deliver a well-integrated set of standards-based management tools leveraging the emerging web technologies such as HTML and XML. WBEM facilitates the use of the same terms and formatting in management applications so that the applications can communicate and users can more

easily compare information from different application and devices. It comes with three elements:

- HyperMedia Management Protocol (HMMP): an object-oriented management protocol implemented on top of HTTP
- HyperMedia Object Manager (HMOM): a data model to incorporate different information sets
- HyperMedia Management Schema (HMMS): an object oriented data model for representing the managed environment

4. Implementing WBEM

The smoothly run wide area network is essential to the operation of the Indonesian Eastern fleet mission critical. We cannot tolerate a lot of down time occurred in our network system. Therefore, network management is a fundamental requirement of our network. The network management keeps our network devices up and running.

SNMP and the network management consoles including WBEM are useful tools. In order to implement WBEM in our network we have to have management agents reside in all network components. We can use HP OpenView to help us manage our network by giving a clear view of its components, including not only hardware such as routers and hubs, but SNMP objects such as applications and databases as well. We should create customized views to reflect our organization's information needs. Performance and trend reporting show us in real-time how our systems are performing. Using HP OpenView as a network management tool allows the management agents reside in the network components such as hubs, bridges, routers, and hosts. A management agent plays an important role in network management systems by providing the management station with important information. Our legacy gear such as radio transmitter would also have agents in them. Further, our telecommunication stuff such as ISDN switches would have

telco-proprietary management interfaces using the functionalities of HP OpenView network management tool.

The implementation of WBEM needs tools that identify and solve performance problem of our network. The tools must monitor, diagnose, trend and even predict server performance. HP OpenView delivers integrated tools to solve those performance problems. In addition to managing devices like routers, bridges, and hubs, the HP OpenView Extensible SNMP Agent allows us to manage applications, printers, users, and databases that are central to business success. Network managers can configure new SNMP objects without programming. With support of all types of management information base (MIB) objects, we can completely customize network and systems management to include objects that meet our needs.

Web-based network management systems using the functionalities of complex platforms such as HP OpenView allow managers to specifically obtain or manipulate the desired information by simply typing the required data sets. Web-based interfaces can supplement the network management system by allowing managers to access information in another format on top of such products as HP OpenView by simply selecting an option in OpenView's drop down menu.

The use of a web-based network management tool provides the ability to manage objects directly from a web-based management station. The web-pages are accessed via an ordinary web browser, such as Internet Explorer or Netscape Navigator, that interfaces with HP OpenView-Network Node Manager (HP-NNM). HP-NNM manages objects on the network and would feed the status of the objects via MIBs.

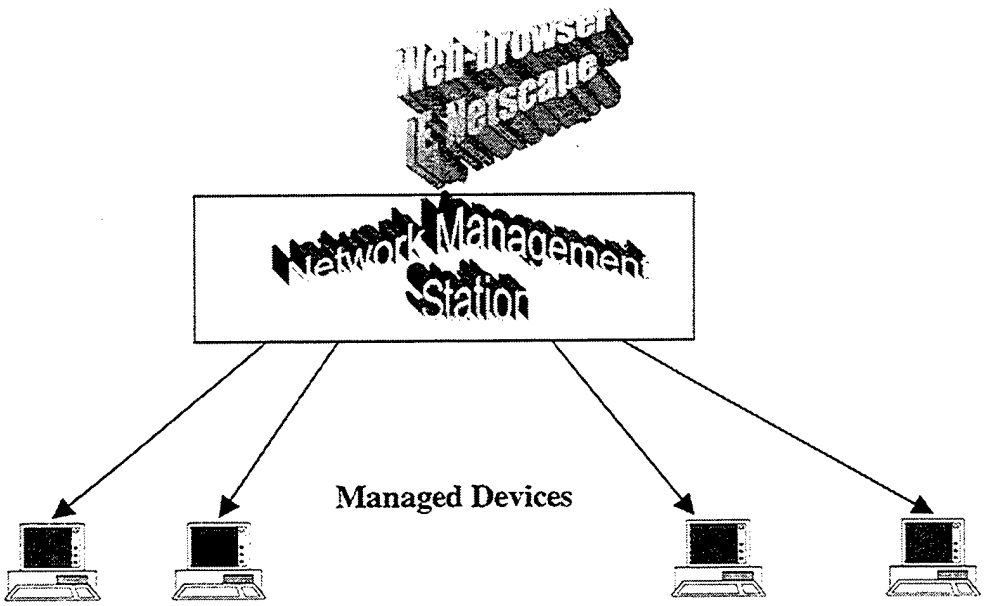

Figure 10. Web-based Network Management

By using "automated device discovery and layout" HP-NNM discovers TCP/IP and layer 2 devices on both LANs and WANs and presents this information in a graphical format. It continuously monitors the network for new devices and for the status of previously discovered equipment [Green, 1999]. It also has user interface based on Java™ that provides easy access to network maps and enables management of data from anywhere on the web. The purpose of its map is to illustrate the structure of the network and the status of devices and segments.

WAN connectivity can be achieved in a manner which optimizes economy and design. The management and maintenance of the Indonesian Eastern Fleet network is simplified through standardization. Simple Network Management Protocol (SNMP) clients and WAN management applications using HP OpenView are valuable tools to assist personnel in the management of a WAN. The web has emerged as a new paradigm in information access and display, becoming the preferred method for accessing

corporate data over the network. Web technologies can serve as an excellent infrastructure for simple and powerful tools to address the current problems of network management systems. Web-based tools can provide portability across platforms and a good framework for network management application architecture. Managing the WAN can significantly benefit from the use of web-based technology, such as easy-to-reach information, operation reuse, and consistency in presenting and accessing information and objects.

M. TRAINING PROGRAM

The site network administrators require training in network administration particularly in troubleshooting problem area. A clear path for troubleshooting and points-of-contact needs to exist and be understood by local administrators. The majority of network errors encountered throughout the implementation phase have been unrelated to WAN connectivity. This would reduce the burden of the WAN administrators.

Training program should be conducted in order to ensure the network always running well because its managing by the right personnel that has been trained properly. Network management needs the implementation of the process of using hardware and software by trained personnel to monitor the status of network components. They also monitor line facilities, question end users and carrier personnel, and recommend actions to alleviate outages and improve communications performance as well as conduct administrative tasks associated with the operation of the network. The training program for network administrators designed such a thing so that they knows the system's features and the functions and has knowledge about how to use and maintain the network management system.

Beside network administrators, the network operators also should be trained. Network operators responsible for operating the network in each LAN. They report the condition, status and operation of the network regularly to a network administrator. The trained network operators would recognize that WAN connectivity is exists or not.

People who will be trained should be the potential personnel that is required to support their unit organization and has a background in computer skills. The training program will take place in the computer training facility in the Eastern Fleet Training Command in Surabaya. Personnel that would be trained should be the military personnel from information technology units and also from command, control and communication units of each main naval base.

For network administrators, their ranks should be First Class Petty Officer until Ensign (E-6 until O-1). Windows 2000 MCSE certification exam should be used as a quality measurement for a network administrator and the training program should be executed based upon its syllabi. After completed the training these personnel are qualified as the network administrator which has a responsibility to maintain a set of procedures, software, and operations in order to keep a network operating near maximum efficiency. The success of any information system in each LAN depends on the skills of network administrators.

The ranks for network operators would be Third Class Petty Officer and Second Class Petty Officer (E4 and E5). The trained Second Class Petty Officer would responsible for operating HP OpenView tools. Their place of work would be in the Indonesian Eastern Fleet Network Operation Center in Surabaya. Third Class Petty

Officer would responsible for all network devices and they would be placed in each main naval bases LAN.

The qualification process is based on their experience and ability in computer communication systems. The selection process for network administrators and network operators personnel could bring an improvement to Navy's return of investment. This training program is a career cycle for all personnel that had been trained, not just once. The well trained personnel would have value added that support his job and promotion. Network management required complex and continuously program including training to provide the optimal solution in improving the Indonesian Eastern Fleet information technology systems.

VI. PROPOSED WAN DESIGN USING EXTEND-4 SIMULATION SOFTWARE PROGRAM

This chapter explores the use of modeling and simulation as a tool in designing and evaluating the Indonesian Eastern Fleet network system. The author has developed a wide area network (WAN) design model using an object oriented modeling and simulation tool called EXTEND-4 made by Imagine That, Incorporated. EXTEND-4 is used to measure specific performance variables in a quantitative fashion. It is an easy to use graphical simulation tool that allows a user to model complex discrete or continuous systems while varying performance parameters. EXTEND-4 makes it easy for the user to recognize and configure Graphical User Interface (GUI) icons with predefined properties that are adaptable to represent steps and links in a process.

A. ESTIMATING NETWORK TRAFFIC DATA REQUIREMENTS

The network traffic data requirements were used as a source to compute the flow of network messages all over the WAN for modeling and simulation. Each LAN in this network design uses Fast Ethernet 100BaseT LANs architecture that shares a network media 100 Mbps CAT-5 UTP cable. All LANs are linked by ISDN 128 Kbps WAN service and connected by the Cisco 1003 ISDN router. As the second alternative we use T1 line 1.5 Mbps to offer the best solution for network performance.

The messages are delayed in the Ethernet LAN by 100 Mbps CAT-5 UTP bandwidth, and in the wide area network by the WAN connection bandwidth. Currently the Indonesian Eastern Fleet network exhibits worst case delays of approximately 10 minutes. There is no set requirement on e-mail traffic; delivery within a few minutes is

desirable although a few hour delays are usually acceptable. Video is presently sent only within the headquarters LAN and delays are consistent with medium quality video. Data transfer delays are currently approximately 3 to 5 minutes going from one Indonesian Eastern Fleet LAN to another Indonesian Eastern Fleet LAN. Any new network must meet, or preferably reduce, these data latencies.

Network traffic involves email traffic volume, video conferencing network traffic, and data transfer traffic volume which are counted per one workday which is equal to 12 hours. The result of this sum in Mega bits is multiplied by 8, to convert to Mega bytes per day, and then divided by (12hours x 60 minutes x 60 seconds) to provide the result of message sizes in bytes per second that would be sent to destinations all over the WAN.

In this network model 45 computers are represented as one node. Thus, for example, the Surabaya main Naval base LAN that consists of 225 computers has a total of 225 nodes: 45 = 5 nodes. Network traffic for one node is the aggregated traffic of 45 computers. This simplification was done in order to keep the network model reasonably sized. There are total 24 origin nodes and 24 destinations in our WAN design. The detail lists are shown at the estimated network traffic data of the Indonesian Eastern Fleet WAN design as follows:

1. **Surabaya Metropolitan Area Network (MAN)**

   a. Surabaya Main Naval Base LAN

- Ethernet LAN transmission data rate = 100 Mbps
- WAN Bandwidth using ISDN = 128 Kbps, using T1 line = 1.5 Mbps
- Total computers = 225
- Total nodes = 225: 45 = 5
- Email traffic volume = 26 Mbits per day
- Video conferencing network traffic = 2340 Mbits per 30 minutes per day

- Data transfer (text, image, graphic) traffic volume = 68 Mbits per day
- Average total traffic rate = 7040 bytes per sec

b. The Indonesian Eastern Fleet Headquarters LAN

- Ethernet LAN transmission data rate = 100 Mbps
- WAN Bandwidth using ISDN = 128 Kbps, using T1 line = 1.5 Mbps
- Total computers = 315
- Total nodes = 315: 45 = 7
- Email traffic volume = 40 Mbits per day
- Video conferencing network traffic = 2730 Mbits per 35 mnts per day
- Data transfer (text, image, graphic) network traffic = 96 Mbits per day.
- Average total traffic rate = 8290 bytes per sec

c. Juanda Naval Air Base LAN

- Ethernet LAN transmission data rate = 100 Mbps
- WAN Bandwidth using ISDN = 128 Kbps, using T1 line = 1.5 Mbps
- Total computers = 90
- Total nodes = 90: 45 = 2
- Email user traffic volume = 10 Mbits per day.
- Video conferencing network traffic = 1170 Mbits per 15 mnts per day
- Data transfer network traffic (text, image, graphic) = 24 Mbits per day
- Average total traffic rate = 3480 bytes per sec

2. Ujung Pandang Main Naval Base LAN

- Ethernet LAN transmission data rate = 100 Mbps
- WAN Bandwidth using ISDN = 128 Kbps, using T1 line = 1.5 Mbps
- Total computers = 180
- Total nodes = 180: 45 = 4
- Email user traffic volume = 20 Mbits per day
- Video conferencing network traffic = 1950 Mbits per 25 mnts per day
- Data transfer network traffic (text, image, graphic) = 50 Mbits per day
- Average total traffic rate = 5840 bytes per sec

3. Bitung Main Naval Base LAN

- Ethernet LAN transmission data rate = 100 Mbps

- WAN Bandwidth using ISDN = 128 Kbps, using T1 line = 1.5 Mbps
- Total computers = 135
- Total nodes = 135: 45 = 3
- Email user traffic volume = 15 Mbits per day.
- Video conferencing network traffic = 1560 Mbits per 20 mnts per day
- Data transfer network traffic (text, image, graphic) = 36 Mbits per day
- Average total traffic rate = 4660 bytes per sec

4. Jayapura Main Naval Base LAN

- Ethernet LAN transmission data rate = 100 Mbps
- WAN Bandwidth using ISDN = 128 Kbps, using T1 line = 1.5 Mbps
- Total computers = 135
- Total nodes = 135: 45 = 3
- Email user traffic volume = 15 Mbits per day.
- Video conferencing network traffic = 1560 Mbits per 20 mnts per day
- Data transfer network traffic (text, image, graphic) = 36 Mbits
- Average total traffic rate = 4660 bytes per sec

B. NETWORK MODELING AND SIMULATION

We use the blocks from the EXTEND-4 standardized libraries of process objects. These blocks are designed to facilitate the rapid development of simulation models of queuing systems by dragging and dropping them from the library to the model workspace. The three most-used libraries that come with the basic EXTEND-4 package are Generic, Discrete Event, and Plotter Libraries [Diamond, 1997]. The Generic Library is used for continuous modeling and the Discrete Event library is used for discrete event modeling. The Plotter library holds all the common types of plotters used in our models. Some of these plotters are specific to continuous or discrete event models, while others can be used with either. Models can be built to simulate discrete events or continuous flow problems. The different libraries that are built into the application are generally

application are generally designed specifically for one or the other. However, many objects within the libraries are interchangeable with either type of model

EXTEND-4 uses two main types of blocks in its simulation program: item blocks and attribute blocks. Item blocks receive and process discrete events or items that pass through them. Attribute blocks receive and process attribute values associated with items, although the items do not specifically transit through these blocks. The flow of the model is determined by the order of the connections between blocks of the model.

The actual moving of items between blocks is done through a messaging communication structure using item connectors and connections. This messaging system allows modelers to place blocks in a more intuitive sequence. Discrete event blocks send messages to each other during the course of a simulation run. These messages are used for communication regarding whether items are available, whether they have been taken, and whether a block is free to receive items.

In this network design, the blocks are grouped together as a hierarchical block and represented as custom blocks in the model workspace. A hierarchical block is unique. It has some characteristics of a block and some characteristics of a model worksheet. Hierarchical blocks have two windows: the layout pane window, which can be seen by double-clicking on a hierarchical block, and the structure window. The structure window contains another view of the layout pane, and we build a new hierarchical block or make changes to an existing hierarchical block's icon, connector position, and so forth. When a hierarchical block is opened by double-clicking on it, the layout of the submodel can be seen in the hierarchical window.

The first step in building the network model is to develop the model of each local area network (LAN). EXTEND-4 provides the blocks necessary to construct the LAN model using communications component logic that was built based upon the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) Fast Ethernet LAN architecture using the CAT-5 UTP 100 Mbps cabling system. All LANs are linked up together as an integrated wide area network (WAN) using the ISDN 128 Kbps/T1 Line 1.5 Mbps. The model descriptions are intended to provide a basic working knowledge of the model.

1. Generating the Message

The messages for the network traffic come from the origin message hierarchical blocks in each LAN. Figure 10 shows the high level hierarchical block of messages originating at node 1, and Figure 11 shows detailed view or the layout of the submodel in the node 1 hierarchical window.

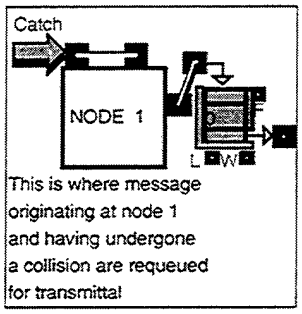

Figure 11. High Level View of the Origin Message Hierarchical Block

Node 1 represents the first 45 workstations at the Surabaya main Naval base LAN. The Surabaya main Naval base LAN has 225 computers that can be substituted to 5 nodes: Node 1, Node 2, Node 3, Node 4, and Node 5.

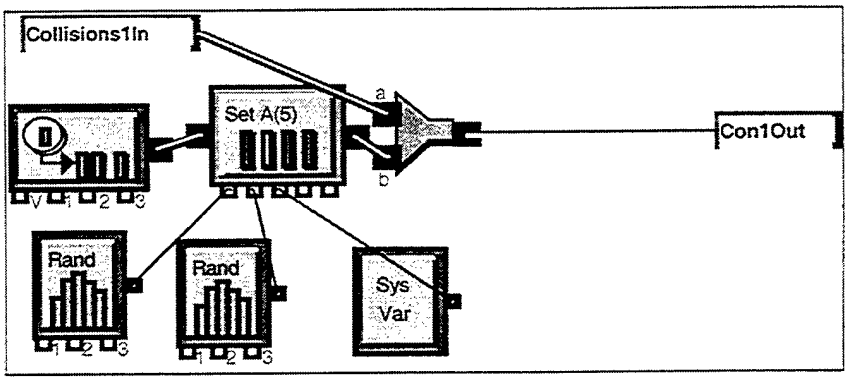

Figure 12. Detailed View of the Origin Message Hierarchical Blocks.

Each node generates messages that consist of e-mail, video conferencing, and data transfer with a certain amount of average message traffic rate already discussed in the previous section. The messages are generated by the "Generator" program block in these nodes with a certain message size that are defined by the Set Attribute program block. The generator provides items for a discrete event simulation at specified interarrival times. Each block has a dialog box that allows for customization of its performance parameters. The parameters for the distribution arrival times are set in the dialog box. At the first run of the Simulation, the exponential random distribution with frequency 1 second is used. For the second run of simulation, frequency 0.5 second is used. Figure 12 shows the generator program blocks and Figure 13 shows its dialog box.

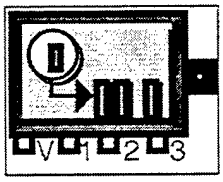

Figure 13. Generator Program Block.

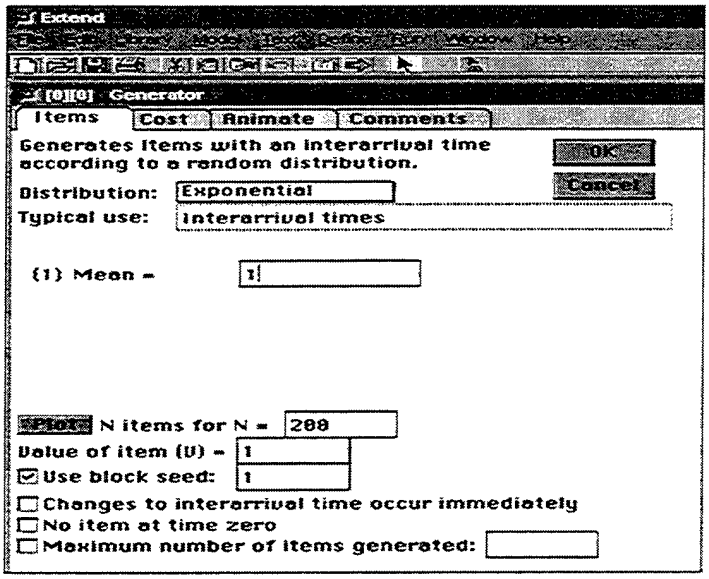

Figure 14. Generator Dialog Box

The "Set Attribute" block sets the specific attribute of items passing through the block. A "Get Attribute" block reads these attributes as the objects pass through the model, facilitating routing of the objects. Up to five attribute names and values may be assigned to an item with this block. The attributes may add to or replace existing item attributes. The amount of network traffic message size is specified with the value input connector at the dialog tab, and this is the message size that will be sent to all destinations over the network. Figure 14 shows the Set Attribute program block, and Figure 15 shows its dialog box.

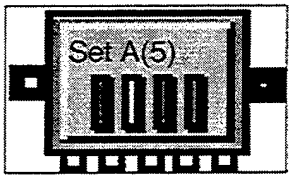

Figure 15. Set Attribute Block

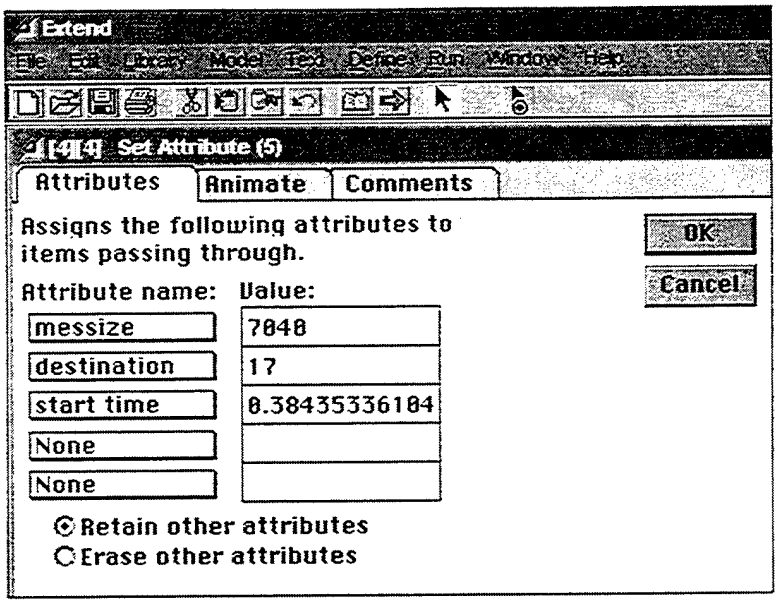

Figure 16. Set Attribute Dialog Box

The probabilities of the messages that will arrive at each destination is set by the input random number block. The input random number generates random integers or real numbers based on the selected distribution. The type of distribution can be selected from among Uniform, Beta, Binomial, Erlang, Exponential, Gamma, Geometric, HyperExponential, LogLogistic, LogNormal, Negative Binomial, Normal, Pearson type, Poisson, Triangular, Weibull, and Empirical. [Diamond, 1997]

In our network design the type of distribution used is the "Empirical table". All message's destinations are appointed by its origin nodes. As mentioned previously, there are a total of 24 origin nodes and 24 destinations in the Indonesian Eastern Fleet WAN design that consist of the Surabaya main Naval base LAN = 5 nodes, the Indonesian Eastern Fleet headquarters LAN = 7 nodes, the Juanda Naval Air base LAN = 2 nodes, the Ujung Pandang main Naval base LAN = 4 nodes, the Bitung main Naval base LAN = 3 nodes, and the Jayapura main Naval base LAN = 3 nodes. Each node sends the

messages to all 23 destinations (not including itself) with a probability = 1 : (24 – 1) = 1 : 23 = 0.043478.

Figure 16 shows the Input Random Number program block, and Figure 17 shows its dialog tabs. The values of our message destinations are entered in the first column of the dialog tabs, and the probability (=0.043478) of that value is entered in the second column. The value column contains the various values that will be output. Probability describes the chance that value will occur. The probability only needs to have the proper values relative to each other, since Extend scales them automatically.

Figure 17. Input Random Number Block

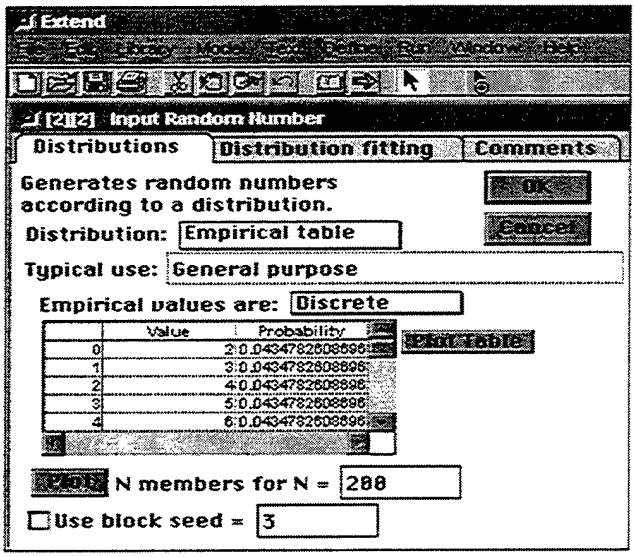

Figure 18. Input Random Number Dialog Box

2. Ethernet Bus

The messages are sent to the network via the Ethernet bus. Due to the 100 Mbps bandwidth (using Cat-5 UTP cable) the messages are delayed in the local area network

(LAN), represented by the activity delay program block. Each node senses the network and transmits only if the network is free.

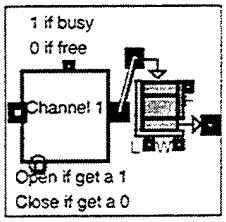

Figure 19. High Level View of the Ethernet Bus Hierarchical Block

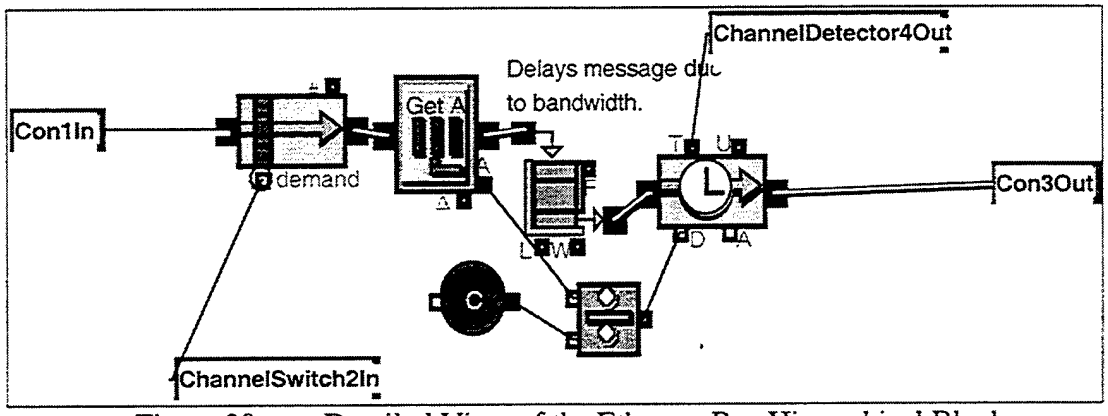

Figure 20. Detailed View of the Ethernet Bus Hierarchical Blocks

3. Initial Local Area Network Configuration

Message traffic generated from an origin node flows to the "first in first out" (FIFO) queue block (see figure 20), and then is sent to the Ethernet Bus in each channel where there is a sensor and detector to implement the channel access protocol of Carrier Sense Multiple Access with Collision Detection (CSMA/CD).

In the Ethernet bus (see figure 18 and 19) the messages pass through the activity service block. The *"Activity Service"* block acts as a gate. It passes an item only when the demand connector is connected and certain conditions exist at the demand input. This block serves as a conditional wait. It accumulates demand based on the values at the demand connector. When the demand input is 1 (greater than > 0.5) or when an item is pulled in at demand, the item input connector allows the items through

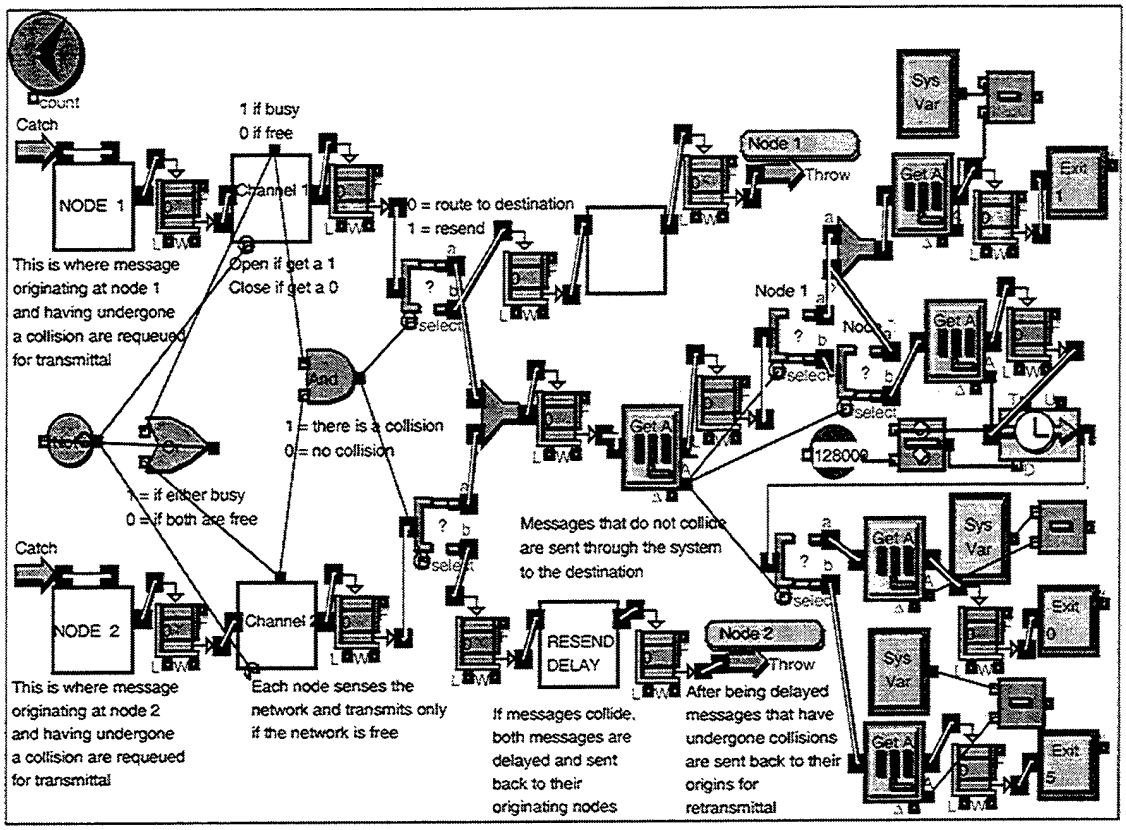

Figure 21. Initial Local Area Network Configuration

this block. If this is 0, the items will not be allowed through this block.

After passing through the activity service block, the message will come to the "*Get Attribute*" block. It displays attributes on items, then passes the items through. The attribute value is shown in the dialog and output at the A connector. As items are passed through the block, the block can either read or remove an attribute, and that attribute can be specified as the first attribute in the list or a named attribute. The name of the attribute to read should correspond to one of the names set in the Set Attribute block.

Whenever the Get Attribute reads the attribute "*message size*", the items in the Ethernet Bus continue flowing via the FIFO queue to the Activity delay. In the Activity Delay the message is delayed due to the bandwidth 100Mbps. If no collisions occur,

messages are sent to the combine block and continue to flow to the destination in the wide area network via the Cisco 1003 ISDN router. The CSMA/CD protocol is invoked to control all the different types of message transmissions.

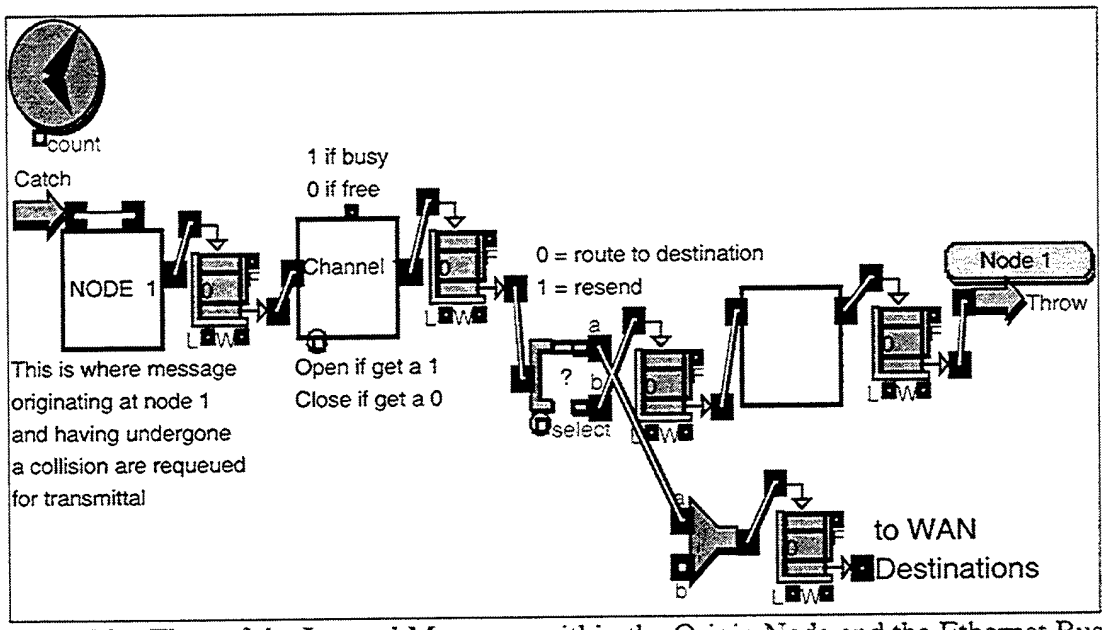

Figure 22. Flow of the Internal Messages within the Origin Node and the Ethernet Bus.

If there is a collision, messages are delayed and messages that have undergone collisions are sent back by the throw block to their origins for retransmittal. Figure 21 illustrates flow of the internal messages within the original node and the Ethernet bus in a local area network.

Internal messages must be sensed and detected. Both the sensor and detector work the bandwidth delay in the Ethernet Bus hierarchical block. If a message is being delayed, the sensor and detector will transmit the information.

The *"Select Discrete Event Output"* selects the input item to be output at one of two output connectors based on a decision. The item at the input is passed through the selected output. The dialog has options for changing the outputs after a given number of items have passed and selecting based on the select connector. The outputs are selected

based on the choices in the dialog. In this network design we define that if it is 0, messages will route to destinations in the network. If it is 1, a collision has occurred and the message has to be retransmitted.

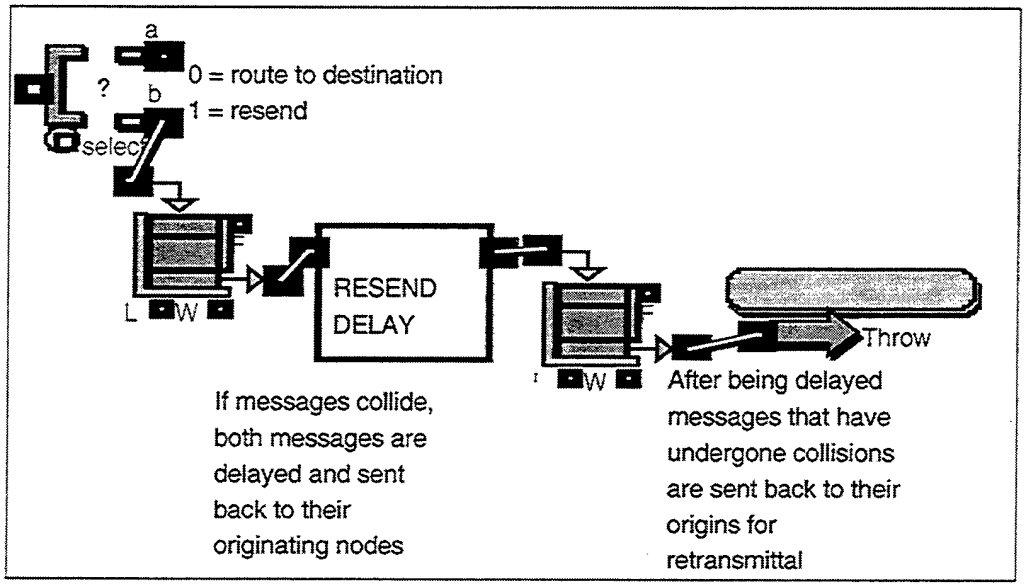

Figure 23. High Level Resend Delay Hierarchical Block

When messages collide, both messages are delayed and sent back to their originating nodes. A retransmitted message is resent to the identified catch block through the Resend Delay hierarchical block. Figure 31 shows the high level view of Resend Delay hierarchical block, and Figure 32 shows the detailed view of Resend Delay hierarchical block.

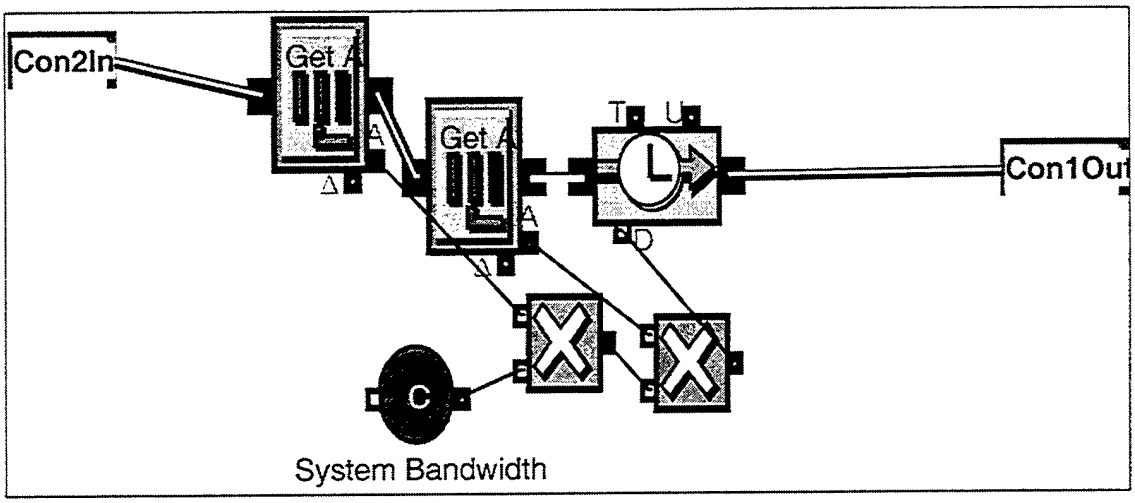

Figure 24. Detailed View of Resend Delay Hierarchical Block

4. Interconnecting the Indonesian Eastern Fleet Wide Area Networks

Each LAN can be consists of two nodes, three nodes, four, and so forth. Once LANs are created, they can be interconnected to construct WAN communication architectures of virtually any size. Next Figures show the Extend-4 simulation model workspace of the Indonesian Eastern Fleet WAN design that consists of:

- Figure 25 shows high level view of the Indonesian Eastern Fleet WAN design
- Figure 26 shows detailed view of Surabaya main Naval base LAN
- Figure 27 shows detailed view of the Indonesian Eastern Fleet headquarters LAN
- Figure 28 shows detailed view of Juanda Naval air base LAN
- Figure 29 shows detailed view of Ujung Pandang main Naval base LAN
- Figure 30 shows detailed view of Bitung main Naval base LAN
- Figure 31 shows detailed view of Jayapura main Naval base LAN

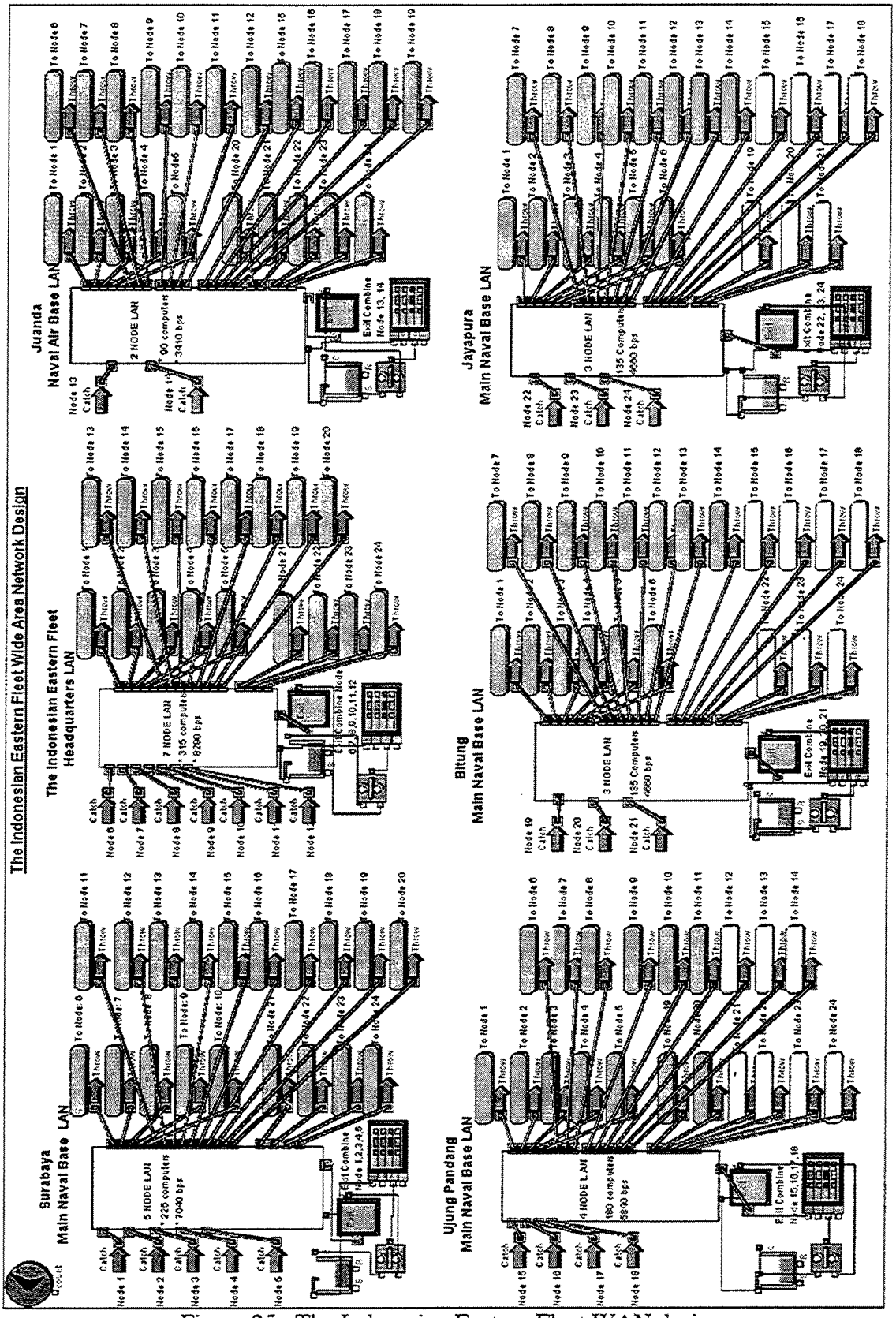

Figure 25. The Indonesian Eastern Fleet WAN design

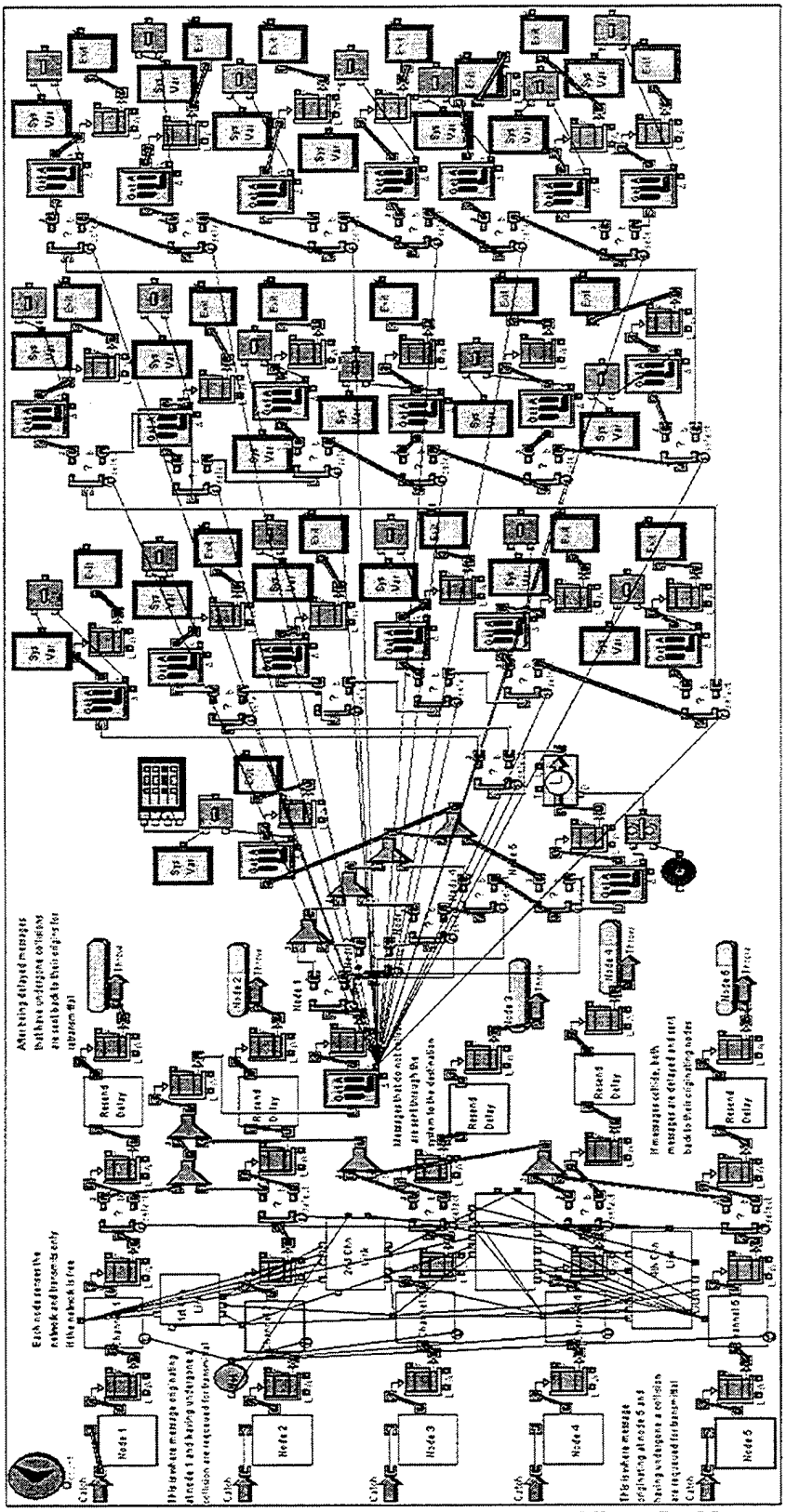

Figure 26. Surabaya Main Naval Base LAN

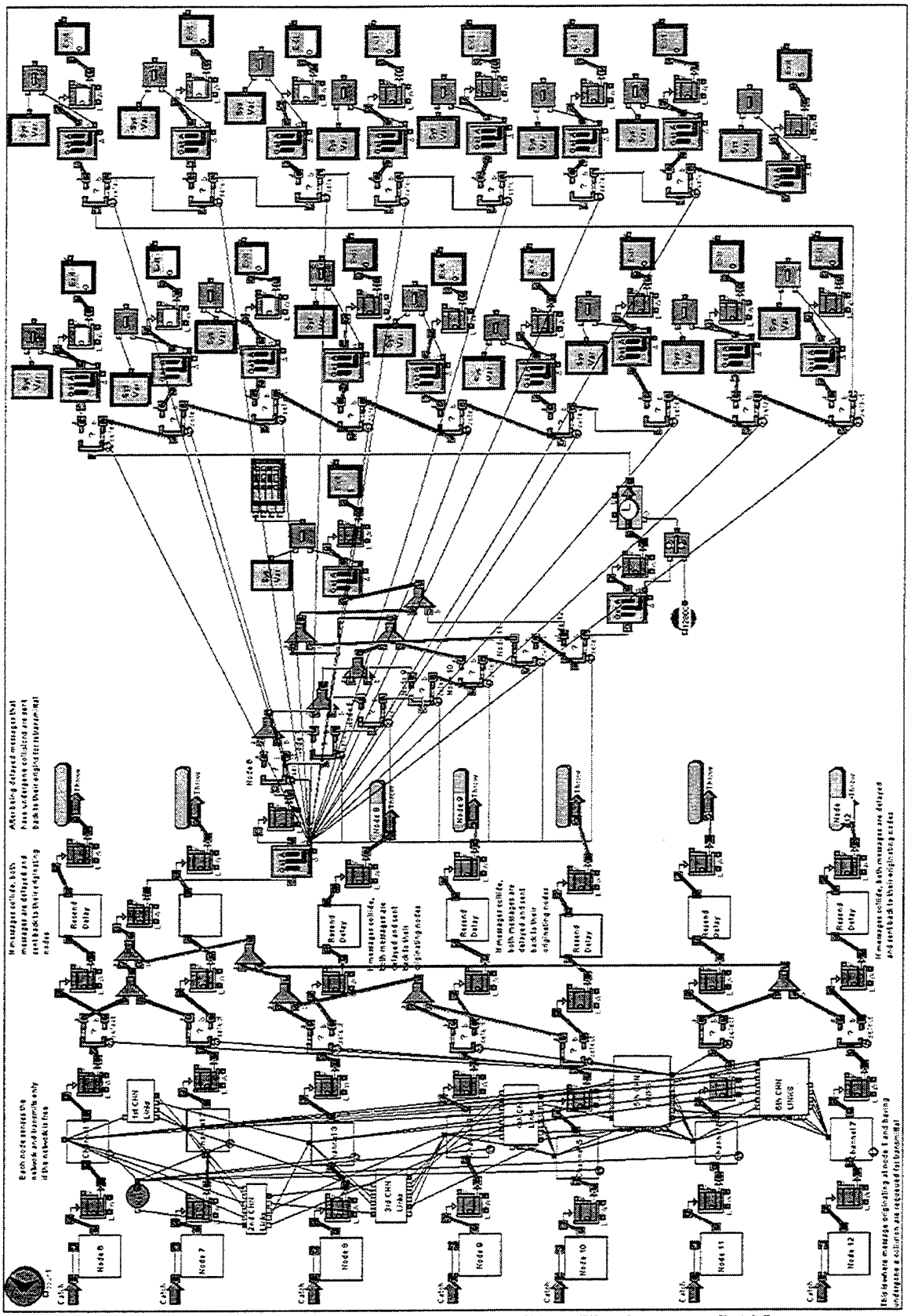

Figure 27. The Indonesian Eastern Fleet Headquarters LAN

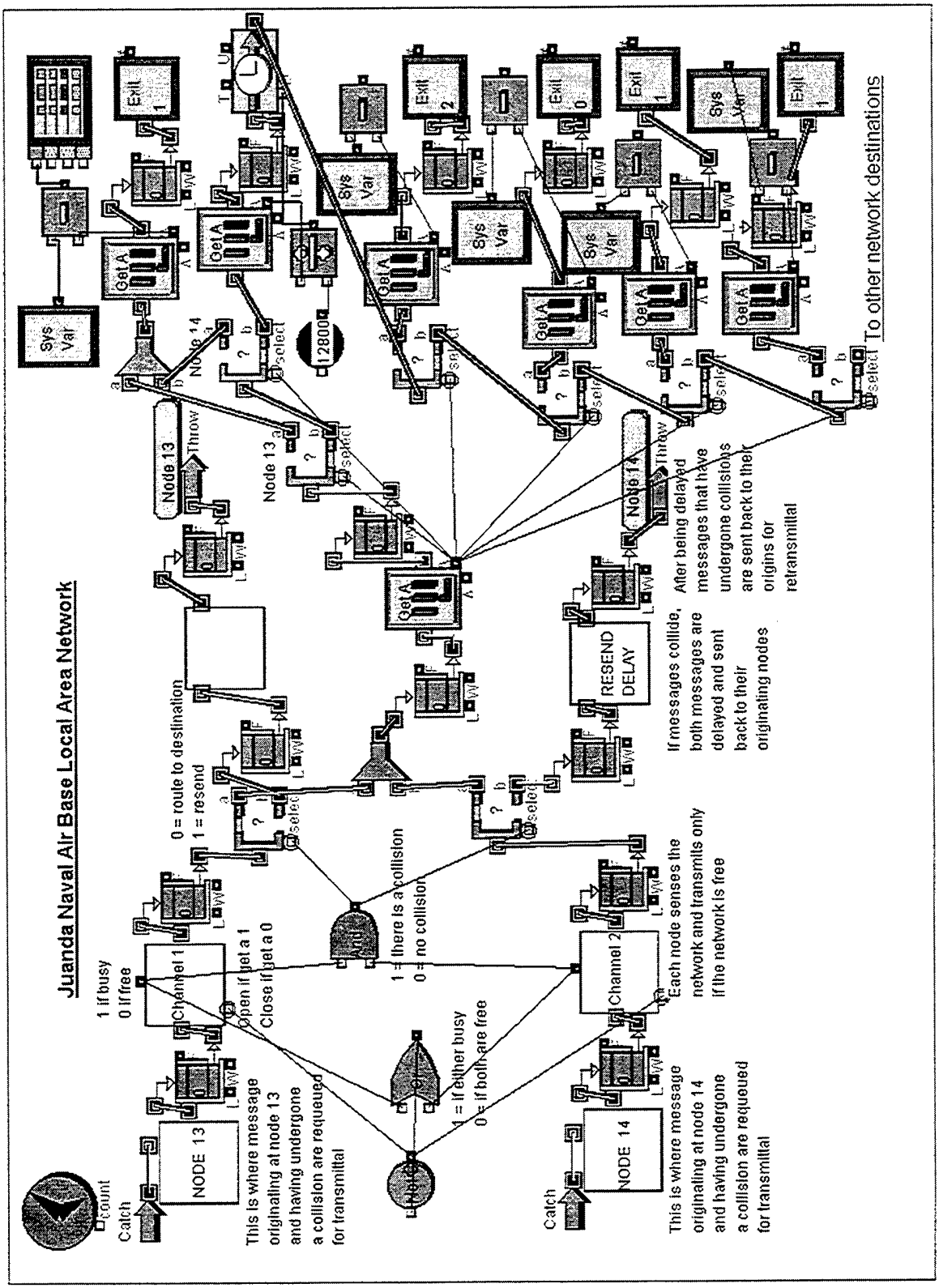

Figure 28. Juanda Naval Air Base LAN

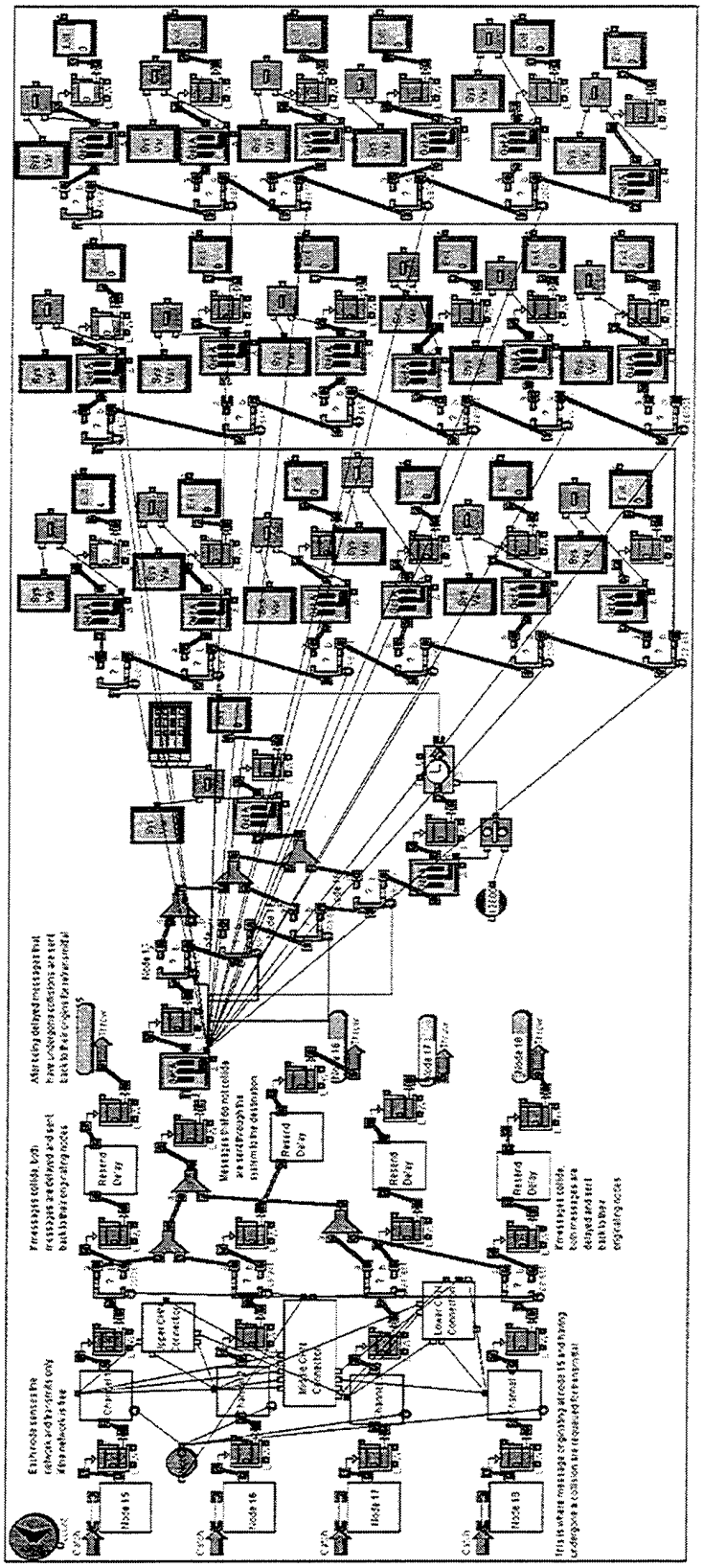

Figure 29. Ujung Pandang Main Naval Base LAN

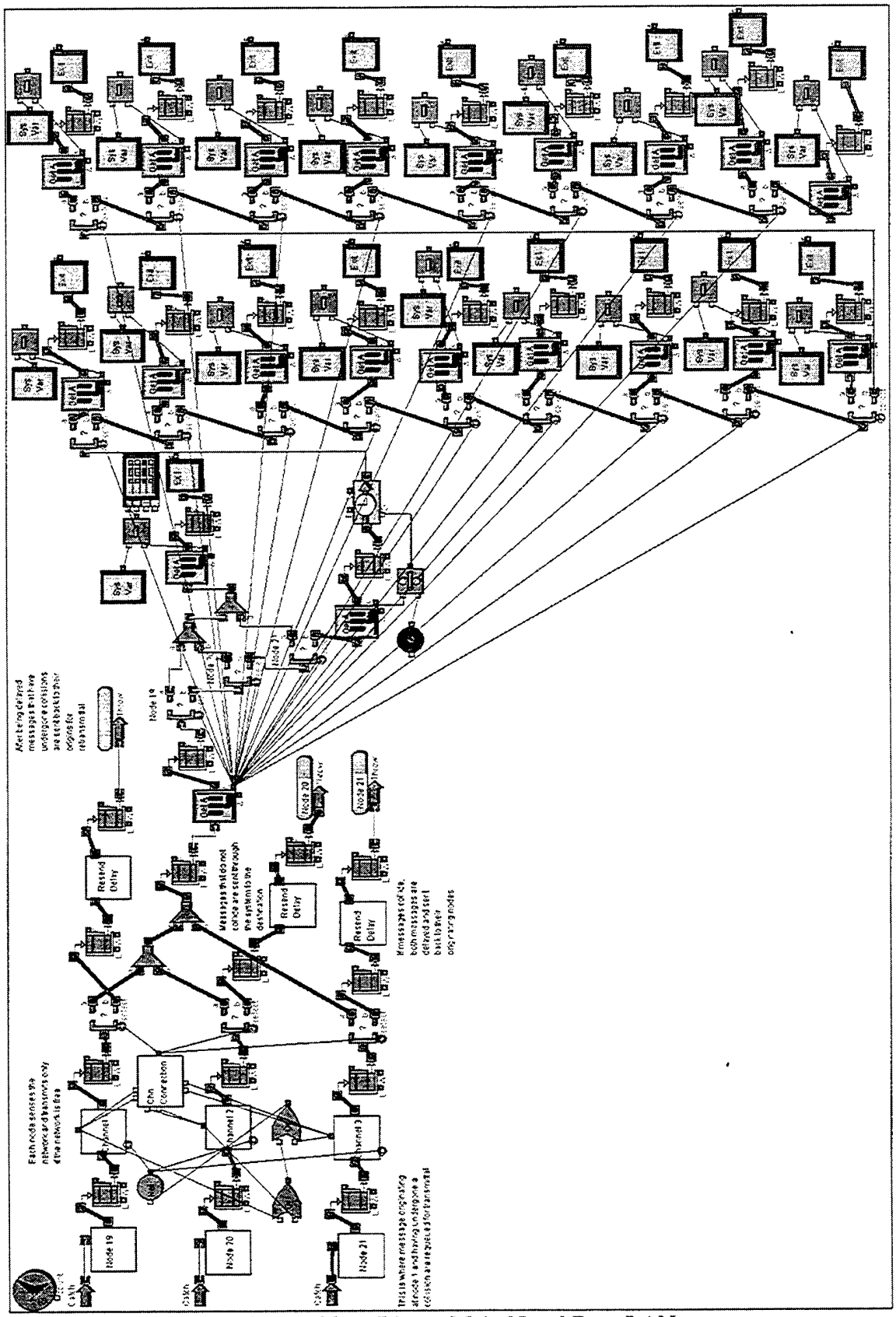

Figure 30. Bitung Main Naval Base LAN

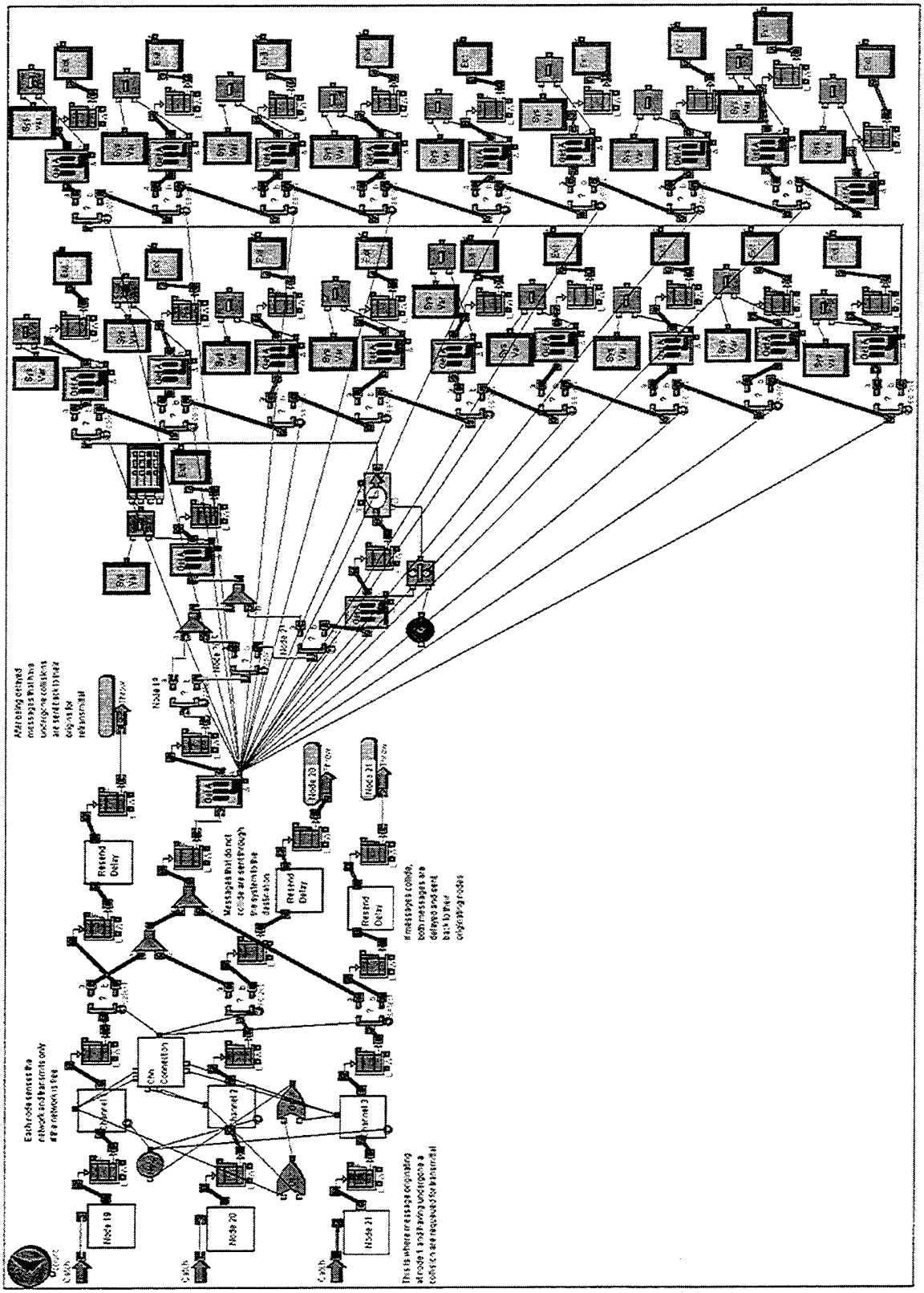

Figure 31. Jayapura Main Naval Base LAN

C. TESTING AND SIMULATION RUN

This section provides results of testing and simulation runs of our wide area network design. A simulation was run using the initial network depicted in Figure 24. All simulations run for a specified time. Extend-4 determines the duration of a simulation based on the values entered in the Simulation Setup dialog (see Figure 31); the duration is the period from the start time to the end time.

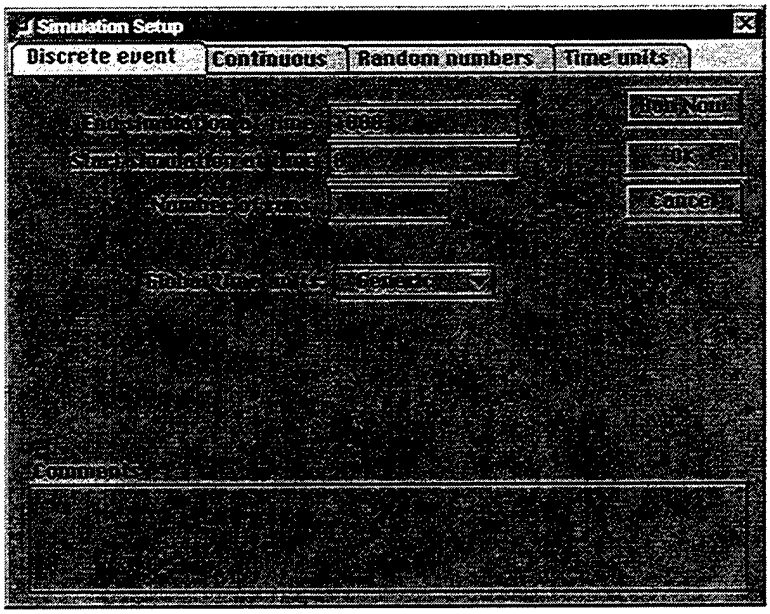

Figure 32. Simulation Set Up Dialog

A Run was executed for 100 seconds simulation time which constituted about 660 seconds real time, and 350 seconds simulation time which constituted about 2040 seconds real time. We executed two simulation runs in each simulation setup. The first run of simulation we used a frequency distribution of 1 second that we set in the Generator program block at each origin node. At the second run we use frequency distribution 0.5 second. All communications that started and ended within an origin nodes and the Ethernet bus showed a delay equal to the message size divided by the

bandwidth. The "Solid Blue" line indicates the bandwidth delay and the "Gray Pat Green" line indicates the average bandwidth delay. The charts depict the delay according to time for each LANs. The vertical axis depicts the delay incurred for each message. The horizontal axis displays the simulation time.

The charts on the figures 32 through figure 57 show some significant spikes in time delay during the messages flows in the network using WAN connection service ISDN 128Kbps and using T1 Line 1.544 Mbps.

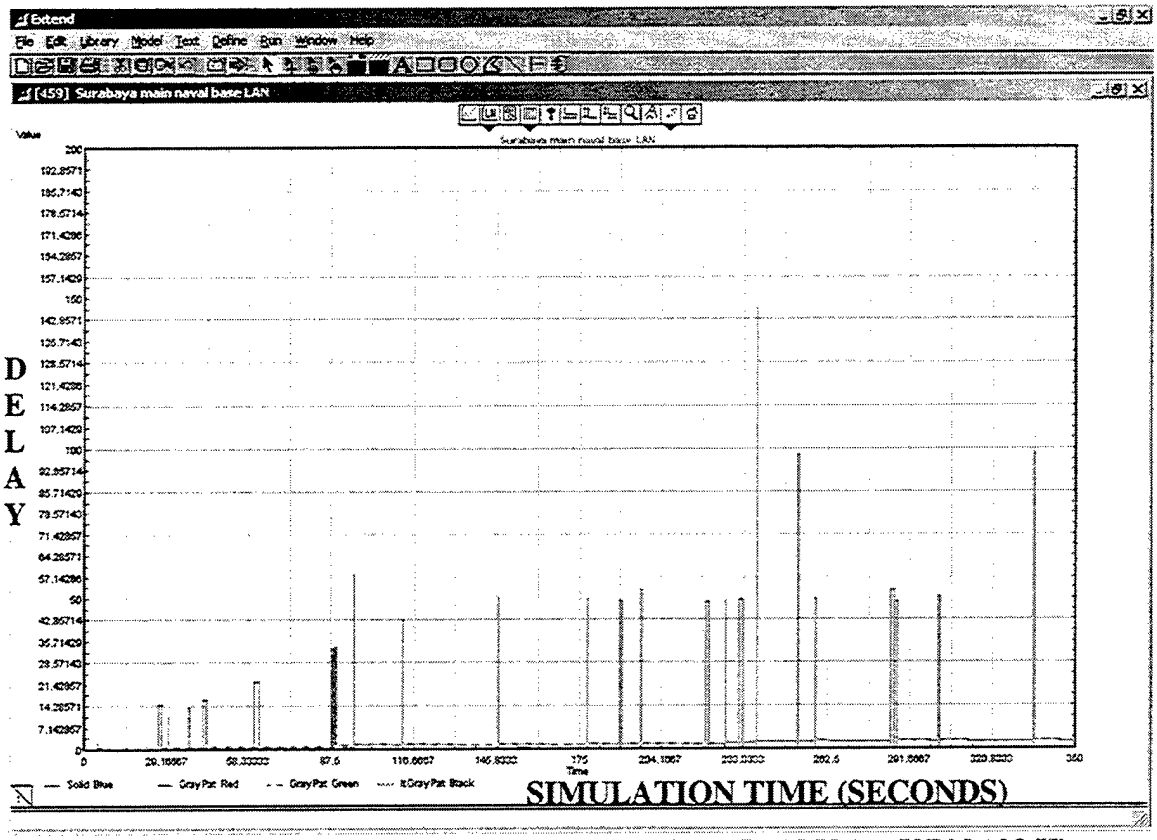

Figure 33. Delay Within Surabaya Main Naval Base LAN Using ISDN 128 Kbps

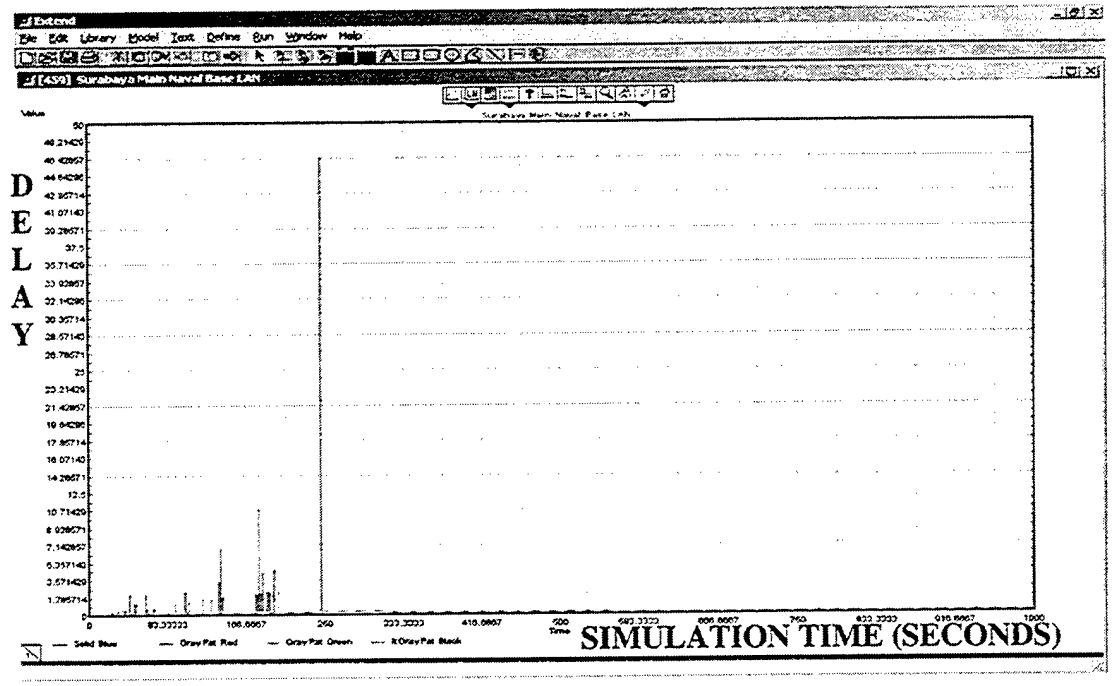

Figure 34. Delay Within Surabaya Main Naval Base LAN Using T1 Line 1.544 Mbps

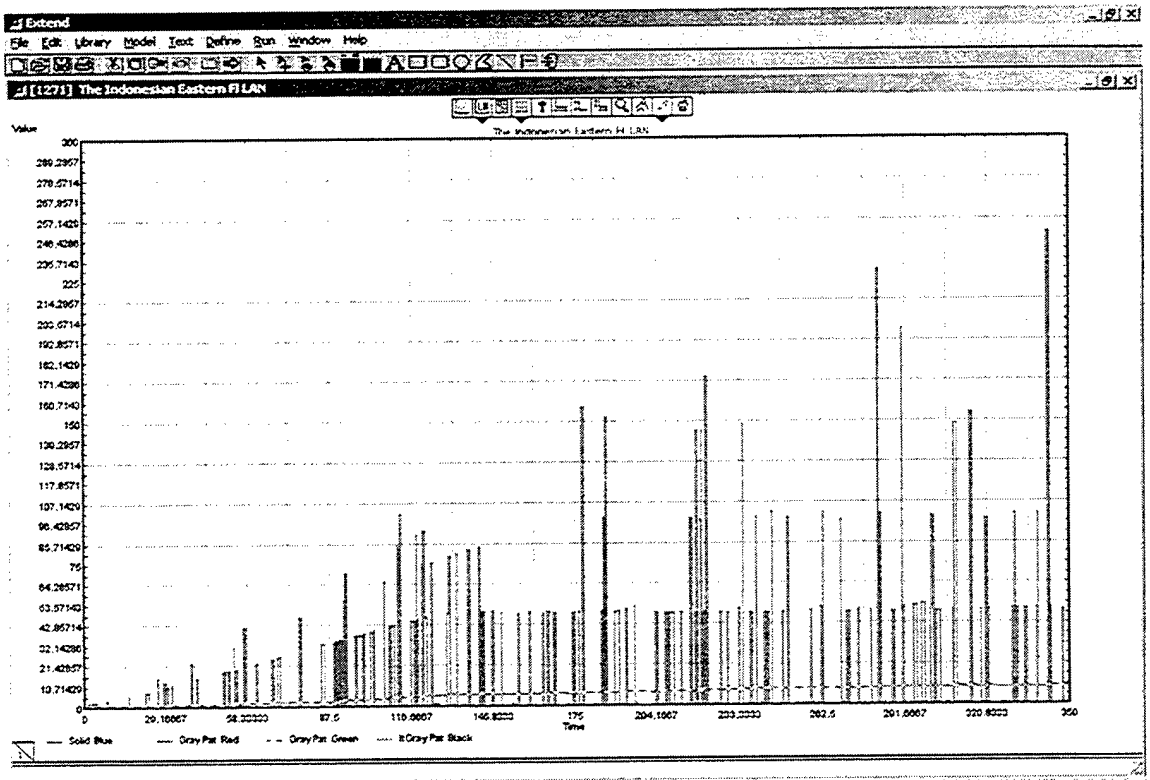

Figure 35. Delay Within the Indonesian Eastern Fleet Headquarters LAN Using ISDN 128 Kbps

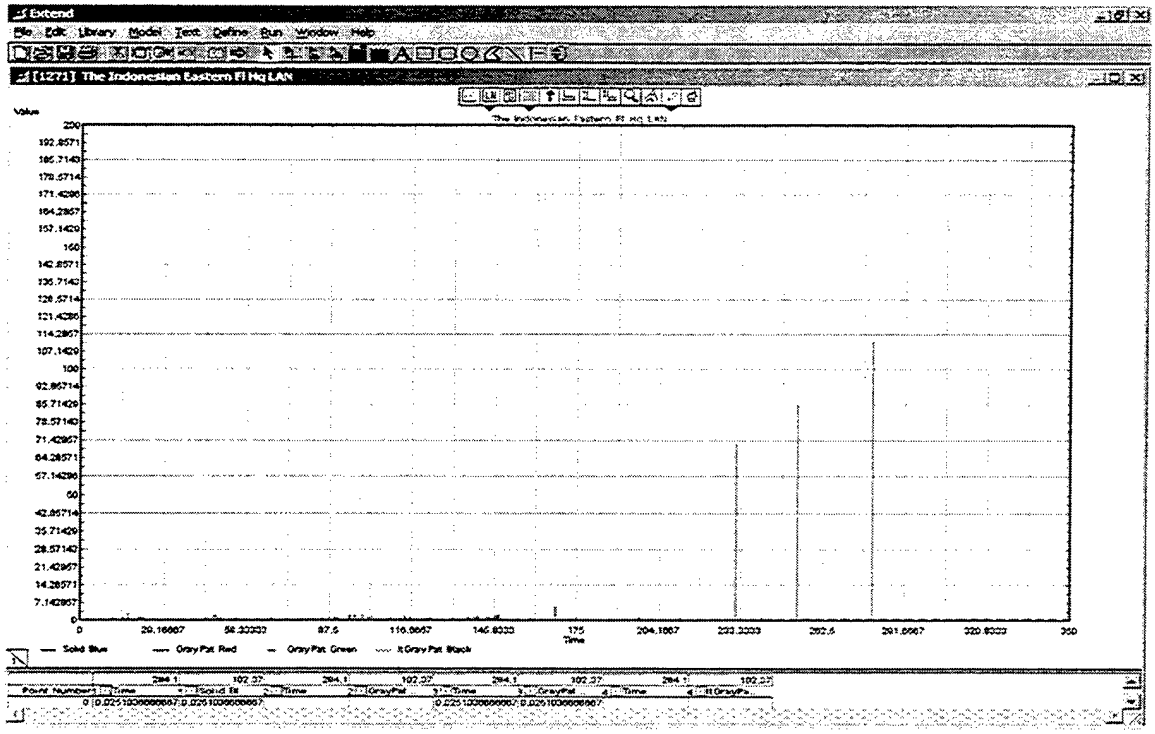

Figure 36. Delay Within the Indonesian Eastern Fleet Headquarters LAN Using T1 Line 1.544 Mbps

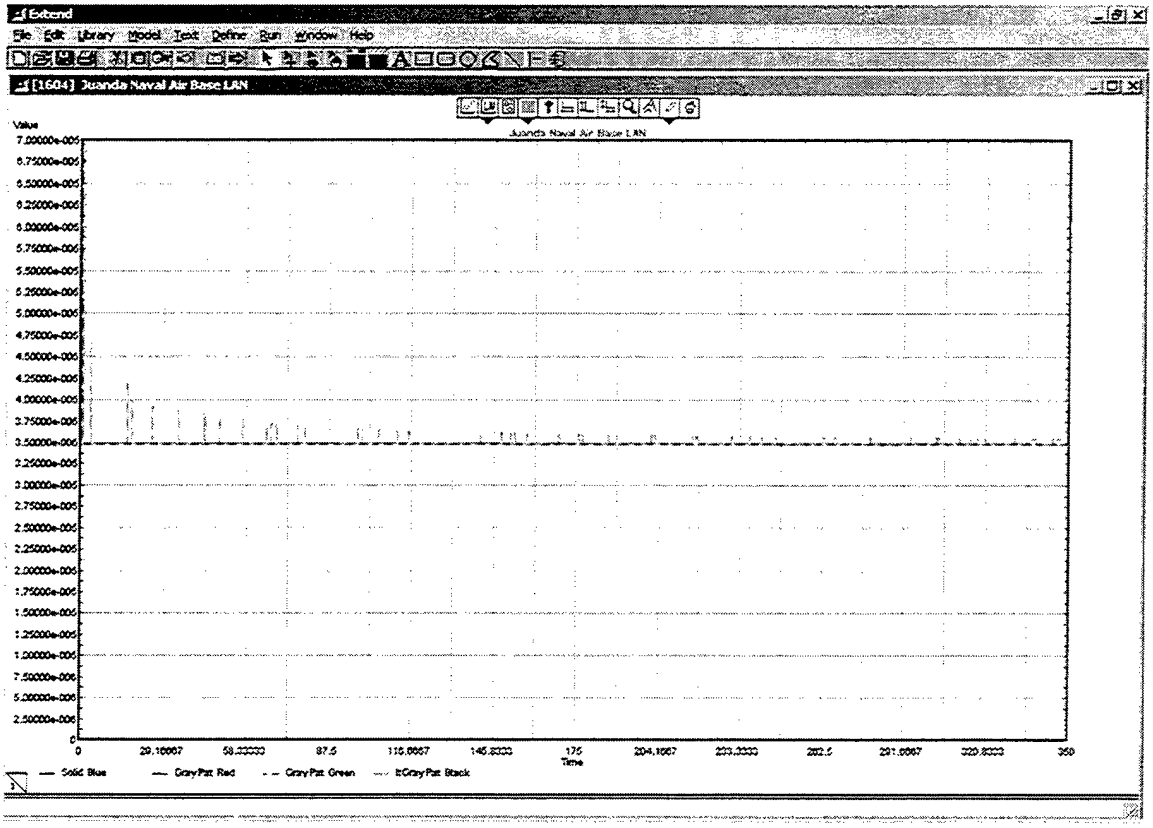

Figure 37. Delay Within Juanda Naval Air Base LAN Using ISDN 128 Kbps

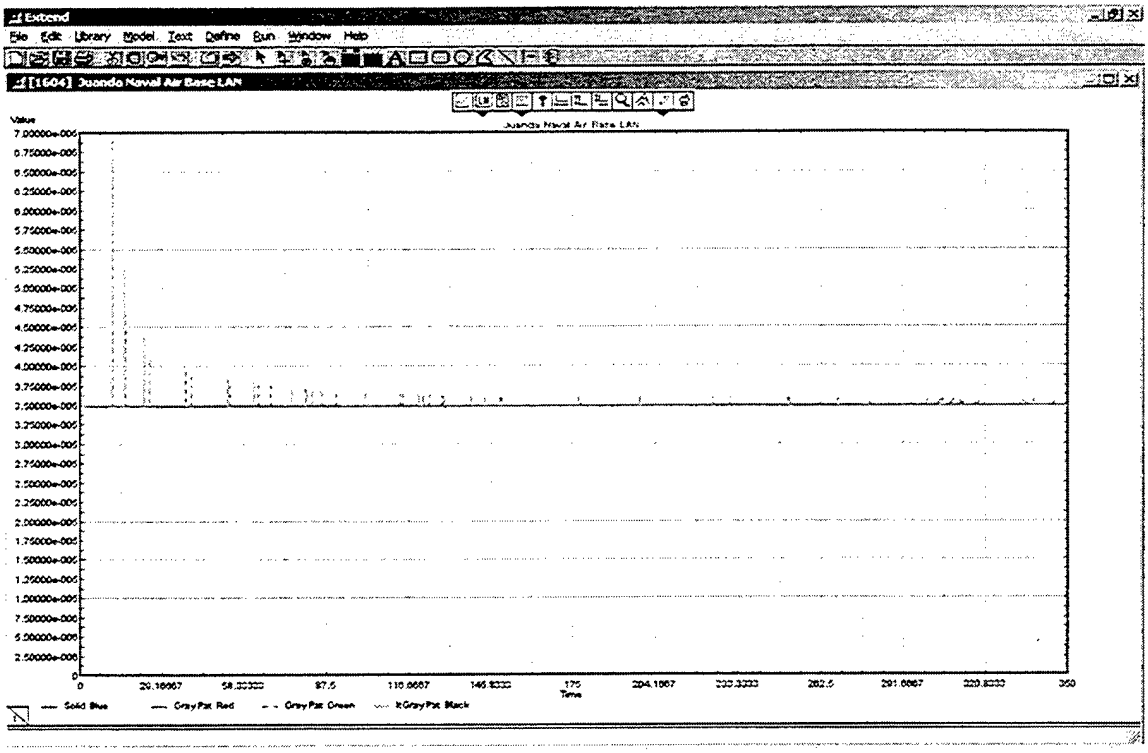

Figure 38. Delay Within Juanda Naval Air Base LAN Using T1 Line 1.544 Mbps

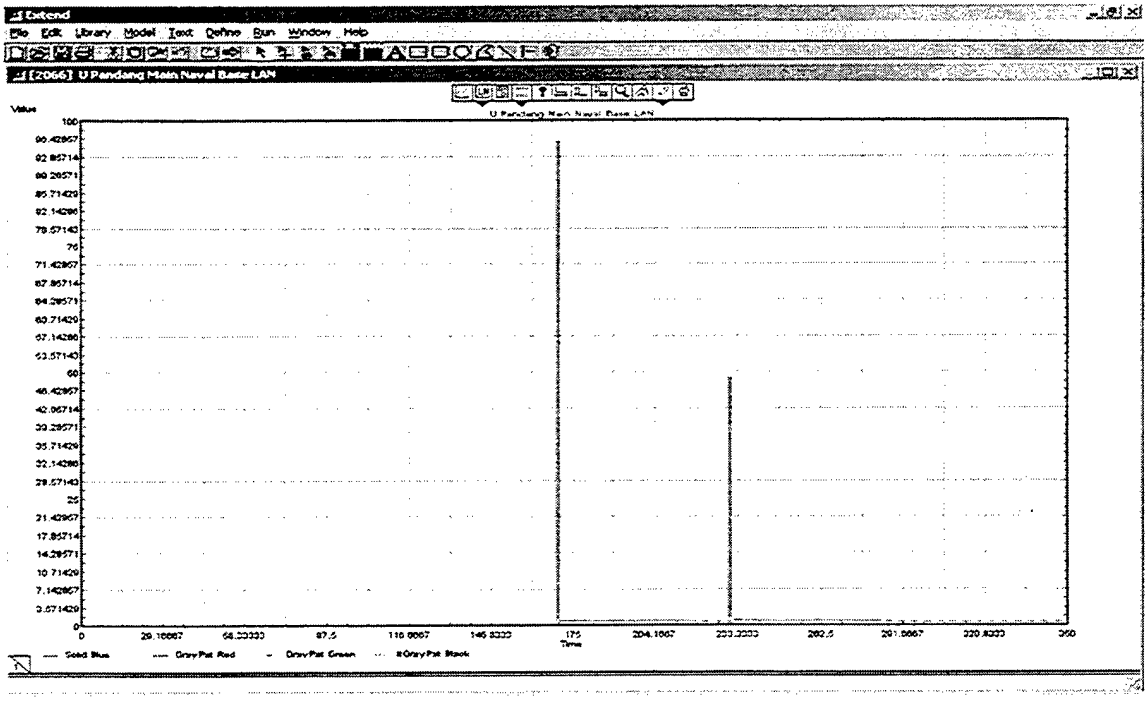

Figure 39. Delay Within Ujung Pandang Main Naval Base LAN Using ISDN 128 Kbps

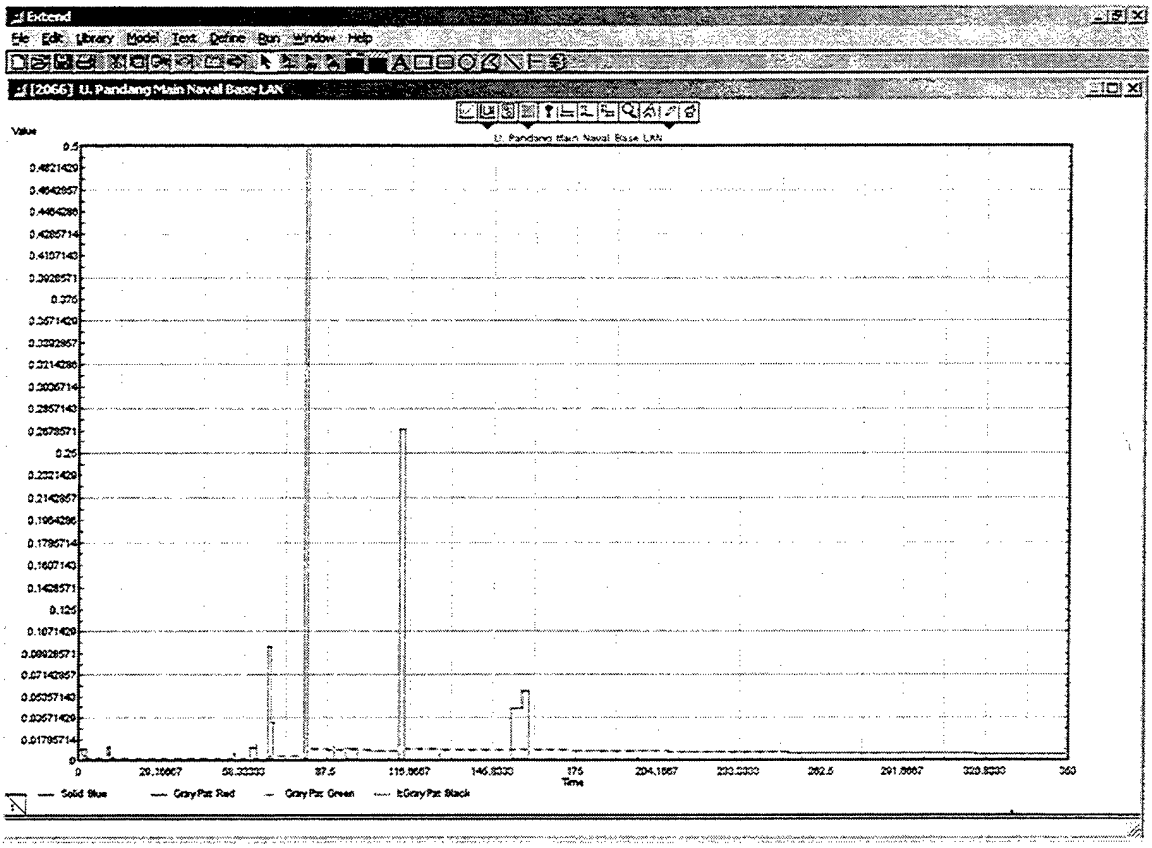

Figure 40. Delay Within U. Pandang Main Naval Base LAN Using T1 Line 1.5 Mbps

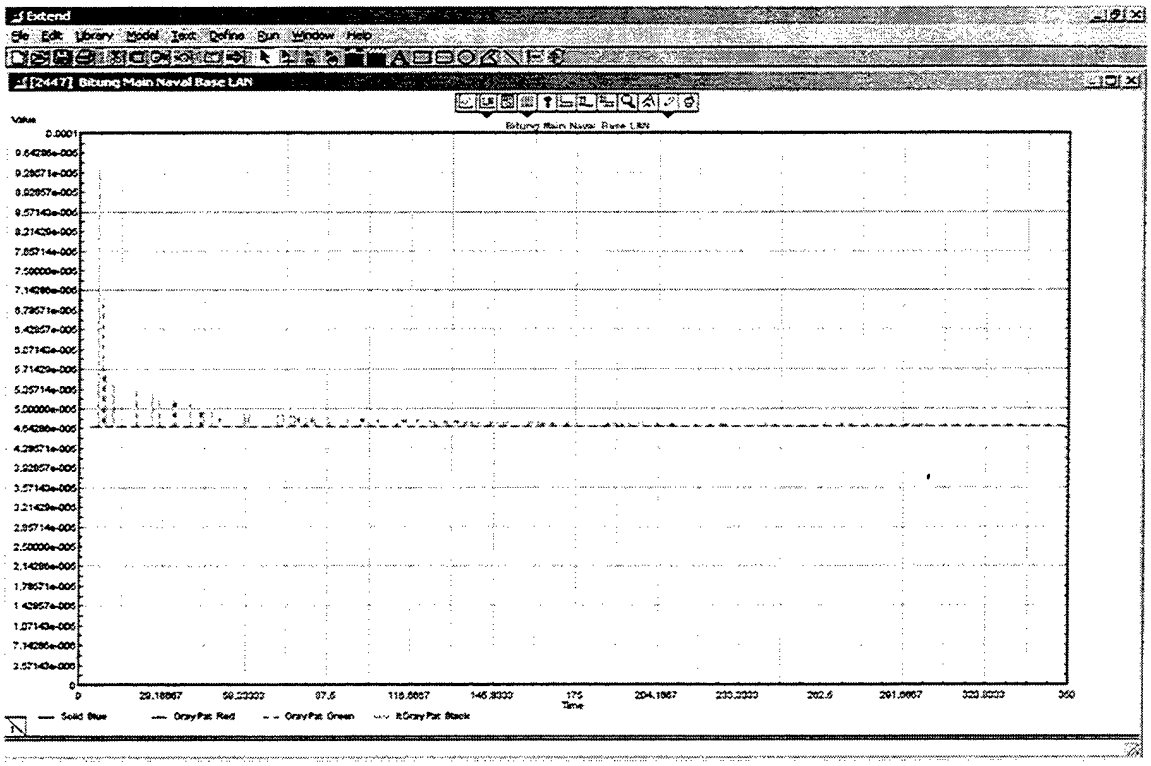

Figure 41 Delay Within Bitung Main Naval Base LAN Using ISDN 128 Kbps

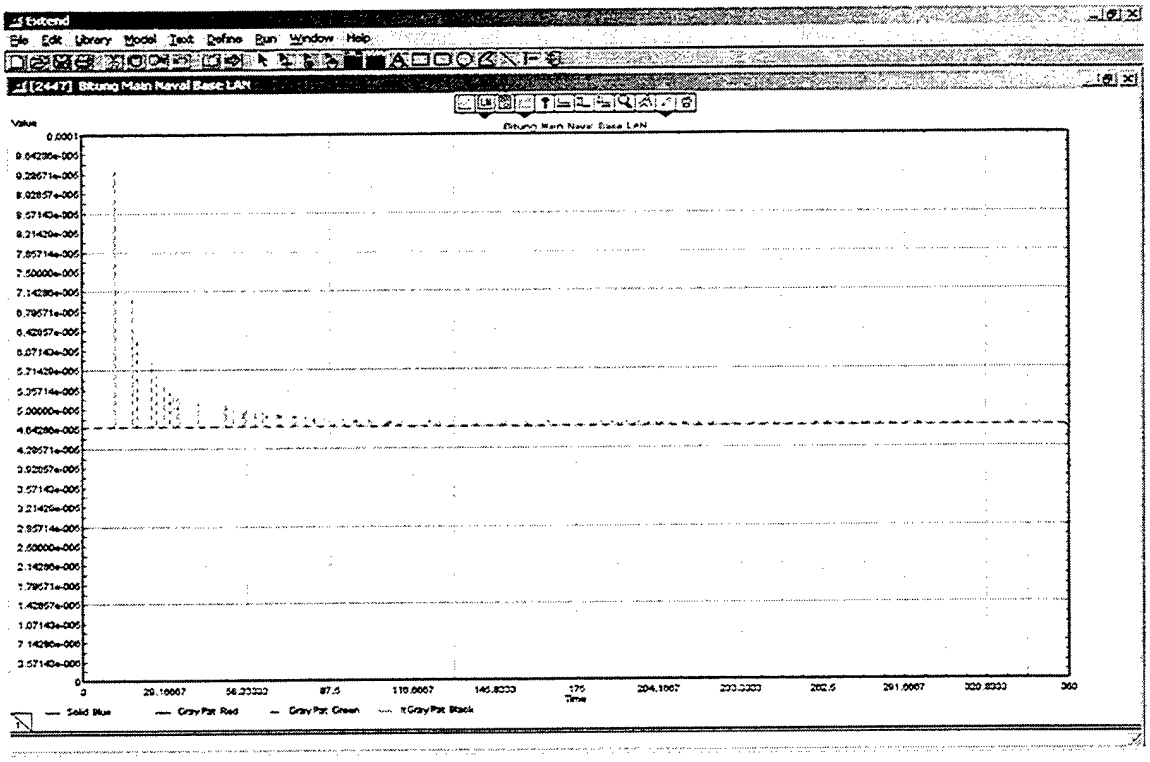

Figure 42. Delay Within Bitung Main Naval Base LAN Using T1 Line 1.544 Mbps

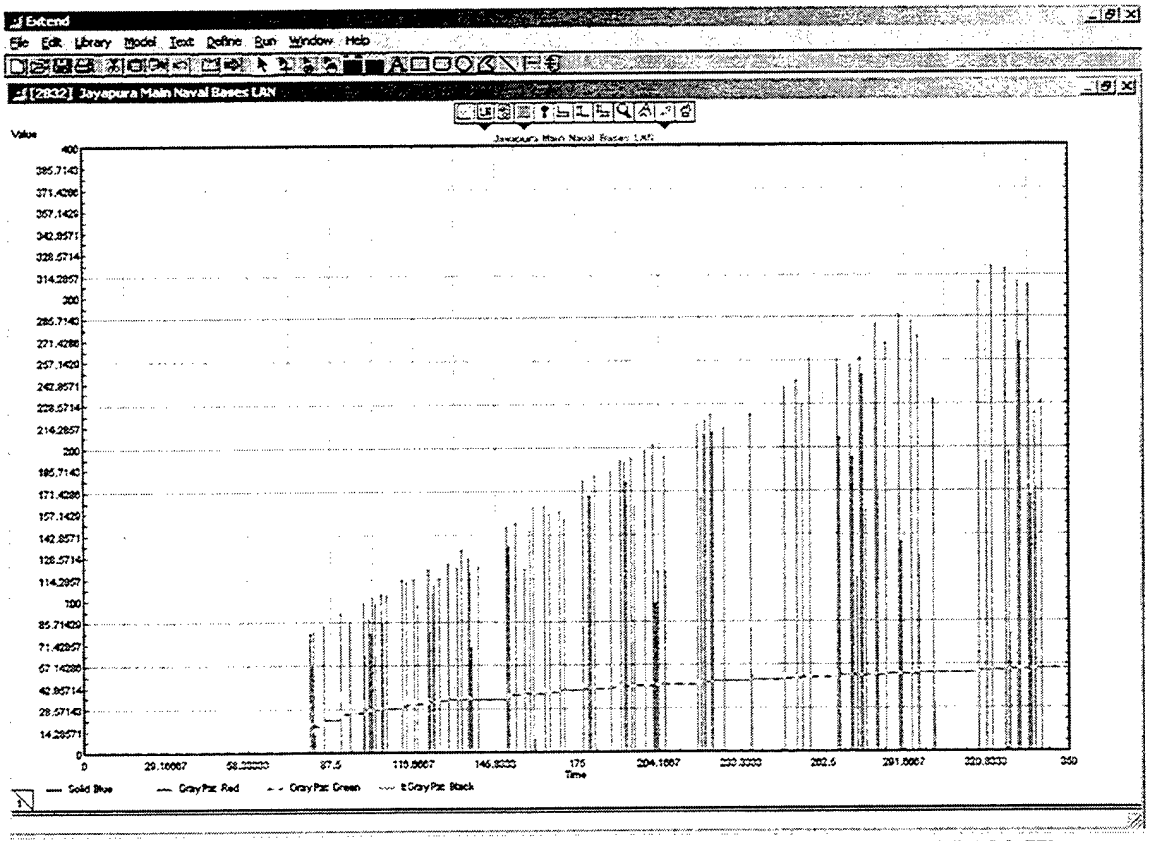

Figure 43. Delay Within Jayapura Main Naval Base LAN Using ISDN 128 Kbps

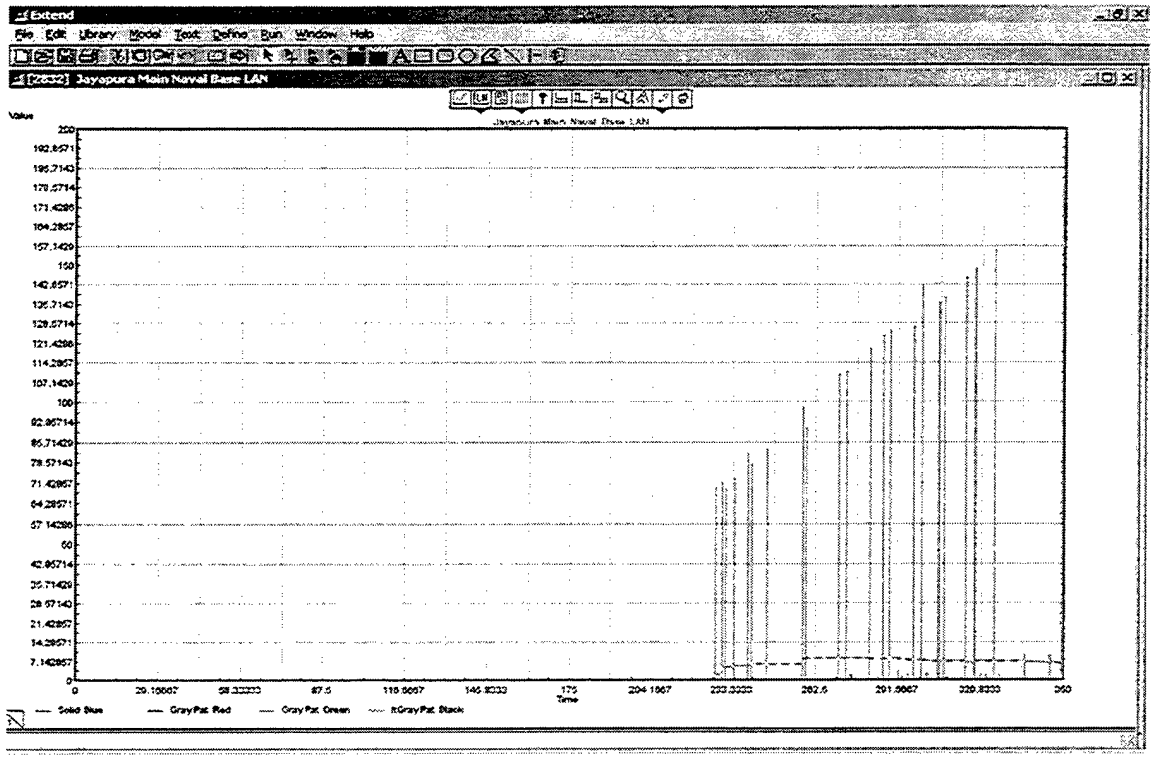

Figure 44. Delay Within Jayapura Main Naval Base LAN Using T1 Line 1.544 Mbps

A total of four simulation runs were conducted. The data is summarized in the plots and charts provided in Appendix A; the charts contain detailed message traffic reports for randomly selected nodes. Run 0 was programmed for duration of 350 simulation seconds using a frequency distribution of 1 second, which took 2040 seconds real time to accomplish. Run 1 was programmed for duration of 350 simulation seconds using frequency distribution 0.5 second, which took 2150 seconds real time to accomplish. Run 2 was programmed for a duration of 100 simulation hours using a frequency distribution of 1 second, which took 660 seconds real time to accomplish. Run 3 was programmed for a duration of 100 simulation seconds using a frequency distribution 0.5 second, which took 660 seconds real time to accomplish.

The final results of the simulation showed that the wide area network communication architecture which consists of six FAST ETHERNET 100 Mbps LAN

configuration had minimal delays that caused by messages collisions and the load of the network traffic. The worst case of maximum bandwidth delay (indicated by solid blue lines) along the wide area network traffic is 5 minutes. However, these maximum bandwidth delays still within requirement limitations for the flows of network traffic of the Indonesian Eastern Fleet WAN.

T1 Line 1.544 Mbps provides better results on the average bandwidth delay (indicated by the gray pat green lines). All charts showed T1Line's average bandwidth delay is smaller than ISDN's average bandwidth delay which mean the network traffic is working effectively without too much messages collisions and delays. It was occurred because the T1 line 1.544 Mbps provides 12 x faster speed and the network is working more efficiently. The result of the tests and simulation runs indicated that the Indonesian Eastern Fleet WAN design either using ISDN 128 Kbps or T1 Line 1.5 Mbps is reliable and has a good performance in its network traffic management.

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VII. CONCLUSIONS AND RECOMMENDATIONS

An improvement in information systems will increase productivity, speed, and effectiveness of the Indonesian Eastern Fleet in accomplishing their tasks and missions. The Indonesian Eastern Fleet has to deal with many issues related to the fast improvement of the information technology systems. The existing information structure of the Indonesian Eastern Fleet must be optimized to handle fleet missions and tasks. The Indonesian Eastern Fleet network's communication system resources such as telephone, radio communications, microwave-link and satellite systems are still not linked for optimal data communication exchange to computer network systems in LANs or in an integrated WAN. Implementation of an integrated WAN using web-based technology is the best solution to utilize the existing computer communication systems in the Indonesian Eastern Fleet.

The linkage of all main naval base LANs using ISDN WAN connection service provides a reliable computer communication network that can be used by the Indonesian Eastern Fleet to support all naval units in the eastern region with great effectiveness. ISDN connection service is inexpensive compared to other WAN connection lines such as T1, T3, OC-3, OC-12, OC-48, or OC-192. However, it is already met the requirements of the Indonesian Eastern Fleet network. We can migrate easily to a T1 line 1.544 Mbps connection service in the near future if the budget allocation is available in order to achieve better network performance and speed. T1 Line 1.5 Mbps provides robust and reliable network configuration to support the main goal of the Indonesian Eastern Fleet information systems.

The Indonesian Eastern Fleet should use a standardized LANs architecture to provide a responsive and uniform network environment. We recommend Fast Ethernet 100 Mbps LANs configuration as a standardized LANs infrastructure for the Indonesian Eastern Fleet network. Fast Ethernet LANs configuration operating at 100 Mbps using CAT-5 UTP provides a reliable LAN technology that meets high demands for network bandwidth.

To obtain the best performance of our network, we need to determine the appropriate hardware and software compatibility that meets the Indonesian Eastern Fleet network's requirements and allocated budget. Inexpensive is the keyword in designing our network. However, effective local area networks (LANs) and an integrated wide area network (WAN) are required to achieve connectivity of the Indonesian Eastern Fleet Network. Web-based network management using HP OpenView should be implemented to monitor and control the operation of the network to ensure that they always run properly. SNMP was recommended to allow future growth toward remote WAN monitoring to assist fleet operations. Using the Web brings efficient communications and provides faster action in carrying out the tasks and missions.

There are great advantages and benefits in designing and evaluating the Indonesian Eastern Fleet WAN using EXTEND-4 software simulation program. Using EXTEND-4 we measure specific performance variables of our network design in a quantitative fashion. The result of simulation runs of network traffic that consists of email traffic volume, video conferencing network traffic, and data transfer traffic volume indicates that the WAN communication architecture that consists of six FAST ETHERNET 100 Mbps LAN had minimal delays caused by messages collisions and the

load of the network traffic. T1 line 1.544 Mbps connection service provides better results on the average bandwidth delay compared to ISDN 128 Kbps. T1 line has faster transmission than ISDN resulting in less messages collisions and network traffic working more fluently without too much bandwidth delay. The worst case of maximum bandwidth delays showed at the delay within Jayapura main Naval Base LAN using ISDN 128 Kbps (figure 42) along the network traffic is 5 minutes. This maximum bandwidth delay is still within requirement limitations of our WAN traffic flows.

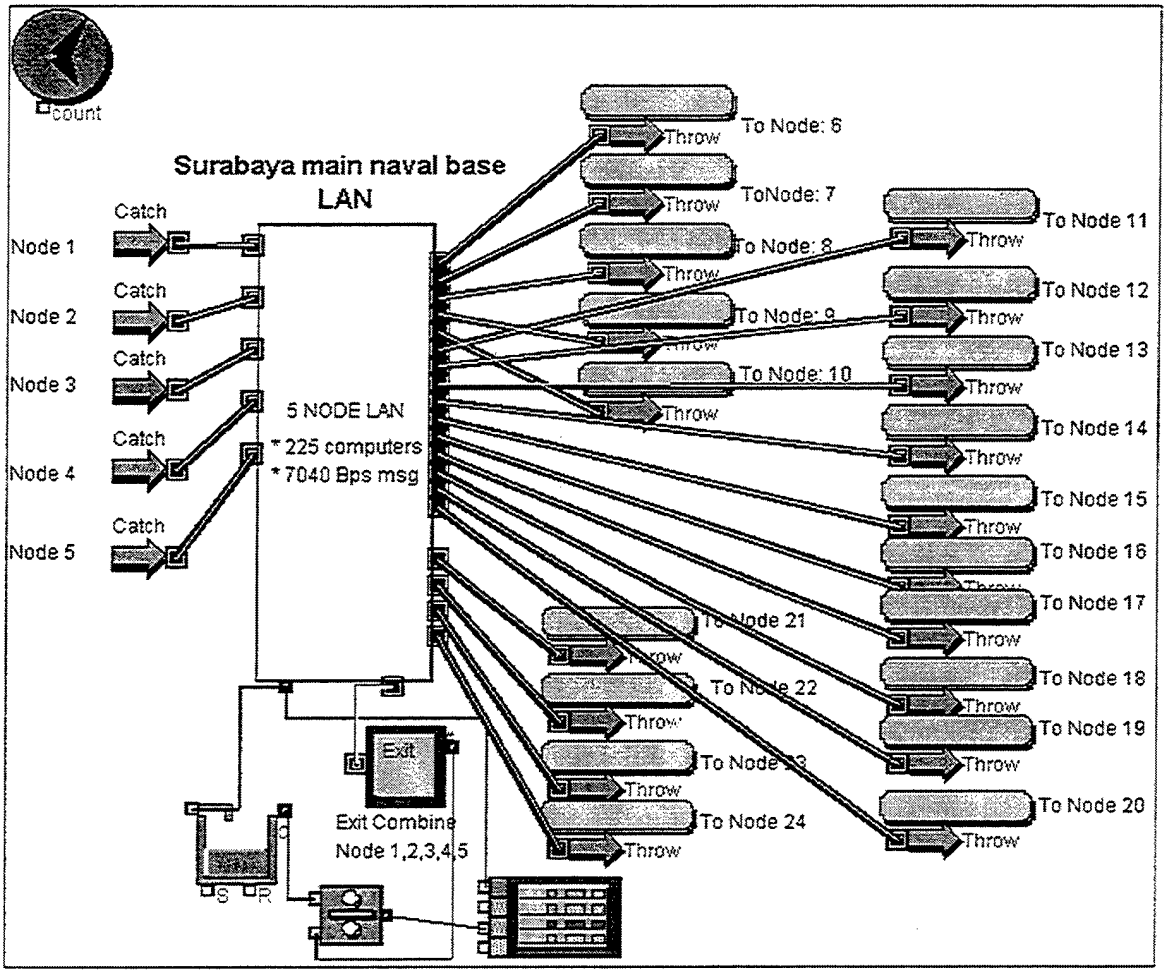
From a total of four simulations run that we conducted, we concluded that the Indonesian Eastern Fleet WAN design either using ISDN 128 Kbps or T1 line 1.5 Mbps was reliable and had good performance in its network traffic management. In this simulation, an increase in delay can readily be seen at the last LAN, which is Jayapura LAN, which showed that the delay climbed sharply caused by the load of the network traffic. We recommend the users of the Indonesian Eastern Fleet WAN define their destination address by priority in order to avoid the network traffic jam and overloaded messages traffic at the busy working time.

The basic configuration of the Indonesian Eastern Fleet wide area network has been built and tested in this thesis. The implementation of web-based network management will maintain and manage our network to run properly and to operate in optimal condition. An area of future research is designing and building mobile platforms networks for supporting operational fleet units including warships and aircraft. Life cycle costs that involve personnel and training need to be included in future research in order to obtain the main goal of an effective and efficient naval fleet. Strategic management needs to take a strong and active leadership role in developing all of the

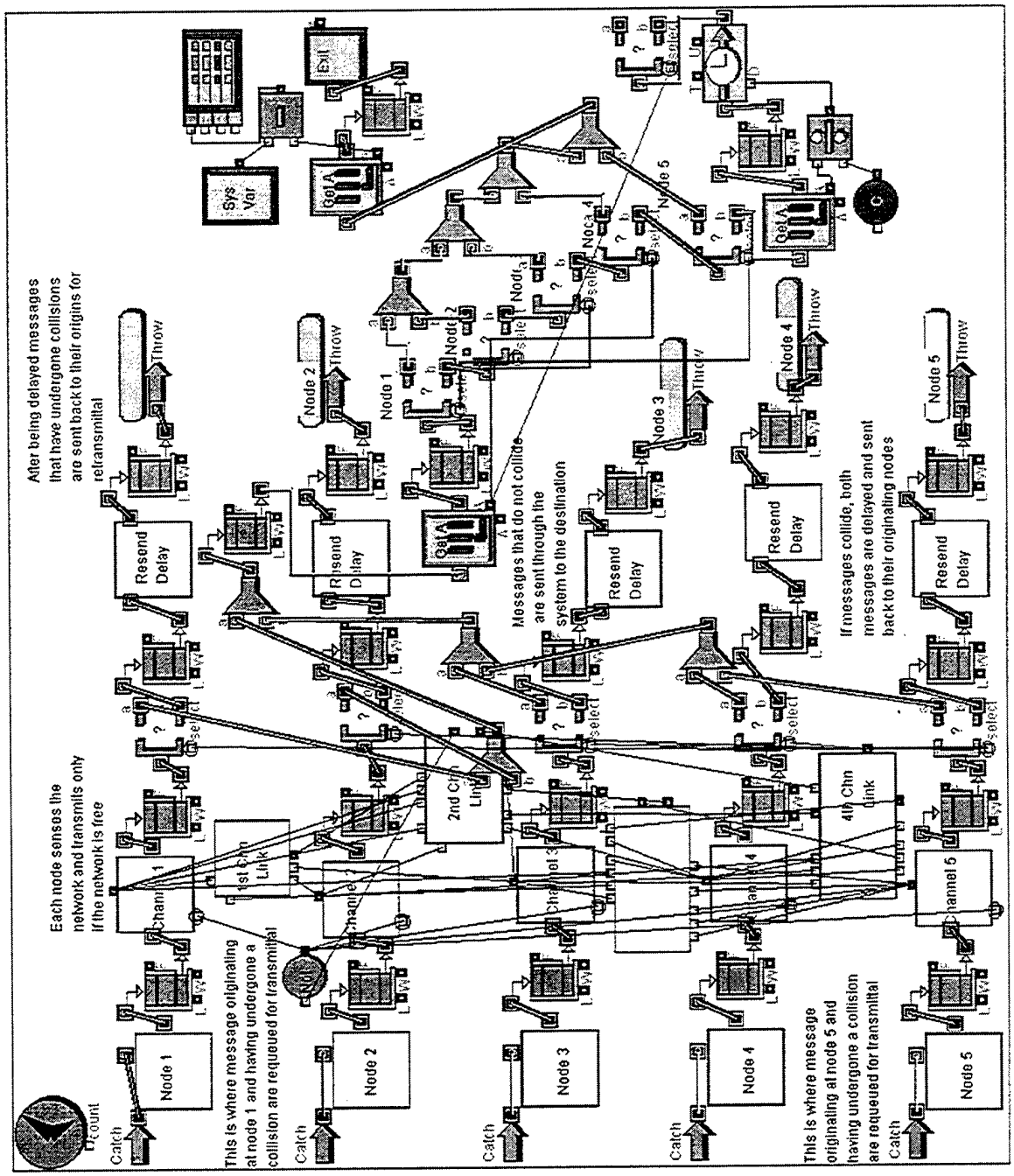
infrastructure to gain a benefit from information technology. The improvement of information technology occurs rapidly and we cannot avoid its influence to our systems. Information technology systems, especially computer communication networks, always improve and keep changing to give performance with time.

APPENDIX A. NETWORK DESIGN MODEL

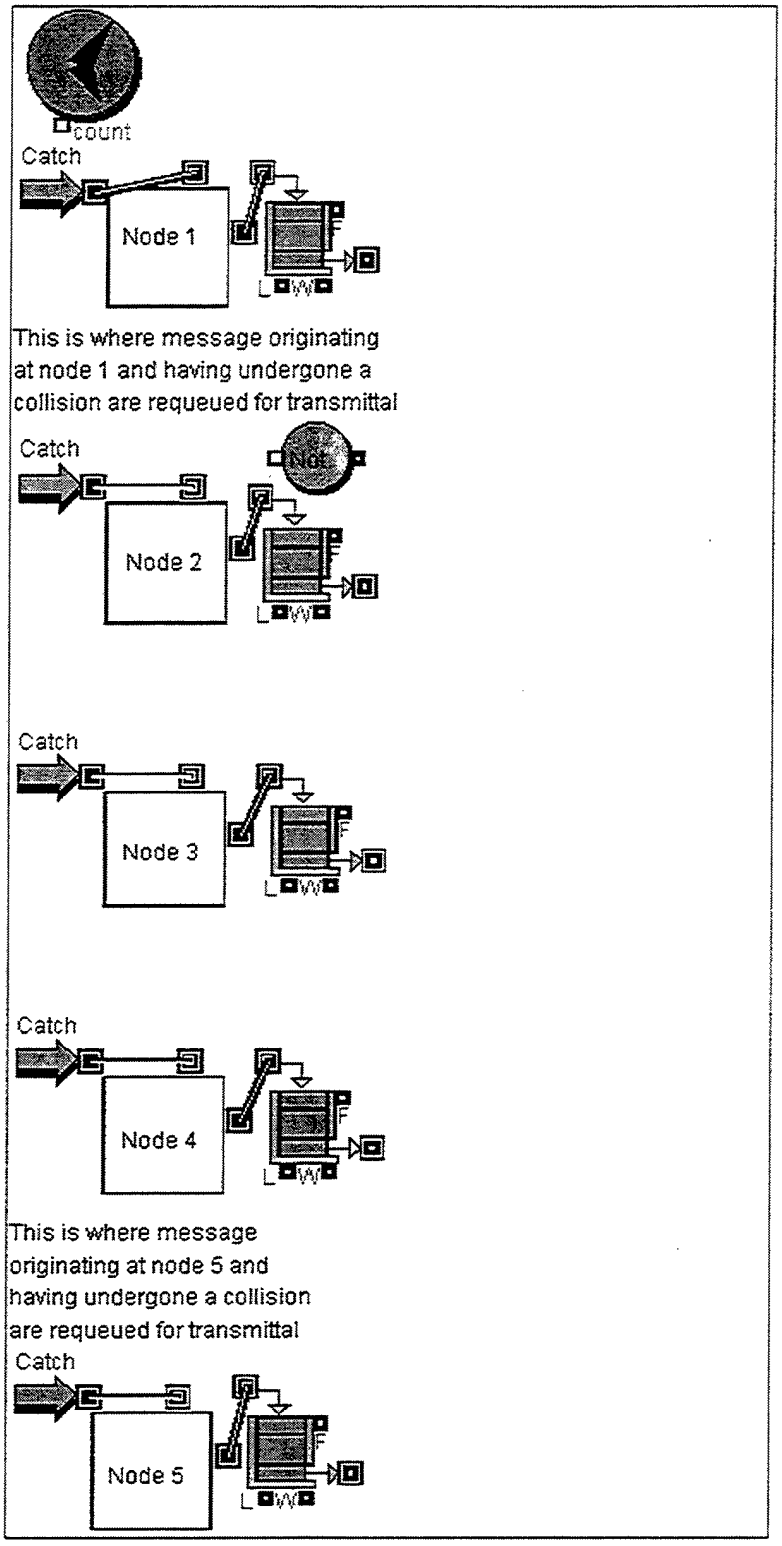
This appendix contains the high level view and detailed view of our local area network design model. The functionality within the model are shown by the low-level design model. Each block is displayed along with the detailed design of the block on the ensuing page. We displayed hierarchical blocks design to layer the model of all blocks. This appendix illustrates the configuration model of messages traffic flow in our Fast Ethernet local area network to all destinations in the wide area network.



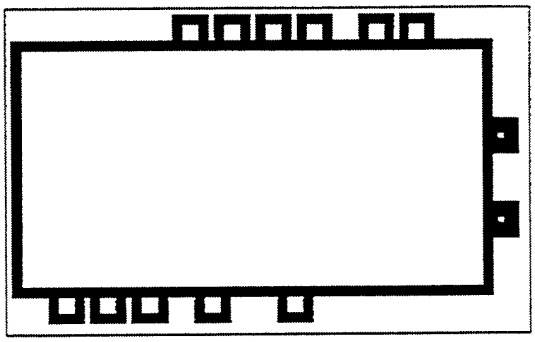
High Level View of LAN Configuration Model



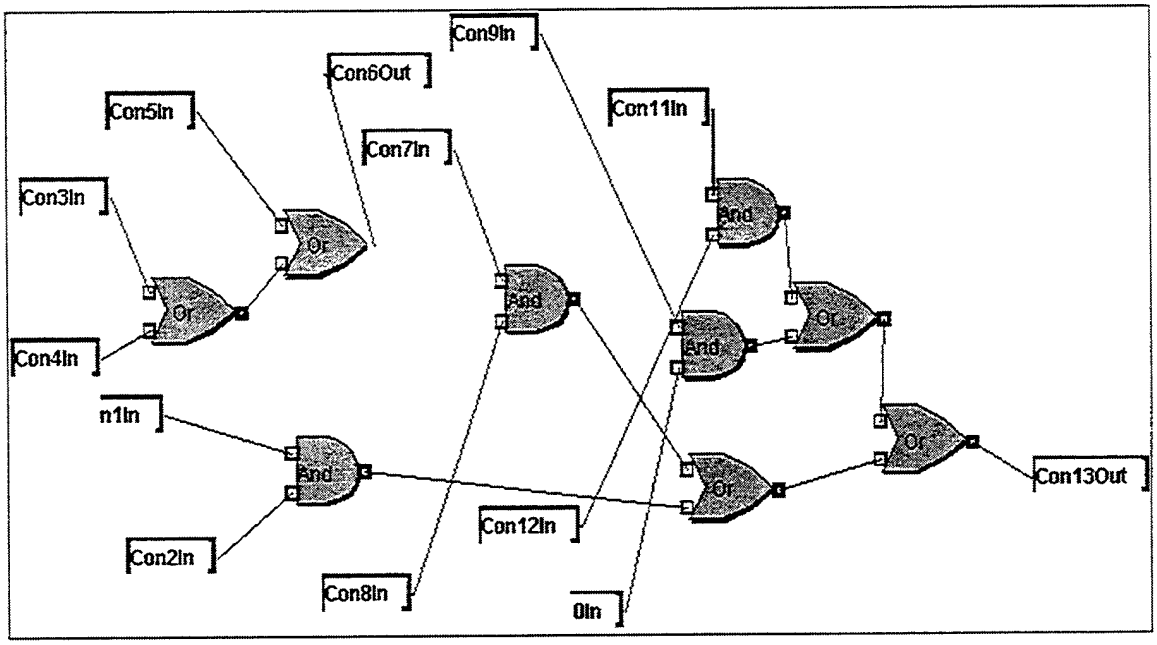
Fast Ethernet LAN Configuration Model



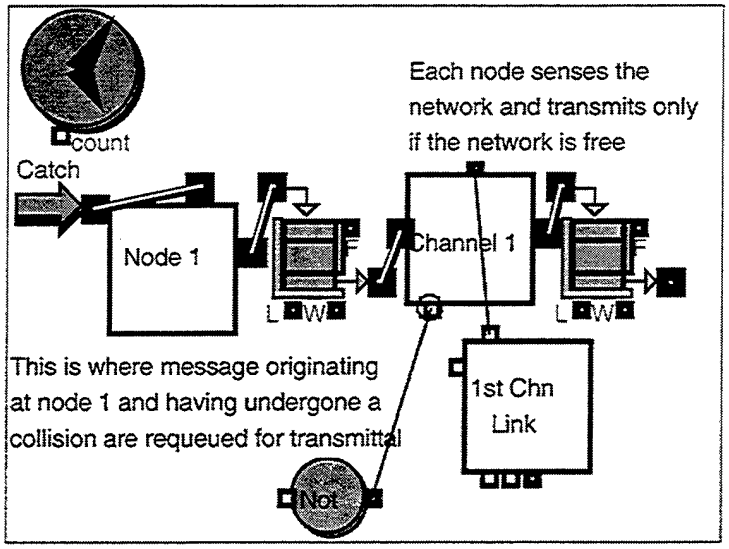
Network Origin Nodes



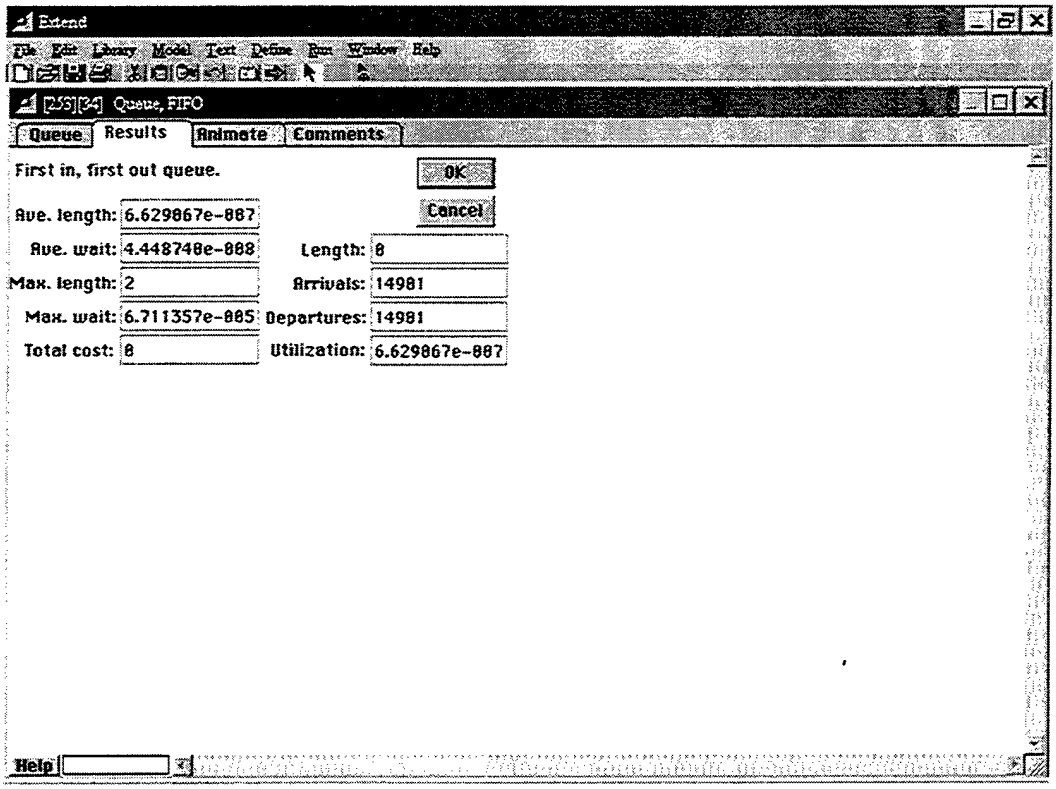
High Level View of LAN Channel Link Sensor



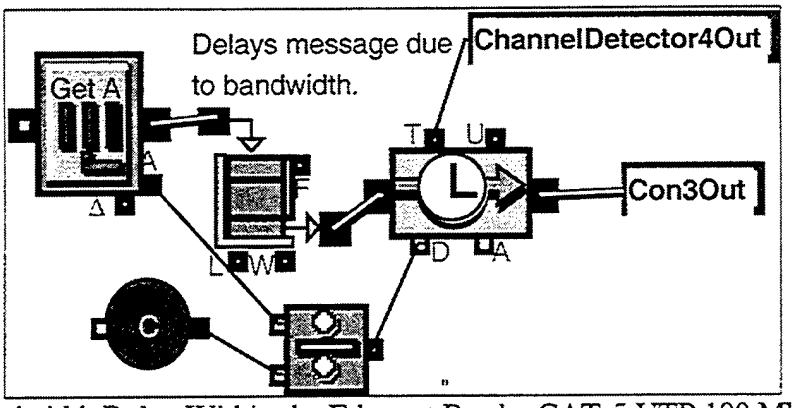
Detailed View of LAN Channel Link Sensor



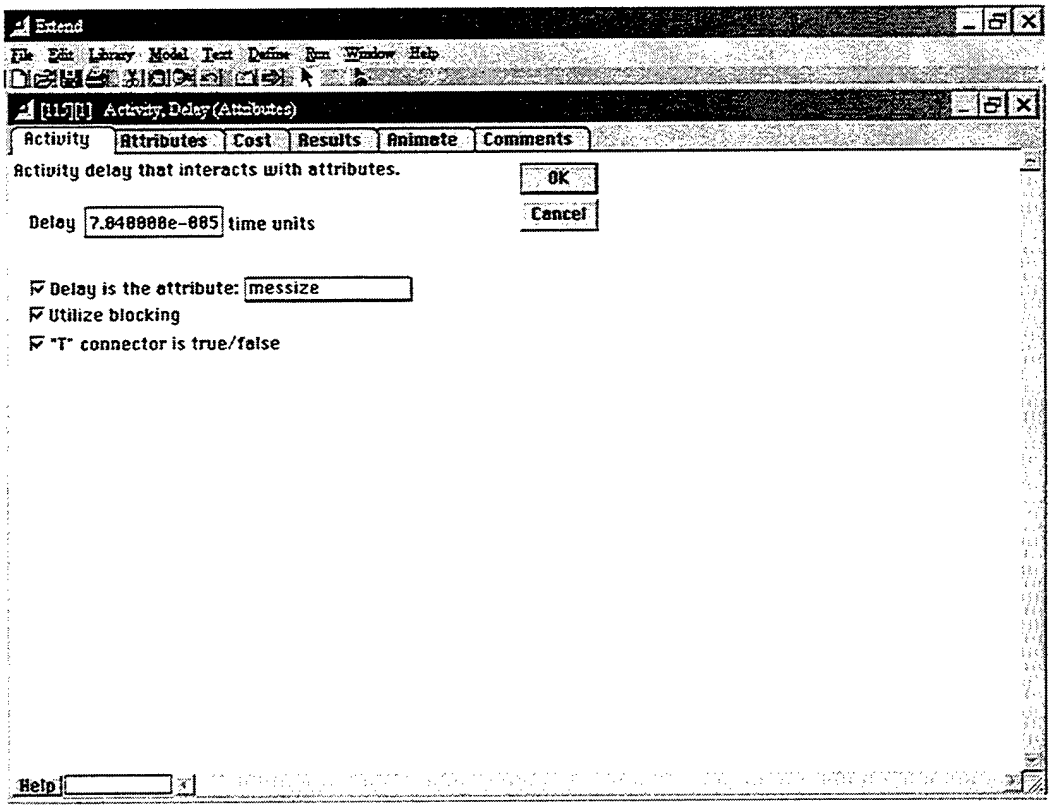
Initial Messages Traffic Flow



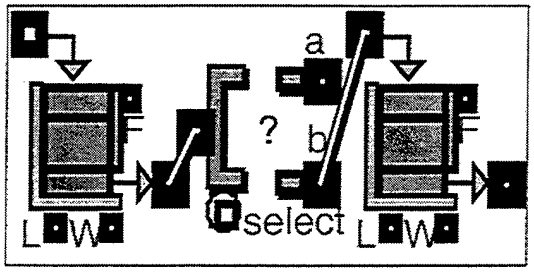
FIFO Queue for the Arrivals and Departures Messages



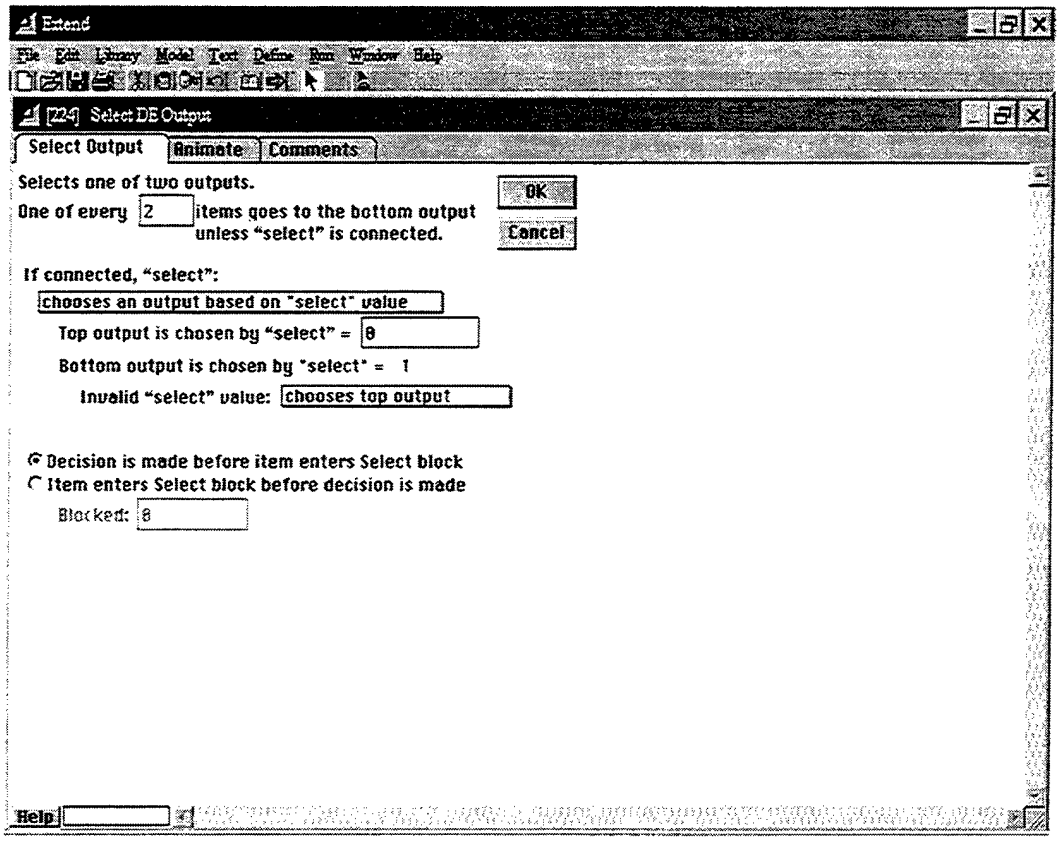
Bandwidth Delay Within the Ethernet Bus by CAT-5 UTP 100 Mbps



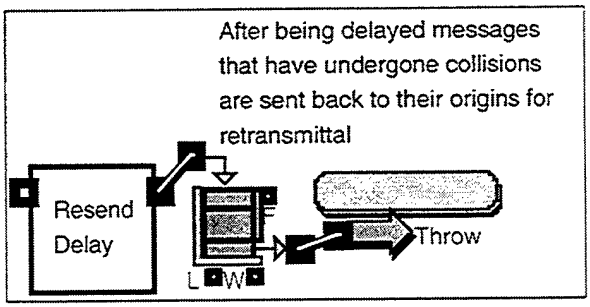
Activity Delay Dialog Box



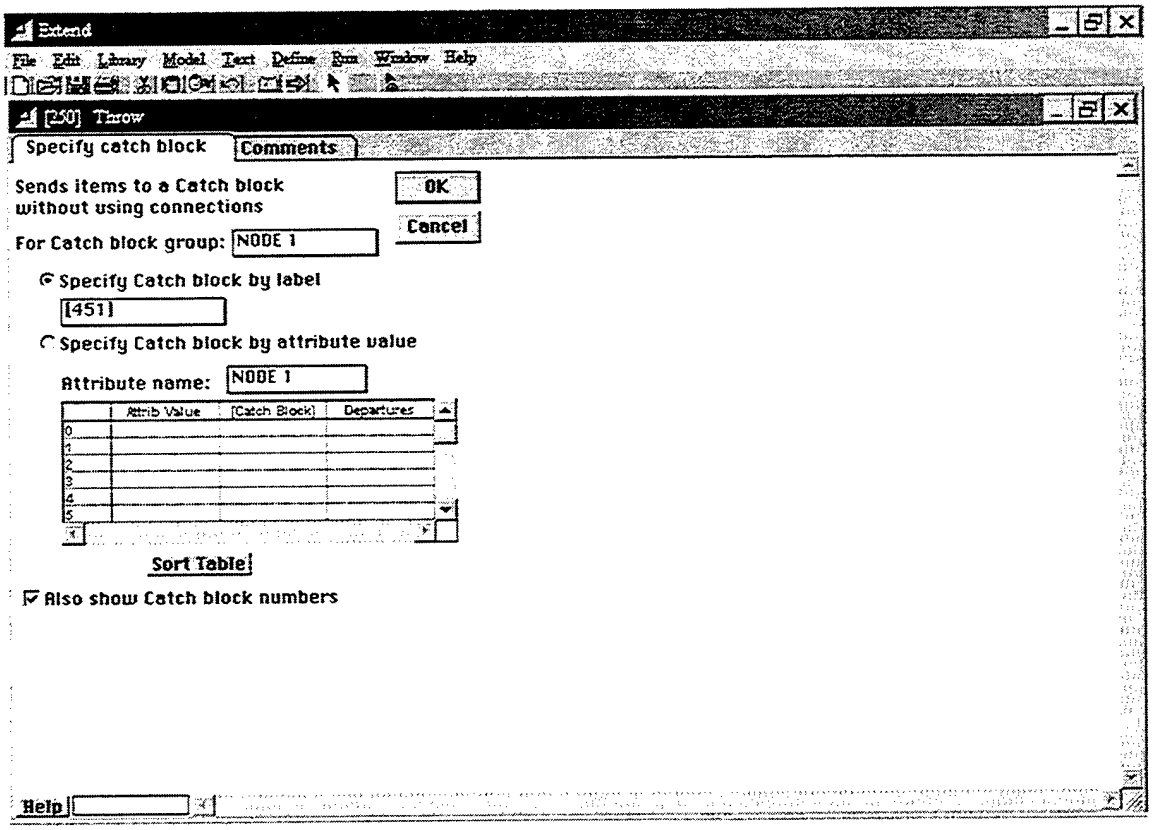
LAN Select Output



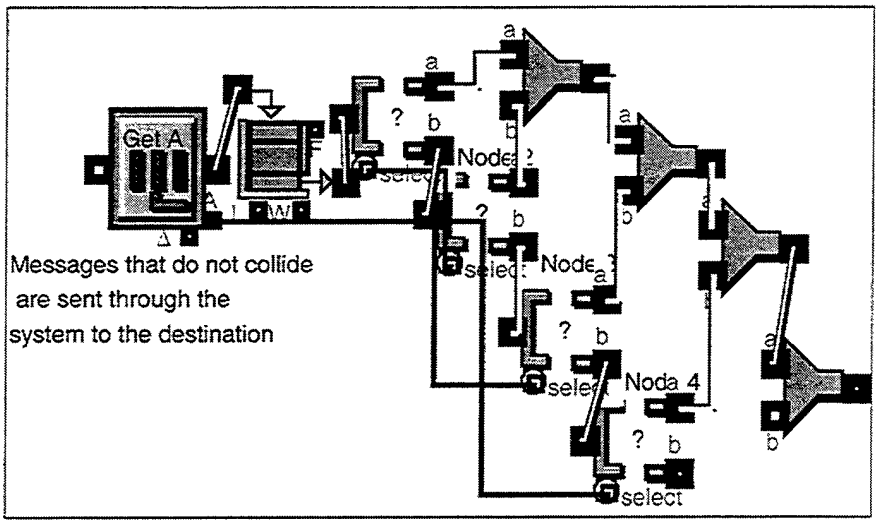
Select Output Dialog Box



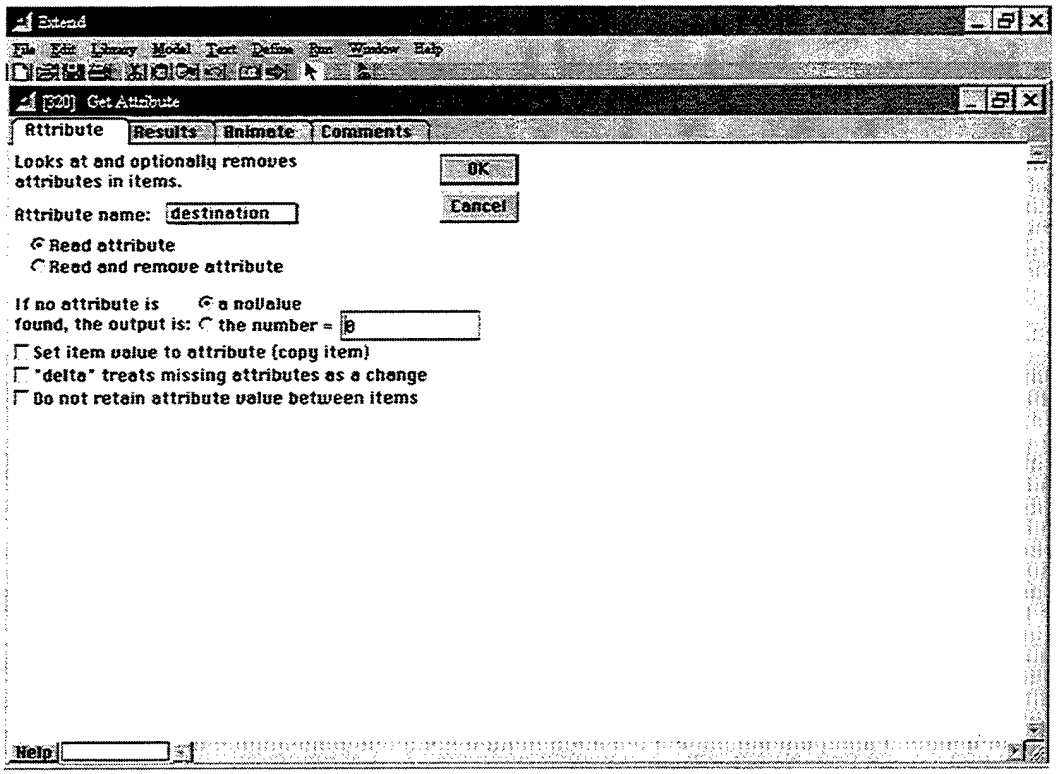
Messages Thrown for Retransmittal



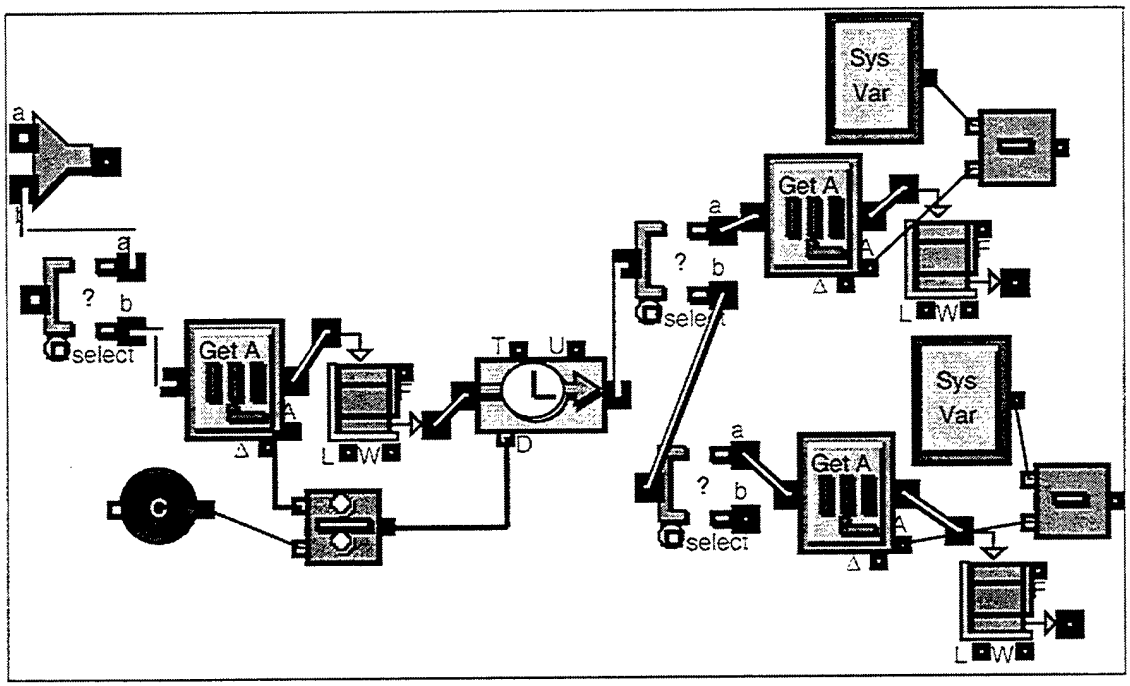
Throw Block Dialog Box



Get Attribute Messages Destination and the Router



Get Attribute Dialog Box



Bandwidth Delay Within the WAN by ISDN/T1 Line Connection Service

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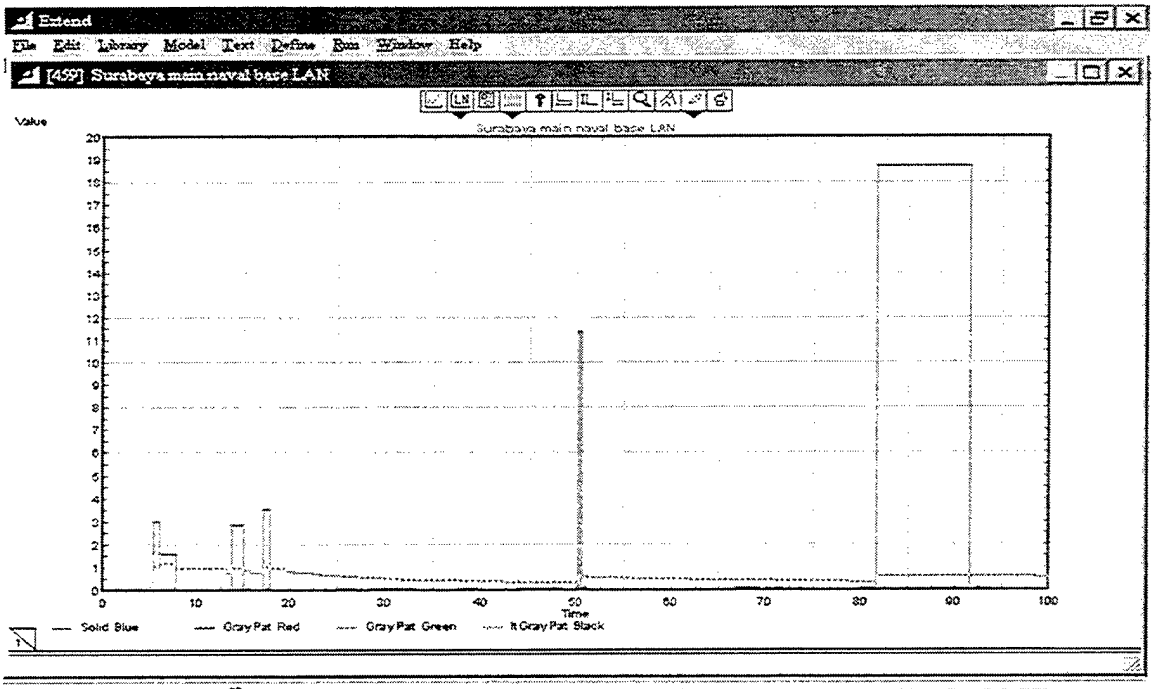
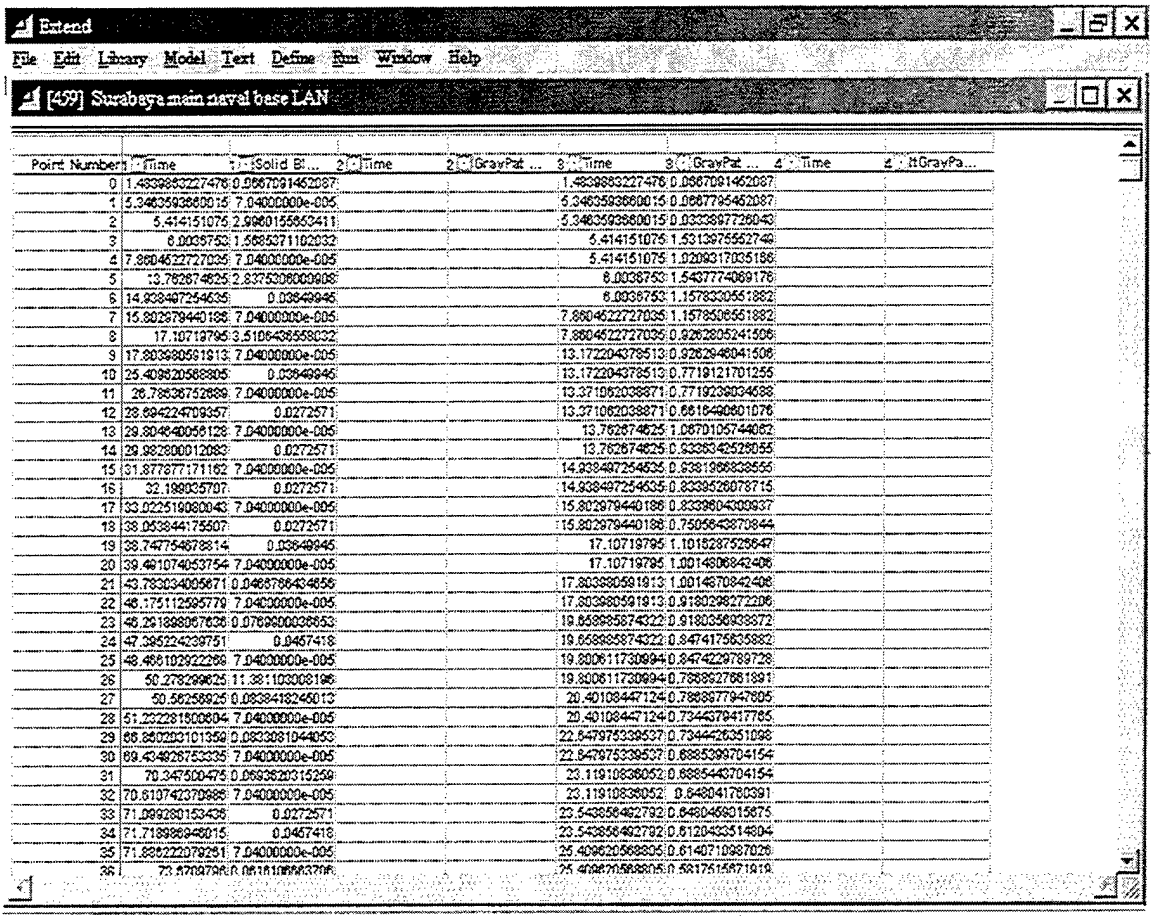
APPENDIX B. NETWORK TRAFFIC TESTS AND SIMULATION RUNS DATA

This appendix contains the result of our network traffic tests and simulation runs. The graph displays the delay experienced within each of the tested network design over the period of the model. The data shows the arrival time of the message and the delay associated with the message using ISDN 128 Kbps, and T1 line 1.544 Mbps.

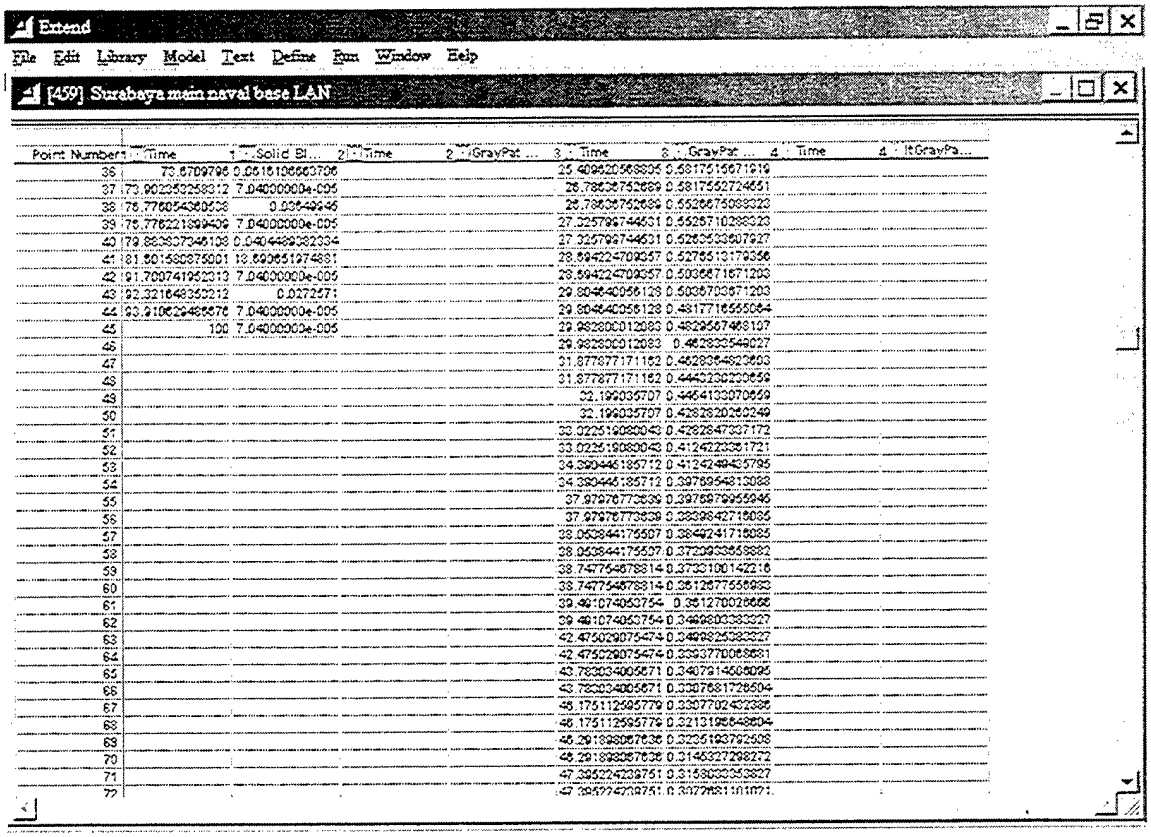


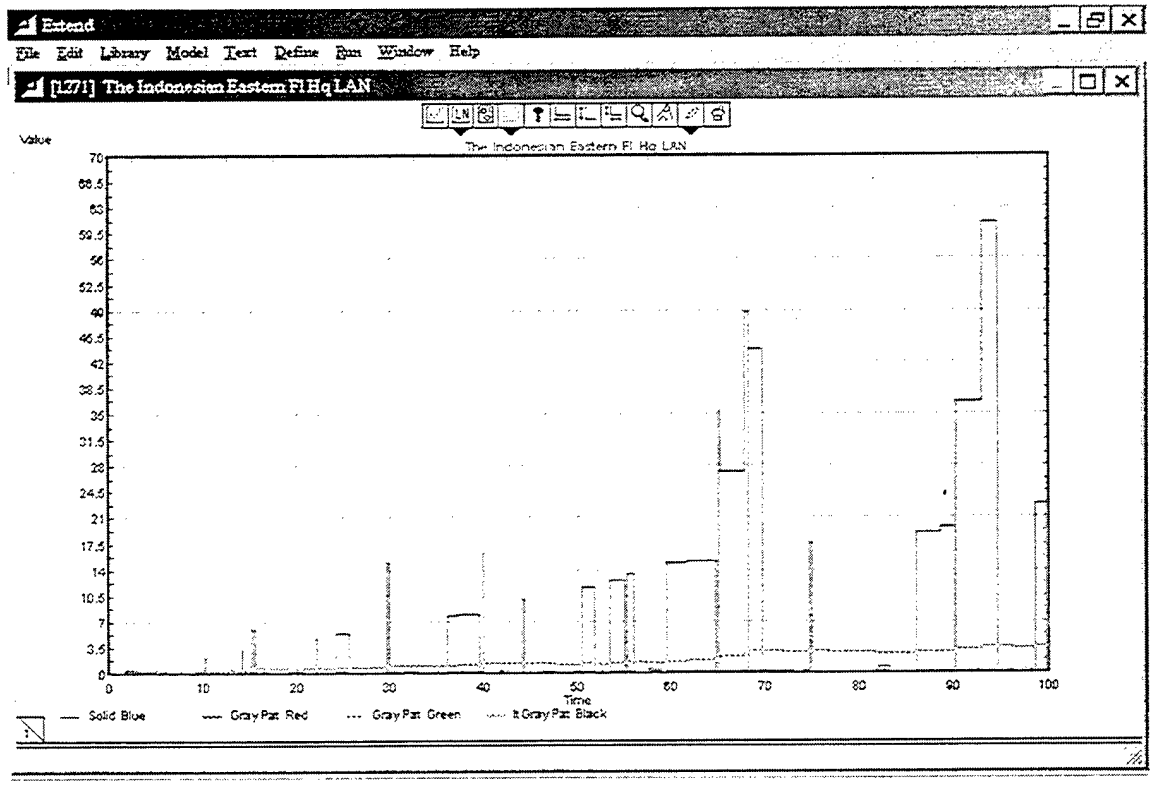
Run 0, The 1st LAN, Using Simulation Set Up 100, Mean 1 sec, ISDN 128 Kbps



Point Number	1 Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ltGrayPa...
0	1.4839863227476	0.0667091452087			1.4839863227476	0.0667091452087		
1	5.3463593660015	7.04000000e-005			5.3463593660015	0.0667795452087		
2	5.414151075	2.9960155653411			5.3463593660015	0.0333897726043		
3	6.0036753	1.5685371102032			5.414151075	1.5313975552749		
4	7.8604522727035	7.04000000e-005			5.414151075	1.0209317035166		
5	13.762674625	2.8375306000908			6.0036753	1.5437774069176		
6	14.938497254635	0.03649945			6.0036753	1.1578330551882		
7	15.802979440186	7.04000000e-005			7.8604522727035	1.1578506551882		
8	17.10719795	3.5106436558032			7.8604522727035	0.9262805241506		
9	17.803980591913	7.04000000e-005			13.172204378513	0.9262946041506		
10	25.409620568805	0.03649945			13.172204378513	0.7719121701255		
11	26.78636752689	7.04000000e-005			13.371062038871	0.7719239034688		
12	28.694224709357	0.0272571			13.371062038871	0.6616490601076		
13	29.804640056128	7.04000000e-005			13.762674625	1.0670105744062		
14	29.982800012083	0.0272571			13.762674625	0.9336342526055		
15	31.877877171162	7.04000000e-005			14.938497254635	0.9381966838555		
16	32.199035707	0.0272571			14.938497254635	0.8339526078715		
17	33.022519080043	7.04000000e-005			15.802979440186	0.8339604300937		
18	38.053844175507	0.0272571			15.802979440186	0.7505643870844		
19	38.747754678814	0.03649945			17.10719795	1.1016287526647		
20	39.491074053754	7.04000000e-005			17.10719795	1.0014806842406		
21	43.783034005671	0.0466766434656			17.803980591913	1.0014870842406		
22	46.175112595779	7.04000000e-005			17.803980591913	0.9180298272206		
23	46.291898067636	0.0769900036653			19.658985874322	0.9180356938872		
24	47.395224239751	0.0457418			19.658985874322	0.8474175635882		
25	48.466102922269	7.04000000e-005			19.800611730994	0.8474229789728		
26	50.278299625	11.381103008196			19.800611730994	0.7868927661891		
27	50.56256925	0.0838418245013			20.40108447124	0.7868977947605		
28	51.232281500604	7.04000000e-005			20.40108447124	0.7344379417765		
29	66.860203101359	0.0833081044053			22.647975339537	0.7344426351098		
30	69.434926753335	7.04000000e-005			22.647975339537	0.6885399704154		
31	70.347500475	0.0693620315259			23.11910836052	0.6885443704154		
32	70.610742370986	7.04000000e-005			23.11910836052	0.648041760391		
33	71.099280153436	0.0272571			23.543856492792	0.6480459015675		
34	71.718986946015	0.0457418			23.543856492792	0.6120433514804		
35	71.886222079261	7.04000000e-005			25.409620568805	0.6140710987026		
36	73.6709796	0.0616106663706			25.409620568805	0.5817515671919		

Run 0, Data Delay within the 1st LAN





Run 0, The 2nd LAN, Using Simulation Set Up 100, Mean 1 sec, ISDN 128 Kbps

Extend

File Edit Library Model Text Define Run Window Help

[1271] The Indonesian Eastern Fl Hq LAN

Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : GrayPa...
0	0.0001658	0.0001658			0.0001658	0.0001658		
1	0.09154705	0.09154705			0.09154705	0.09171285		
2	0.1185543	0.1185543			0.09154705	0.046856425		
3	0.2249730668914	8.29000000e-005			0.1185543	0.105133575		
4	1.260544662151	0.0675463849999			0.1185543	0.07006905		
5	1.401185193485	8.29000000e-005			0.2249730668914	0.0701186833333		
6	1.75654705	0.2926513220445			0.2249730668914	0.0525875125		
7	2.959483371466	8.29000000e-005			1.260544662151	0.0594741087499		
8	3.3403383	0.1135823966307			1.260544662151	0.0555792659999		
9	4.783992425	0.0599491239132			1.401185193485	0.0555958659999		
10	5.638643825	0.2246781468796			1.401185193485	0.0462268891666		
11	6.056521308905	0.0566831939749			1.496600870134	0.0468437058333		
12	8.150541494026	8.29000000e-005			1.496600870134	0.0397231764285		
13	9.291850475	0.1602018317986			1.75654705	0.0615305081492		
14	10.247433869265	8.29000000e-005			1.75654705	0.0713391946305		
15	10.306659	2.009949851203			2.959483371466	0.0713495571305		
16	10.318650018993	8.29000000e-005			2.959483371466	0.0834218285605		
17	13.069196775	0.3127742812447			3.3403383	0.0760420848416		
18	13.422822449319	8.29000000e-005			3.3403383	0.0684578762575		
19	14.22025275	3.047288629939			4.783992425	0.0774327886593		
20	14.260867425	0.1351633550065			4.783992425	0.0703934442353		
21	15.22873685	5.643364118671			5.638643825	0.0908197303152		
22	15.241864325	5.843446184615			5.638643825	0.0822505027895		
23	15.656465832713	8.29000000e-005			6.056521308905	0.0879907689505		
24	16.18658438675	8.29000000e-005			6.056521308905	0.0812222462548		
25	16.31474365	0.1464074204065			8.150541494026	0.0812268251879		
26	16.777102581913	8.29000000e-005			8.150541494026	0.0754265805316		
27	19.181562278627	0.1999690758003			9.291850475	0.0827981399468		
28	20.644603197221	8.29000000e-005			9.291850475	0.0772782539484		
29	22.121123925	4.628040384210			10.247433869265	0.0772637906161		
30	22.146546355143	8.29000000e-005			10.247433869265	0.0724635537026		
31	24.314705875	5.380584600583			10.306659	0.196075419408		
32	25.540402589375	8.29000000e-005			10.306659	0.186429241496		
33	29.640374151085	14.89744658226			10.318650018993	0.186428808201		
34	29.933408229085	0.1959326117406			10.318650018993	0.176071645030		
35	30.129195631847	8.29000000e-005			10.680915368884	0.176078250585		
36	30.352102326085	0.420315142017			10.680915368884	0.166809079502		

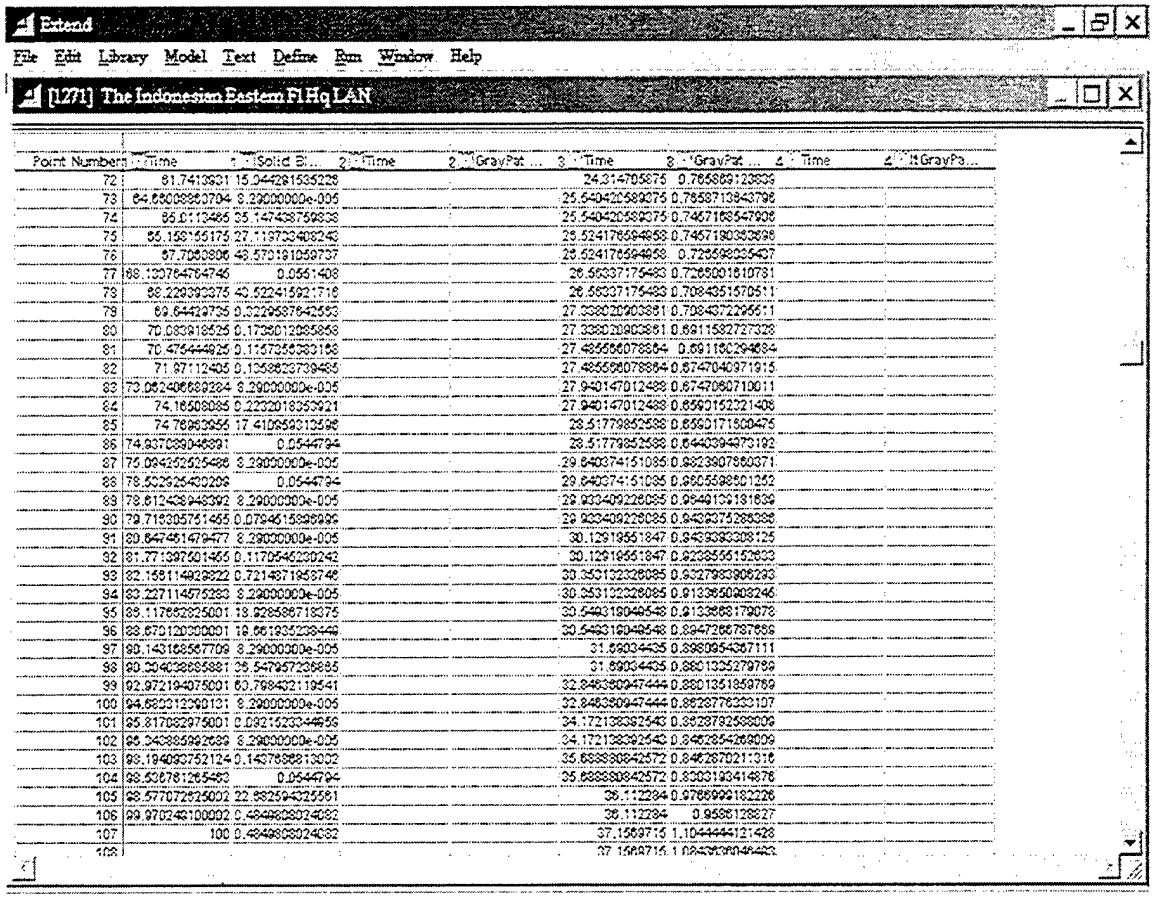
Run 0, Data Delay within the 2nd LAN

Extend

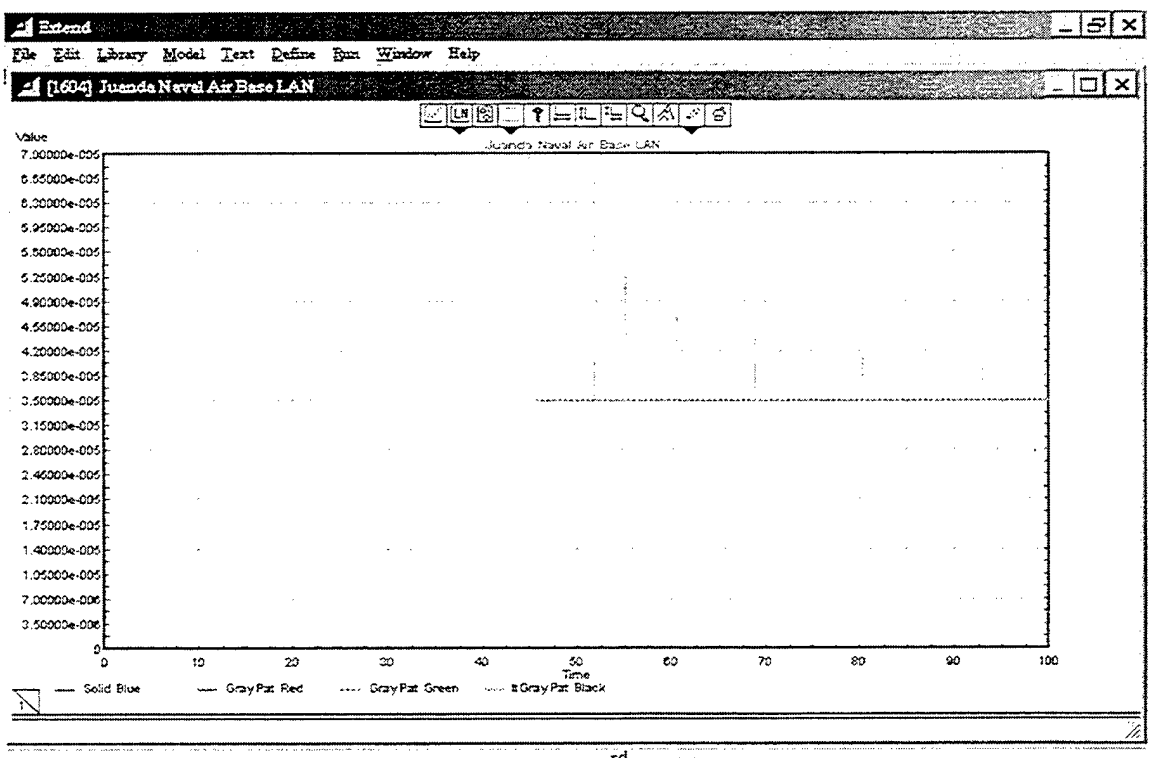
File Edit Library Model Text Define Run Window Help

[1271] The Indonesian Eastern Fl Hq LAN

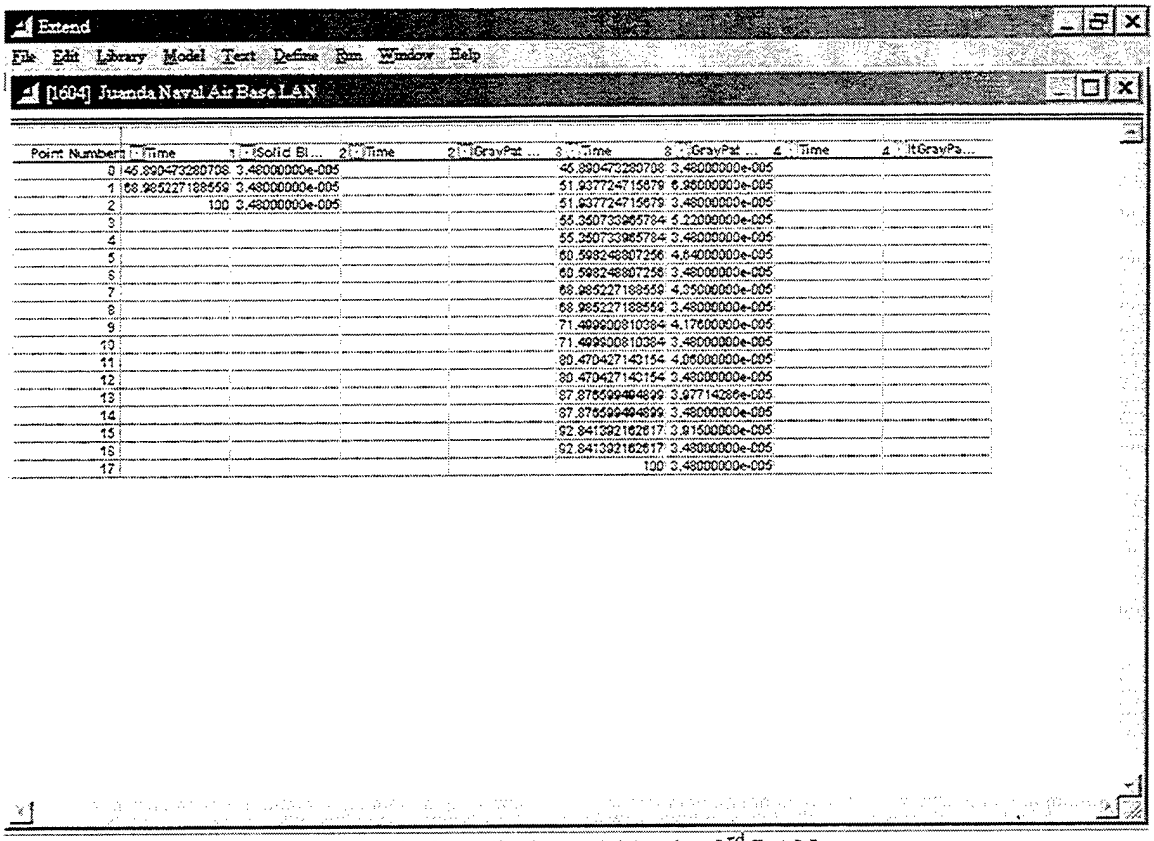
Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : GrayPa...
36	30.352102326085	0.420315142017			10.680915368884	0.166809079502		
37	30.549319049548	8.29000000e-005			12.196404633359	0.166813446601		
38	31.69034435	0.1550691392688			12.196404633359	0.158472770527		
39	32.946360947444	8.29000000e-005			13.069196775	0.174111846894		
40	35.112284	7.756170569546			13.069196775	0.165820461513		
41	37.1569715	7.874602589128			13.422822449319	0.165824491327		
42	39.485023543447	0.344170683913			13.422822449319	0.158285935900		
43	39.831413804347	0.282293951427			14.22025275	0.296800552628		
44	40.026302229347	15.13952634789			14.22025275	0.263895705034		
45	40.041912713905	8.29000000e-005			14.260867425	0.289772372642		
46	41.768229943973	0.322945256150			14.260867425	0.277698523782		
47	42.060235812286	8.29000000e-005			15.22873685	0.512838746277		
48	43.644127250409	0.0551408			15.22873685	0.492325199305		
49	44.197518375	9.853093959741			15.241864325	0.726063035044		
50	44.329437423445	8.29000000e-005			15.241864325	0.698137534658		
51	46.732272909321	0.0551408			15.656465832713	0.698140723119		
52	46.403820929347	0.190159938592			15.656465832713	0.872283593008		
53	46.440228979347	0.098155703152			16.18658438675	0.872286726671		
54	47.527691348505	8.29000000e-005			16.18658438675	0.849276489256		
55	49.650423325	0.161475463622			16.31474365	0.653505257687		
56	49.885541894806	8.29000000e-005			16.31474365	0.630970859362		
57	50.143174276	0.124459117999			16.777102581913	0.630973517993		
58	50.463086525	11.46136603461			16.777102581913	0.609941067284		
59	51.502469327218	8.29000000e-005			18.858284083971	0.609943830717		
60	53.483351108416	12.55186073228			18.858284083971	0.590288232749		
61	55.014358196872	8.29000000e-005			19.181562278627	0.593156128159		
62	55.158000825	0.237123502659			19.181562278627	0.575258874153		
63	55.249407075	10.31902991352			20.644603197221	0.575261455413		
64	56.049515982994	8.29000000e-005			20.644603197221	0.557829999189		
65	57.2871361	0.068999618843			22.121123925	0.698072947925		
66	57.714716313215	8.29000000e-005			22.121123925	0.677541906334		
67	57.907432525	0.504114985763			22.146546355143	0.677543828687		
68	58.072444325	0.417003421373			22.146546355143	0.658185437532		
69	58.332554407651	8.29000000e-005			22.582593844938	0.658187802329		
70	59.40949085	0.080621148748			22.582593844938	0.639940787204		
71	59.503780175	14.77187252668			24.314705875	0.787143261679		
72	61.7413931	15.04492153579			24.314705875	0.765869179838		



Point Number	Time	Solid Bl...	Time	GrayPat ...	Time	GrayPat ...	Time	ltGrayPa...
72	61.7413931	15.044291535228			24.314705875	0.765869123839		
73	64.66008860704	8.29000000e-005			25.540420589375	0.7658713843796		
74	65.0113465	35.147438759838			25.540420589375	0.7457168547906		
75	65.158155175	27.119733408243			26.524176594958	0.7457190363696		
76	67.7060806	48.570191059737			26.524176594958	0.726598035437		
77	68.130764764746	0.0551408			26.56337175483	0.7265001610781		
78	68.229393375	43.522415921716			26.56337175483	0.7084351570511		
79	69.64429735	0.3229587642563			27.338020903861	0.7084372295511		
80	70.083918525	0.1736012085858			27.338020903861	0.6911582727328		
81	70.475444925	0.1157356383168			27.485566078864	0.691160294684		
82	71.97112405	0.1358623739485			27.485566078864	0.6747040971915		
83	73.062406689284	8.29000000e-005			27.940147012488	0.6747060710011		
84	74.16508085	0.2232018353921			27.940147012488	0.6590152321406		
85	74.76963955	17.410959313596			28.51779852588	0.6590171600475		
86	74.937089046891	0.0544794			28.51779852588	0.6440394973192		
87	75.094252525486	8.29000000e-005			29.640374151085	0.9823907860371		
88	78.532925430209	0.0544794			29.640374151085	0.9605598601252		
89	78.612438948392	8.29000000e-005			29.933409226085	0.9649139181639		
90	79.716305751465	0.0794515896999			29.933409226085	0.9439375286386		
91	80.647461479477	8.29000000e-005			30.12919551847	0.9439393308125		
92	81.771397501455	0.1170545230242			30.12919551847	0.9238555152633		
93	82.156114929822	0.7214871958746			30.353132326085	0.9327983906293		
94	83.227114575283	8.29000000e-005			30.353132326085	0.9133650908246		
95	86.117662825001	18.928586718375			30.549319049548	0.9133668179078		
96	88.670120300001	19.661935238449			30.549319049548	0.8947266787669		
97	90.143168567709	8.29000000e-005			31.69034435	0.8980954367111		
98	90.304038685881	36.547957236865			31.69034435	0.8801335279769		
99	92.972194075001	60.798432119541			32.846360947444	0.8801351859769		
100	94.680312390131	8.29000000e-005			32.846360947444	0.8628776333107		
101	95.817082975001	0.0921523344959			34.172138392543	0.8628792588009		
102	96.343885992689	8.29000000e-005			34.172138392543	0.8462854269009		
103	98.194093752124	0.1437686813002			35.688880842572	0.8462870211316		
104	98.536761265463	0.0544794			35.688880842572	0.8303193414876		
105	98.577072625002	22.682594325561			36.112284	0.9766999182226		
106	99.970249100002	0.4849808024082			36.112284	0.9586128827		
107	100	0.4849808024082			37.1569715	1.1044444121428		
108					37.1569715	1.0843636046493		

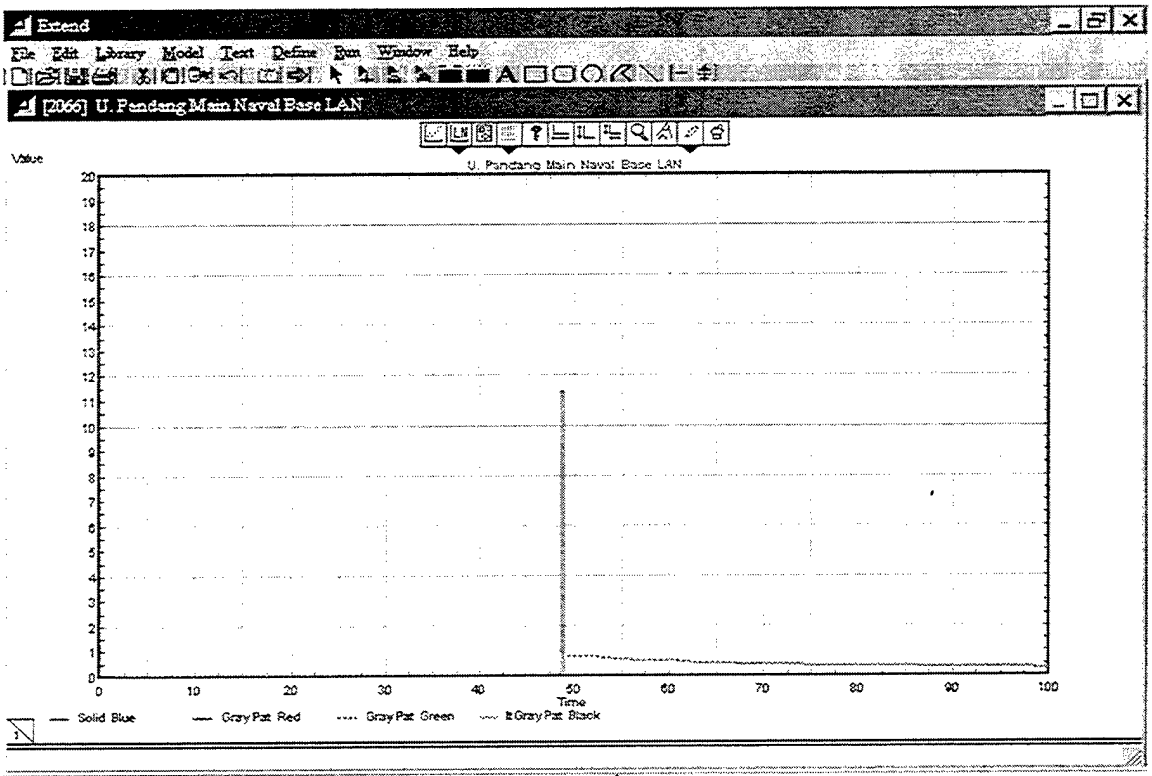


Run 0, The 3rd LAN,

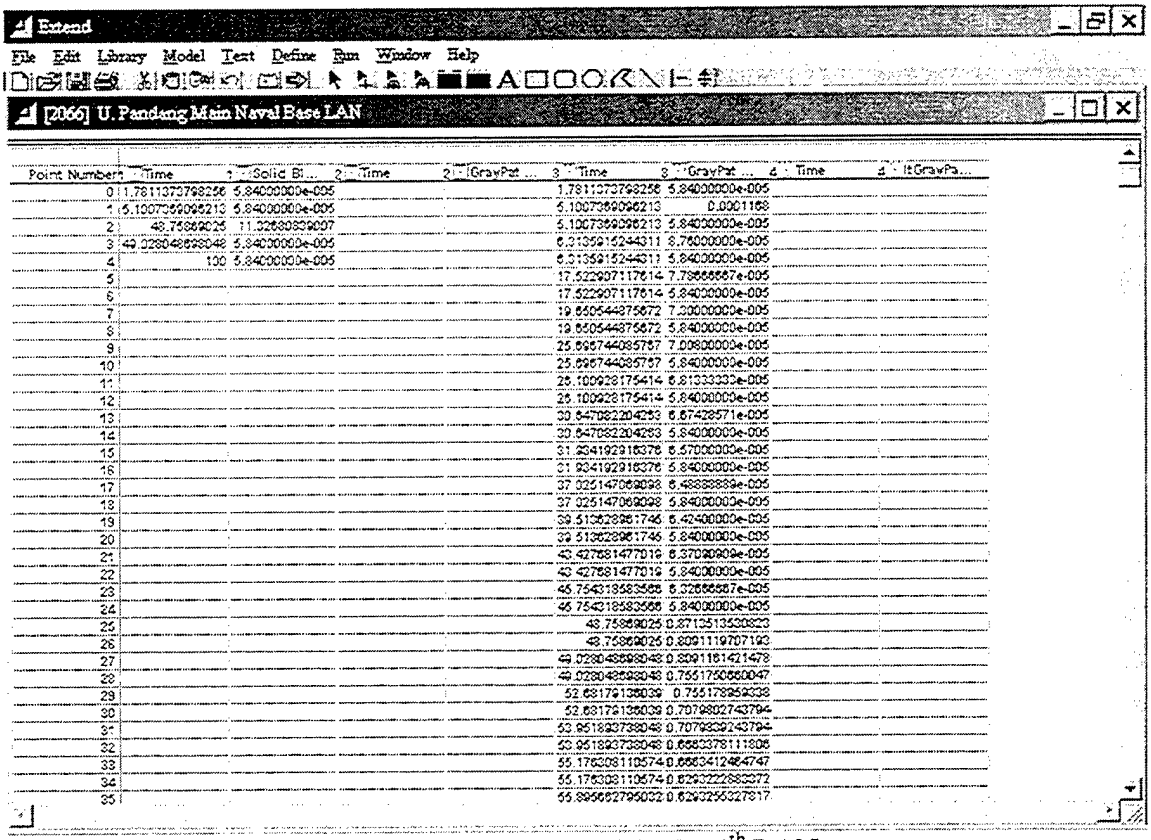


Point Number	Time	Solid Bl...	Time	GrayPat ...	Time	GrayPat ...	Time	ltGrayPa...
0	45.8904732807	3.48000000e-005			45.8904732807	3.48000000e-005		
1	68.9852271885	3.48000000e-005			51.937724715	6.95000000e-005		
2	100	3.48000000e-005			51.937724715	3.48000000e-005		
3					55.3507339657	5.22000000e-005		
4					55.3507339657	3.48000000e-005		
5					60.5932488072	4.64000000e-005		
6					60.5932488072	3.48000000e-005		
7					68.9852271885	4.35000000e-005		
8					68.9852271885	3.48000000e-005		
9					71.4999008103	4.17600000e-005		
10					71.4999008103	3.48000000e-005		
11					80.4704271431	4.06000000e-005		
12					80.4704271431	3.48000000e-005		
13					87.8755994849	3.97714286e-005		
14					87.8755994849	3.48000000e-005		
15					92.8413921626	3.91500000e-005		
16					92.8413921626	3.48000000e-005		
17					100	3.48000000e-005		

Run 0, Data Delay within the 3rd LAN

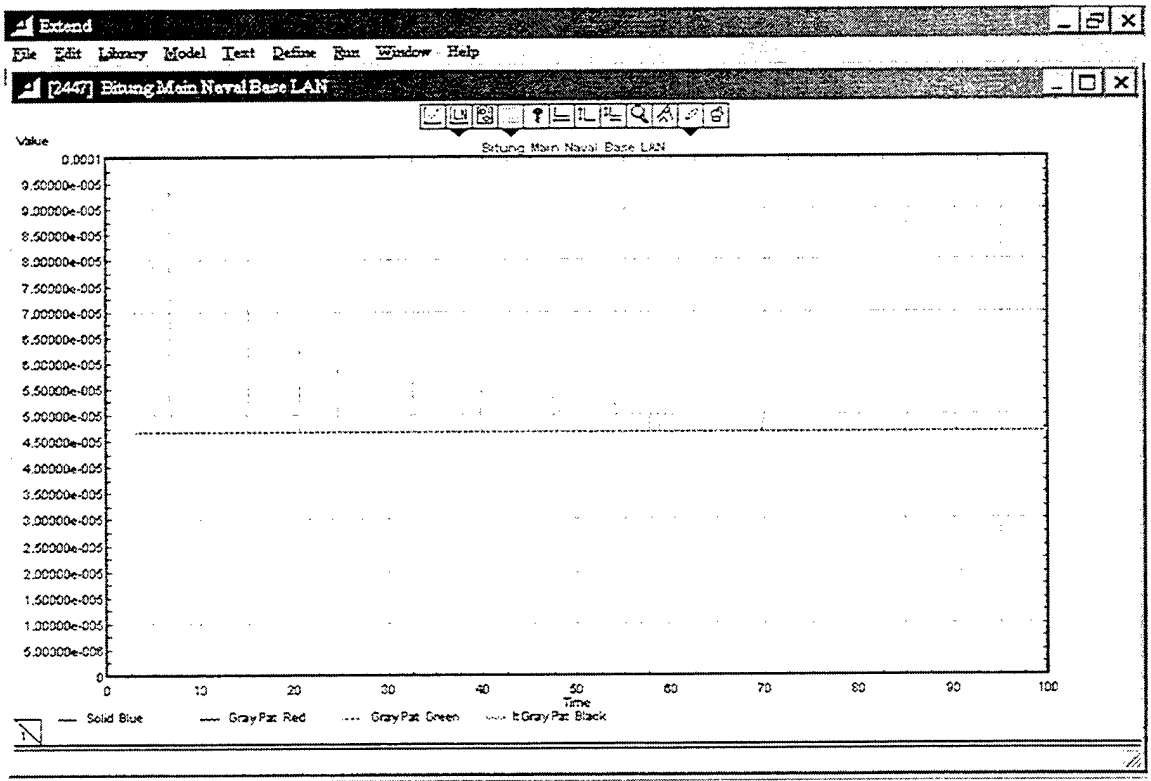


Run 0, The 4th LAN

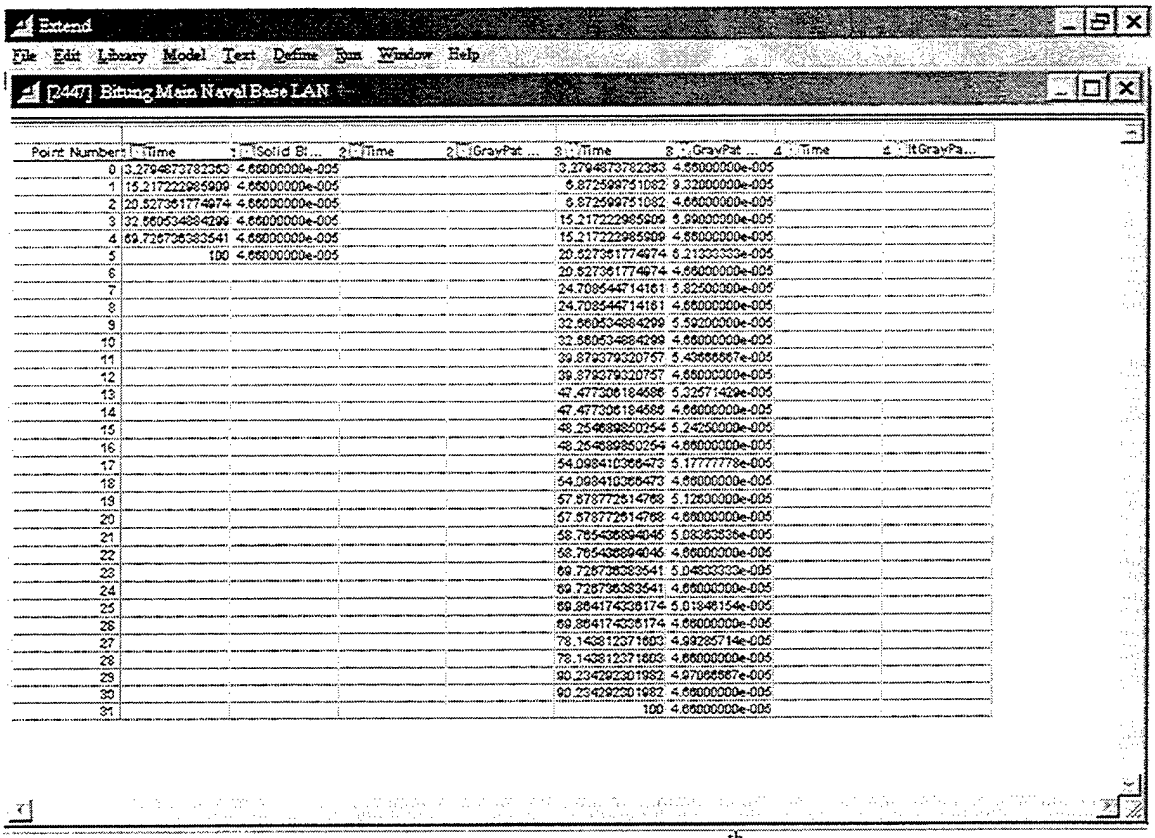


Point Number	1 Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ItGrayPa...
0	1.7811373798256	5.84000000e-005			1.7811373798256	5.84000000e-005		
1	5.1007369096213	5.84000000e-005			5.1007369096213	0.0001168		
2	48.75869025	11.32680839007			5.1007369096213	5.84000000e-005		
3	49.028048698048	5.84000000e-005			6.3135915244311	8.76000000e-005		
4	100	5.84000000e-005			6.3135915244311	5.84000000e-005		
5					17.522907117614	7.78666667e-005		
6					17.522907117614	5.84000000e-005		
7					19.650544875672	7.30000000e-005		
8					19.650544875672	5.84000000e-005		
9					25.696744085757	7.00800000e-005		
10					25.696744085757	5.84000000e-005		
11					26.100928175414	6.81333333e-005		
12					26.100928175414	5.84000000e-005		
13					30.647082204263	6.67428571e-005		
14					30.647082204263	5.84000000e-005		
15					31.934192916376	6.57000000e-005		
16					31.934192916376	5.84000000e-005		
17					37.025147069098	6.48888889e-005		
18					37.025147069098	5.84000000e-005		
19					39.513628961746	6.42400000e-005		
20					39.513628961746	5.84000000e-005		
21					43.427681477019	6.37090909e-005		
22					43.427681477019	5.84000000e-005		
23					45.754318583566	6.32666667e-005		
24					45.754318583566	5.84000000e-005		
25					48.75869025	0.8713513530823		
26					48.75869025	0.8091119707193		
27					49.028048698048	0.8091161421478		
28					49.028048698048	0.7551750660047		
29					52.68179136039	0.755178959338		
30					52.68179136039	0.7079802743794		
31					53.951893738048	0.7079839243794		
32					53.951893738048	0.6663378111806		
33					55.176308110574	0.6663412464747		
34					55.176308110574	0.6293222883372		
35					55.895662795032	0.6293255327817		

Run 0, Data Delay within the 4th LAN

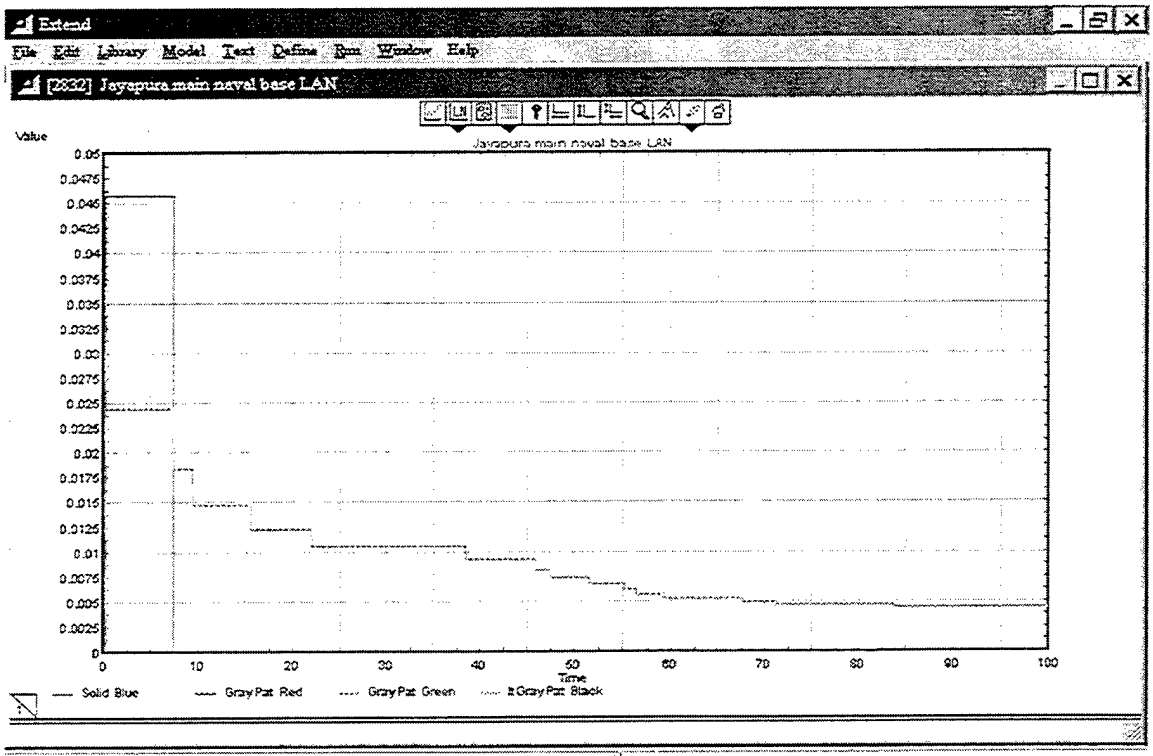


Run 0, The 5th LAN

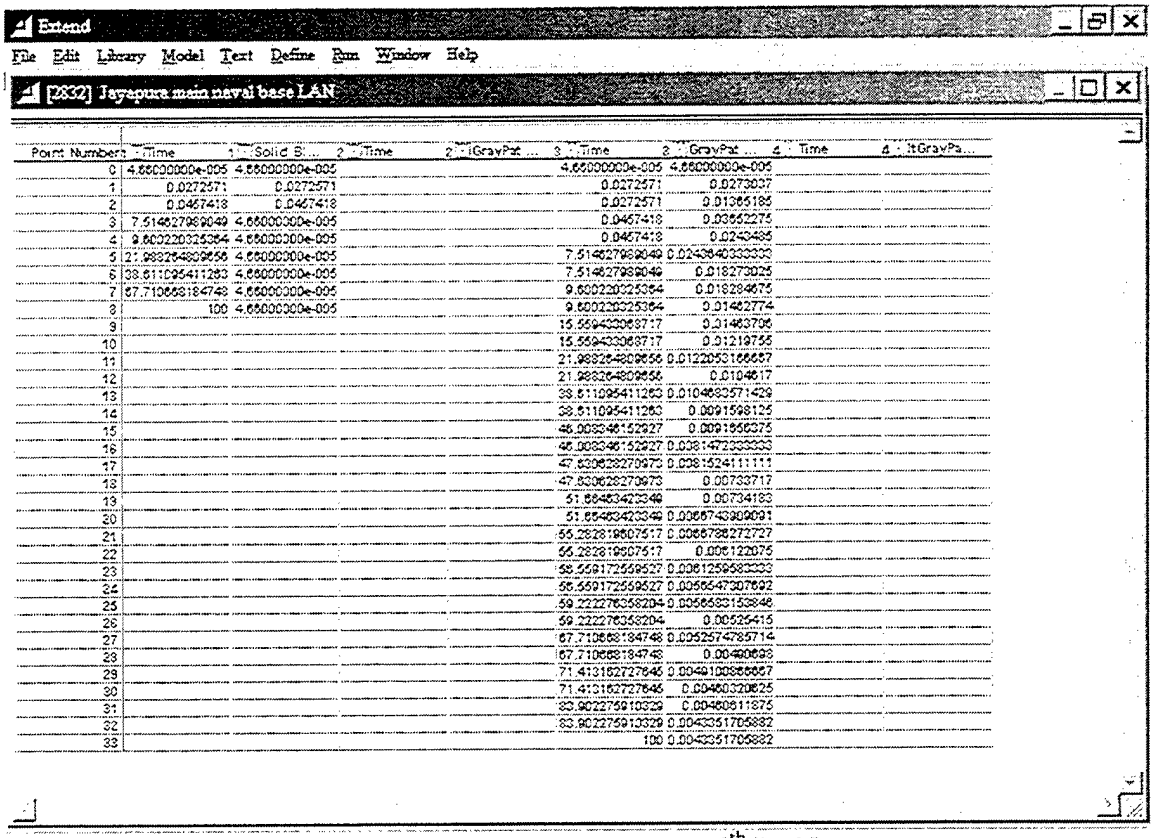


Point Number	Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	8 GrayPat ...	4 Time	4 ltGrayPa...
0	3.2794873782353	4.66000000e-005			3.2794873782353	4.66000000e-005		
1	15.217222985909	4.66000000e-005			6.8725997510082	9.32000000e-005		
2	20.527361774974	4.66000000e-005			6.8725997510082	4.66000000e-005		
3	32.560534884299	4.66000000e-005			15.217222985909	5.59000000e-005		
4	69.726736383541	4.66000000e-005			15.217222985909	4.66000000e-005		
5	100	4.66000000e-005			20.527361774974	5.21333333e-005		
6					20.527361774974	4.66000000e-005		
7					24.708544714161	5.82500000e-005		
8					24.708544714161	4.66000000e-005		
9					32.560534884299	5.59200000e-005		
10					32.560534884299	4.66000000e-005		
11					39.879379320757	5.43666667e-005		
12					39.879379320757	4.66000000e-005		
13					47.477306184585	5.22571429e-005		
14					47.477306184585	4.66000000e-005		
15					48.254689850254	5.24250000e-005		
16					48.254689850254	4.66000000e-005		
17					54.098410366473	5.17777778e-005		
18					54.098410366473	4.66000000e-005		
19					57.878772514768	5.12600000e-005		
20					57.878772514768	4.66000000e-005		
21					58.765436894046	5.08363636e-005		
22					58.765436894046	4.66000000e-005		
23					69.726736383541	5.04833333e-005		
24					69.726736383541	4.66000000e-005		
25					69.864174336174	5.01946154e-005		
26					69.864174336174	4.66000000e-005		
27					78.140812371603	4.99285714e-005		
28					78.140812371603	4.66000000e-005		
29					80.234292301982	4.97066667e-005		
30					80.234292301982	4.66000000e-005		
31					100	4.66000000e-005		

Run 0, Data Delay within the 5th LAN



Run 0, The 6th LAN



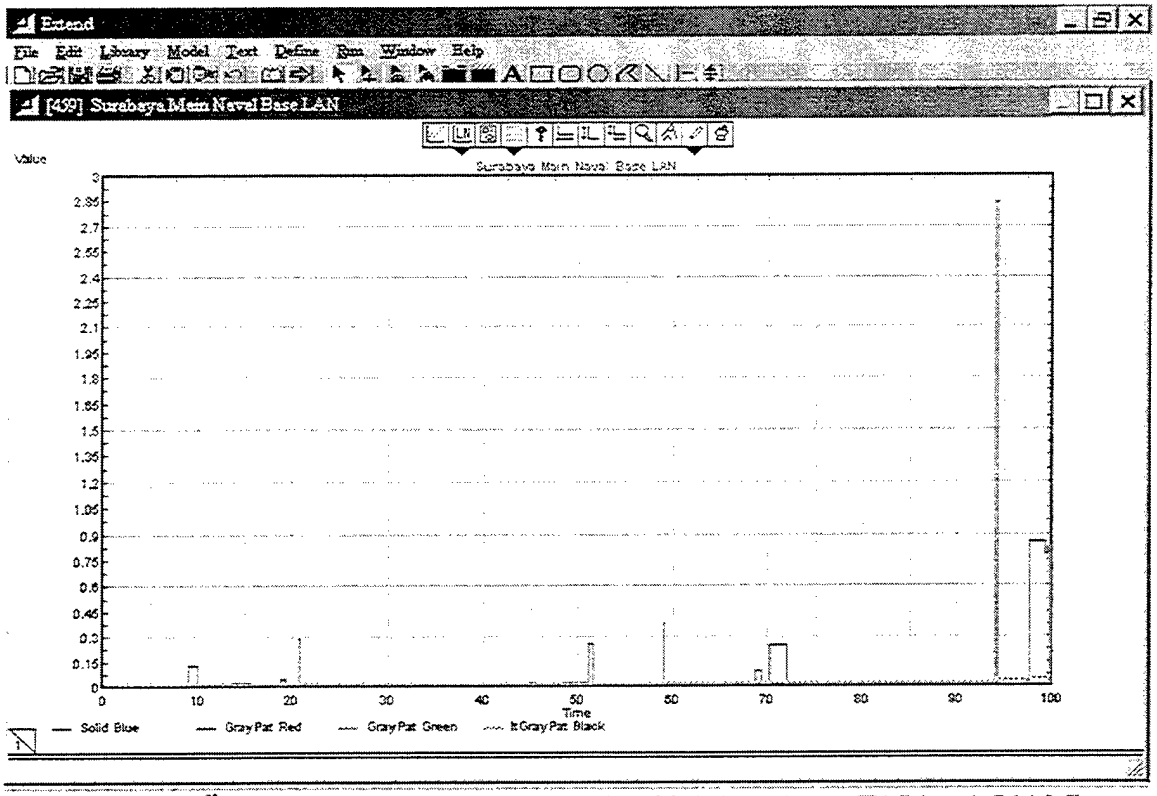
Extend

File Edit Library Model Text Define Run Window Help

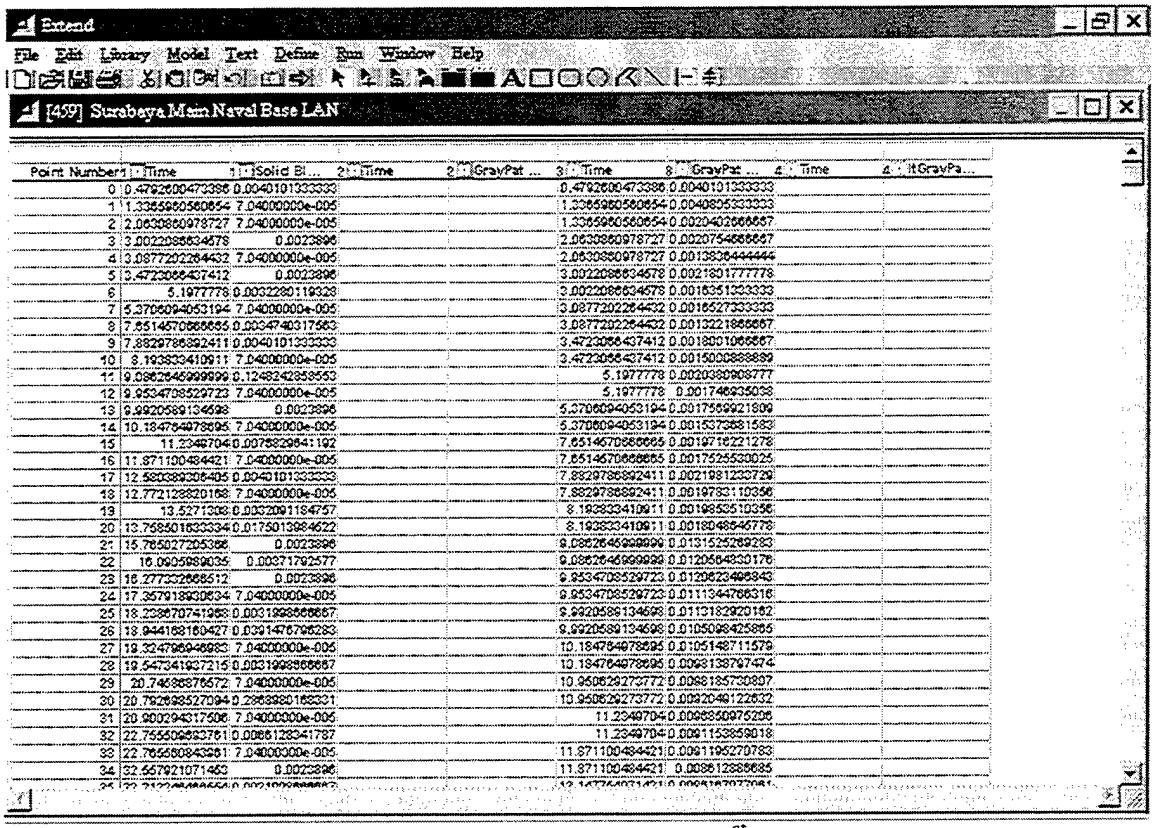
[2832] Jayapura main naval base LAN

Point Number	Time	1 Solid Bl...	2 Time	2 iGrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ItGrayPa...
0	4.66000000e-005	4.66000000e-005			4.66000000e-005	4.66000000e-005		
1	0.0272571	0.0272571			0.0272571	0.0273037		
2	0.0467418	0.0467418			0.0272571	0.01365185		
3	7.514627989049	4.66000000e-005			0.0467418	0.03652275		
4	9.600220325364	4.66000000e-005			0.0467418	0.0243485		
5	21.988264809656	4.66000000e-005			7.514627989049	0.0243640333333		
6	38.611095411263	4.66000000e-005			7.514627989049	0.018273025		
7	67.710668184748	4.66000000e-005			9.600220325364	0.018284675		
8	100	4.66000000e-005			9.600220325364	0.01462774		
9					15.559433068717	0.01463706		
10					15.559433068717	0.01219755		
11					21.988264809656	0.0122053166667		
12					21.988264809656	0.0104617		
13					38.611095411263	0.0104683571429		
14					38.611095411263	0.0091598125		
15					46.008346152927	0.0091656375		
16					46.008346152927	0.0081472333333		
17					47.630628270973	0.0081524111111		
18					47.630628270973	0.00733717		
19					51.66463423349	0.00734183		
20					51.66463423349	0.0066743909091		
21					55.282819607517	0.0066786272727		
22					55.282819607517	0.006122075		
23					56.559172559527	0.0061259583333		
24					56.559172559527	0.0056547307692		
25					59.222276358204	0.0056583153846		
26					59.222276358204	0.00525415		
27					67.710668184748	0.0052574785714		
28					67.710668184748	0.00490698		
29					71.413162727645	0.0049100866667		
30					71.413162727645	0.00460320625		
31					83.902275910329	0.00460611875		
32					83.902275910329	0.0043351705882		
33					100	0.0043351705882		

Run 0, Data Delay within the 6th LAN

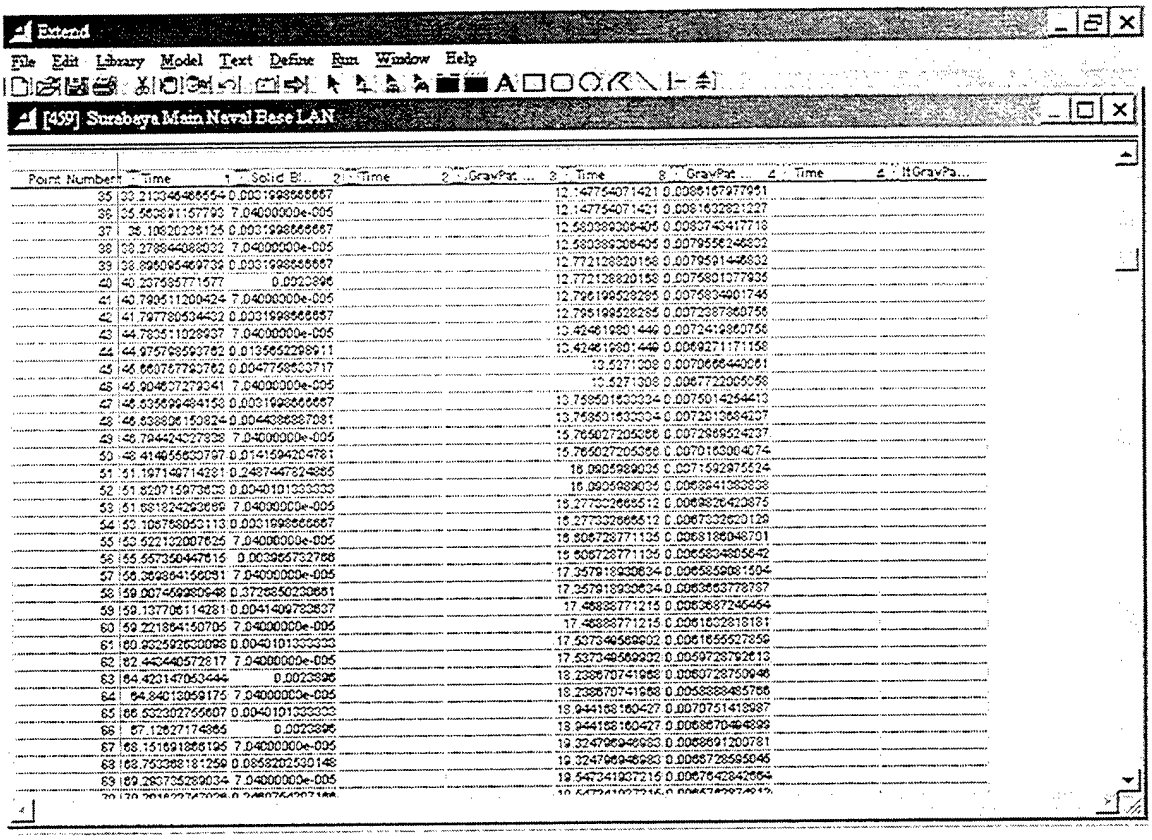


Run 1, The 1st LAN, Using Simulation Set Up 100, Mean 1 sec, T1 Line 1.544 Mbps

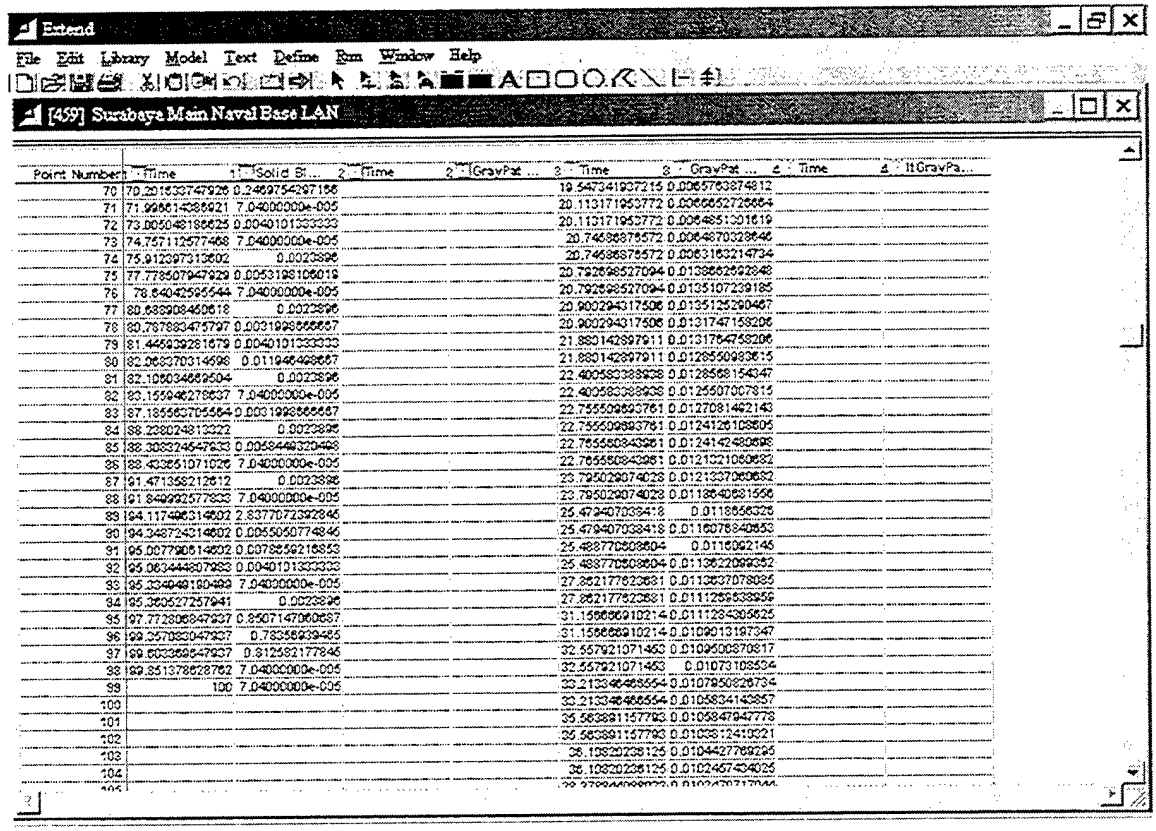


Point Number	Time	Solid Bl...	Time	GrayPat ...	Time	GrayPat ...	Time	ItGrayPa...
0	0.4792600473386	0.0040101333333			0.4792600473386	0.0040101333333		
1	1.3365960560654	7.04000000e-005			1.3365960560654	0.0040805333333		
2	2.0630860978727	7.04000000e-005			1.3365960560654	0.0020402666667		
3	3.0022086634578	0.0023896			2.0630860978727	0.0020754666667		
4	3.0877202264432	7.04000000e-005			2.0630860978727	0.0013836444444		
5	3.4723066437412	0.0023896			3.0022086634578	0.0021801777778		
6	5.1977778	0.0032280119328			3.0022086634578	0.0016351333333		
7	5.3706094053194	7.04000000e-005			3.0877202264432	0.0016527333333		
8	7.6514670666665	0.0034740317563			3.0877202264432	0.0013221866667		
9	7.8829786892411	0.0040101333333			3.4723066437412	0.0018001066667		
10	8.193833410911	7.04000000e-005			3.4723066437412	0.0015000888889		
11	9.0862645999999	0.1248242858553			5.1977778	0.0020380908777		
12	9.9534708529723	7.04000000e-005			5.1977778	0.001746935038		
13	9.9920589134598	0.0023896			5.3706094053194	0.0017569921809		
14	10.184764978695	7.04000000e-005			5.3706094053194	0.0015373681583		
15	11.2349704	0.0076829641192			7.6514670666665	0.0019716221278		
16	11.871100484421	7.04000000e-005			7.6514670666665	0.0017525530025		
17	12.580389306405	0.0040101333333			7.8829786892411	0.0021981233729		
18	12.772128820168	7.04000000e-005			7.8829786892411	0.0019783110356		
19	13.5271308	0.0032091184757			8.193833410911	0.0019853510356		
20	13.758501633334	0.0175013984622			8.193833410911	0.0018048646778		
21	15.765027205366	0.0023896			9.0862645999999	0.0131525269283		
22	16.0905989035	0.00371792577			9.0862645999999	0.0120564830176		
23	16.277332666512	0.0023896			9.9534708529723	0.0120623496843		
24	17.357918930634	7.04000000e-005			9.9534708529723	0.0111344766316		
25	18.238670741968	0.0031998666667			9.9920589134598	0.0113182920162		
26	18.944168160427	0.0391476796283			9.9920589134598	0.0105098425865		
27	19.324796946983	7.04000000e-005			10.184764978695	0.0105148711579		
28	19.547341937215	0.0031998666667			10.184764978695	0.0098138797474		
29	20.74686876572	7.04000000e-005			10.950629273772	0.0098185730807		
30	20.792698527094	0.2868980168331			10.950629273772	0.0092049122632		
31	20.900294317506	7.04000000e-005			11.2349704	0.0096850975206		
32	22.755509693761	0.0066128341787			11.2349704	0.0091153859018		
33	22.765560843961	7.04000000e-005			11.871100484421	0.0091195270783		
34	32.557921071453	0.0023896			11.871100484421	0.008612886685		
35	[illegible]	[illegible]			[illegible]	[illegible]		

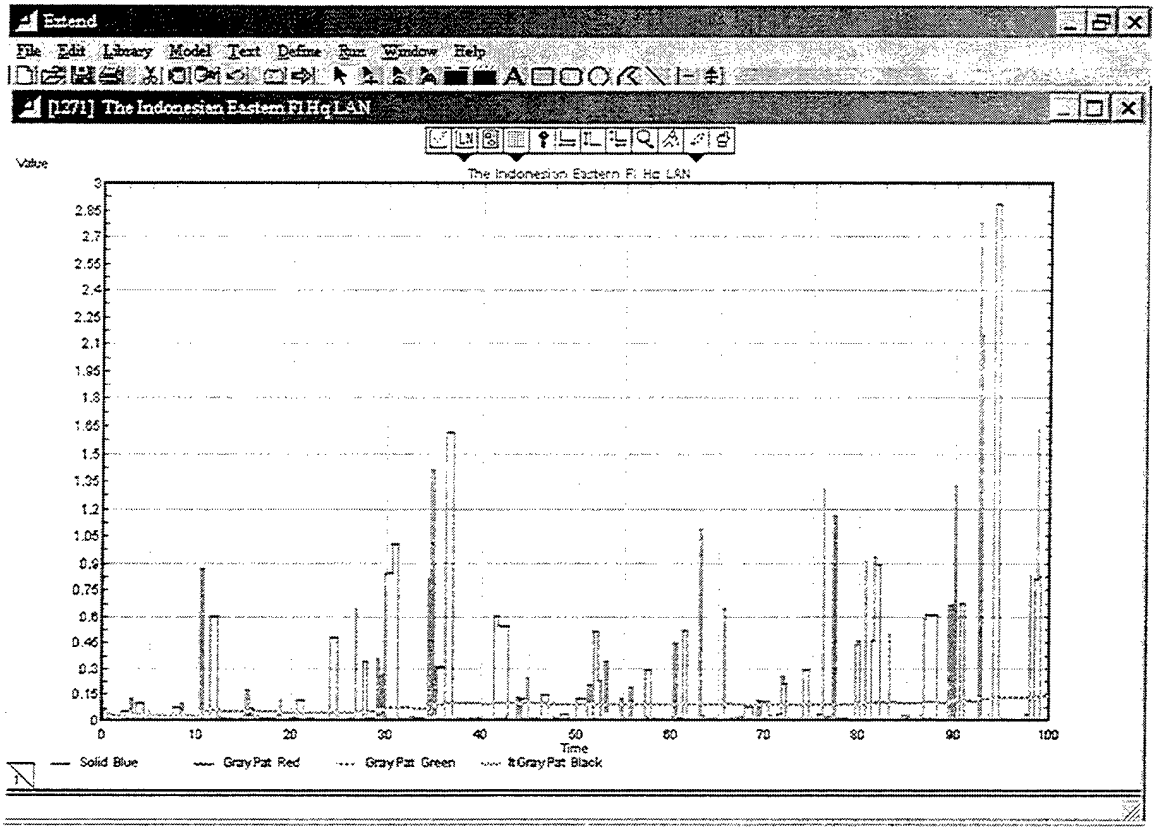
Run 1, Data Delay within the 1st LAN



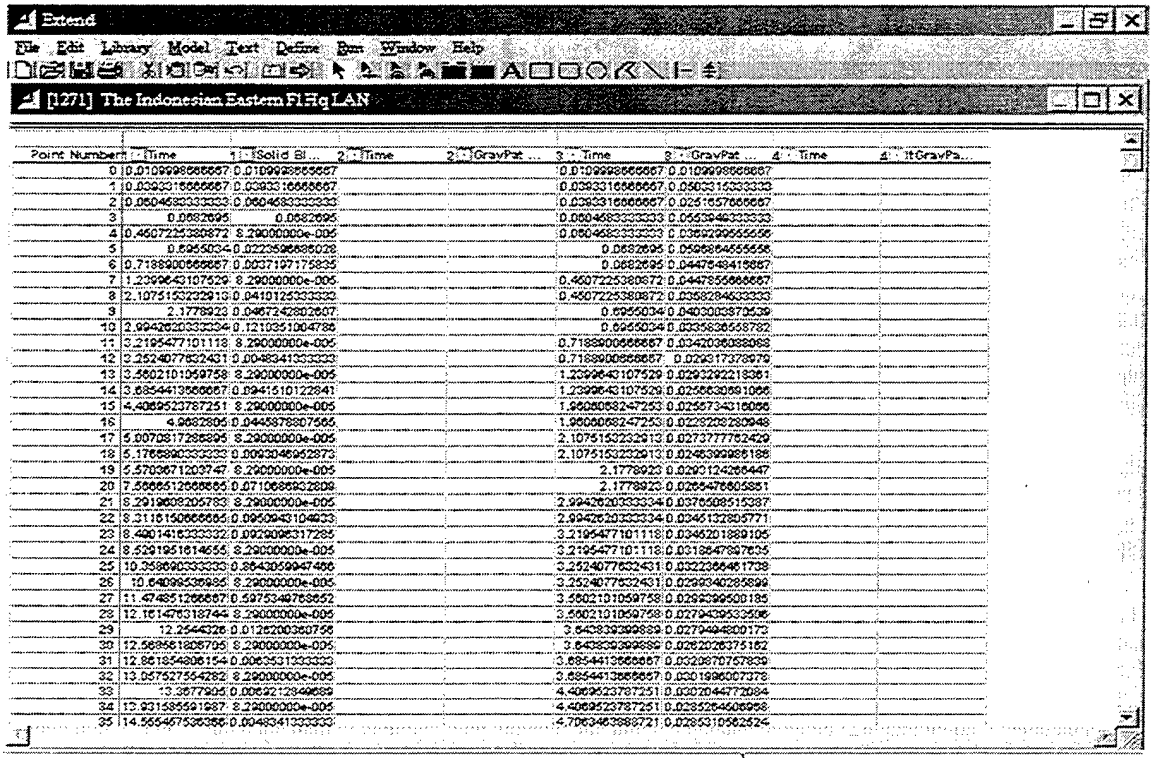
Point Number	Time	1 Solid Bl...	2 Time	2 GravPat ...	3 Time	3 GravPat ...	4 Time	4 GravPa...
35	33.2103464665564	0.0031998666667			12.1477540714210	0.0086157977951		
36	35.5603891157793	7.040000000e-005			12.1477540714210	0.0086162882227		
37	36.1082023835125	0.0031998666667			12.5803892084054	0.0087454417718		
38	39.2786440869032	7.040000000e-005			12.5803892084054	0.0079556246832		
39	39.8950954697936	0.0031998666667			12.7721282201580	0.0079591446832		
40	40.2375857771577	0.0023896			12.7721282201580	0.0075801377935		
41	40.7905112004424	7.040000000e-005			12.7961995282853	0.0075834901745		
42	41.7977805344432	0.0031998666667			12.7961995282853	0.0072387360755		
43	44.7805110228937	7.040000000e-005			13.4246619801446	0.0072419860755		
44	44.9757695937762	0.0135652299111			13.4246619801446	0.0069271171158		
45	46.6607677937762	0.0047758833717			13.5271308	0.0070666440061		
46	46.9046077279341	7.040000000e-005			13.5271308	0.0067722005058		
47	46.9356994984158	0.0031998666667			13.7585016530234	0.0075014254413		
48	46.8388961509824	0.0044386887081			13.7585016530234	0.0072013684207		
49	46.7944242279838	7.040000000e-005			15.7650272050668	0.0072989524237		
50	48.4146556307971	0.0141594204781			15.7650272050668	0.0070163004074		
51	51.1971497114281	0.2487447624265			16.0905989035	0.0071592975524		
52	51.8207159736535	0.0040101333333			16.0905989035	0.0068941382828		
53	51.9818242293699	7.040000000e-005			16.2775026665512	0.0068926402875		
54	52.1067680503113	0.0031998666667			16.2775026665512	0.0067332620128		
55	52.5221320076235	7.040000000e-005			16.806728771135	0.0068186048701		
56	55.5573504476515	9.002965732756			15.806728771135	0.0065804805642		
57	56.3898641660691	7.040000000e-005			17.3579189930634	0.0065859081504		
58	59.0074692805948	0.3726850230851			17.3579189930634	0.0063563778787		
59	59.1377061142810	0.0041409782837			17.4688877121515	0.0063687246564		
60	59.2218641507055	7.040000000e-005			17.4688877121515	0.0061602818181		
61	60.9525926500928	0.0040101333333			17.5373495699902	0.0061655527859		
62	62.4404405728317	7.040000000e-005			17.5373495699902	0.0059728792613		
63	64.4231470653444	0.0023896			18.2386707419568	0.0060728750946		
64	64.8401359591750	7.040000000e-005			18.2386707419568	0.0058688485756		
65	66.5222027555607	0.0040101333333			18.9441581604270	0.0070751418987		
66	67.1262717486515	0.0023896			18.9441581604270	0.0068670464899		
67	68.1516918651955	7.040000000e-005			19.3247969483983	0.0068691200781		
68	68.7533681812599	0.0858202530148			19.3247969483983	0.0067728585046		
69	69.2807352890345	7.040000000e-005			19.5472419372153	0.0067642842564		



Point Number	Time	1 Solid Bl...	2 Time	2 GravPat ...	3 Time	3 GravPat ...	4 Time	4 GravPa...
70	70.2016337479226	0.2469754297156			19.5473419372153	0.0065763874812		
71	71.9966140889221	7.040000000e-005			20.1131719537724	0.0066652725664		
72	73.0050481956625	0.0040101333333			20.1131719537724	0.0064851301619		
73	74.7571125577468	7.040000000e-005			20.7468687557572	0.0064670328646		
74	75.9123973136021	0.0023896			20.7468687557572	0.0063152214734		
75	77.7785079479290	0.0053198106019			20.7925985270940	0.0138662592848		
76	78.6404256555441	7.040000000e-005			20.7925985270940	0.0135107239185		
77	80.6839084606181	0.0023896			20.9002943175060	0.0135125290467		
78	80.7878834757971	0.0031998666667			20.9002943175060	0.0121747152206		
79	81.4469392816791	0.0040101333333			21.8801428979110	0.0131764752206		
80	82.0683703146998	0.0119464986667			21.8801428979110	0.0128550983615		
81	82.1060346695042	0.0023896			22.4005803889038	0.0128568154347		
82	83.1559462786637	7.040000000e-005			22.4005803889038	0.0125507007815		
83	87.1855657055564	0.0031998666667			22.7555099893761	0.0127081462143		
84	88.2380248133222	0.0023896			22.7555099893761	0.0124126108605		
85	88.3083246479633	0.0058449320498			22.7655850843961	0.0124142480698		
86	88.4036510710265	7.040000000e-005			22.7655850843961	0.0121321060682		
87	91.4713582126512	0.0023896			23.7950290740281	0.0121337060682		
88	91.8499925778635	7.040000000e-005			23.7950290740281	0.0118640681556		
89	94.1174963146021	2.837707239284			25.4724070338418	0.0118656326		
90	94.2487243146021	0.0055050774846			25.4724070338418	0.0116078840653		
91	95.0077905146021	0.0078569216853			25.4887705086504	0.0116092146		
92	95.0603446807983	0.0040101333333			25.4887705086504	0.0113622099352		
93	95.3349481804993	7.040000000e-005			27.8621776230681	0.0113637078085		
94	96.3605272579411	0.0023896			27.8621776230681	0.0111256538956		
95	97.7728068479207	0.8507147060657			31.1556869910214	0.0111294305625		
96	99.2570880479207	0.7835859394657			31.1556869910214	0.0109013197047		
97	99.6033694479207	0.8125821778465			32.5579210714630	0.0109008570817		
98	99.8513786287627	7.040000000e-005			32.5579210714630	0.0107310853504		
99	100	7.040000000e-005			33.2103464665564	0.0107950826734		
100					33.2103464665564	0.0105834140657		
101					35.5603891157793	0.0105847947778		
102					35.5603891157793	0.0103612419221		
103					36.1082023835125	0.0104427769295		
104					36.1082023835125	0.0102467434025		

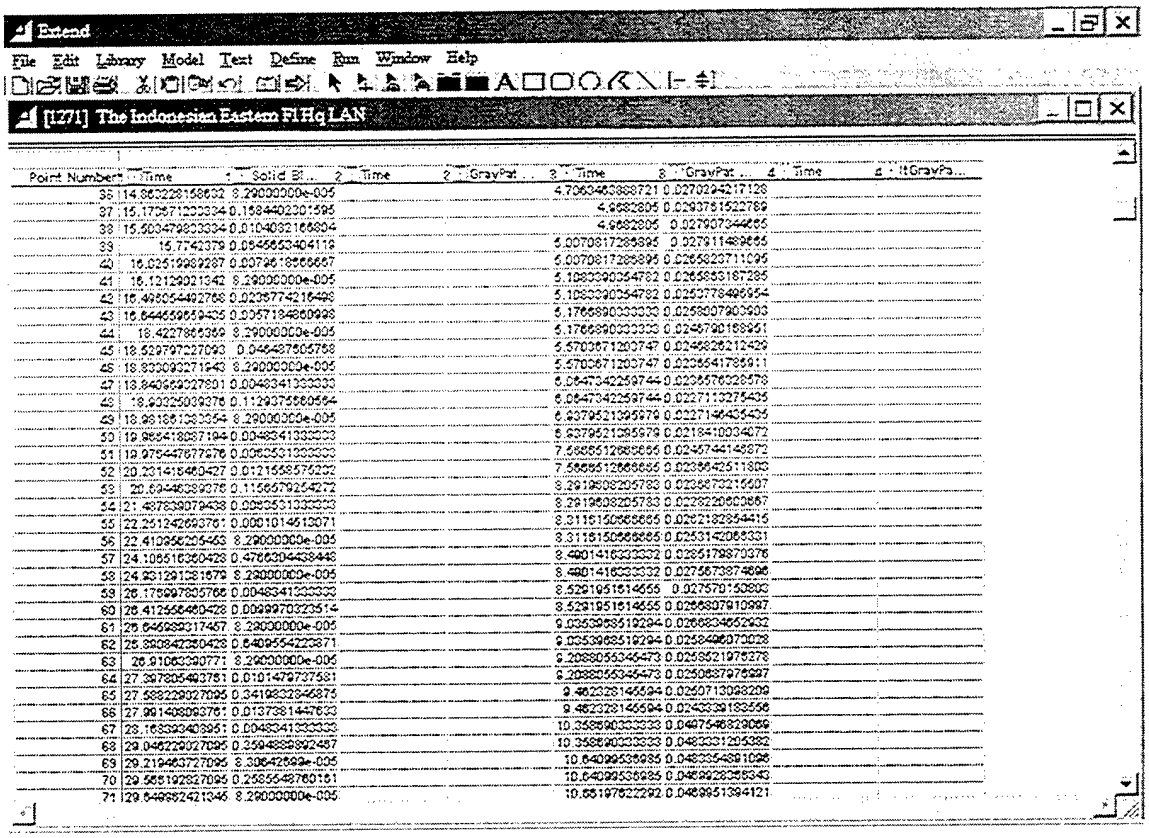


Run 1, The 2nd LAN, Using Simulation Set Up 100, Mean 1 sec, T1 Line 1.544 Mbps

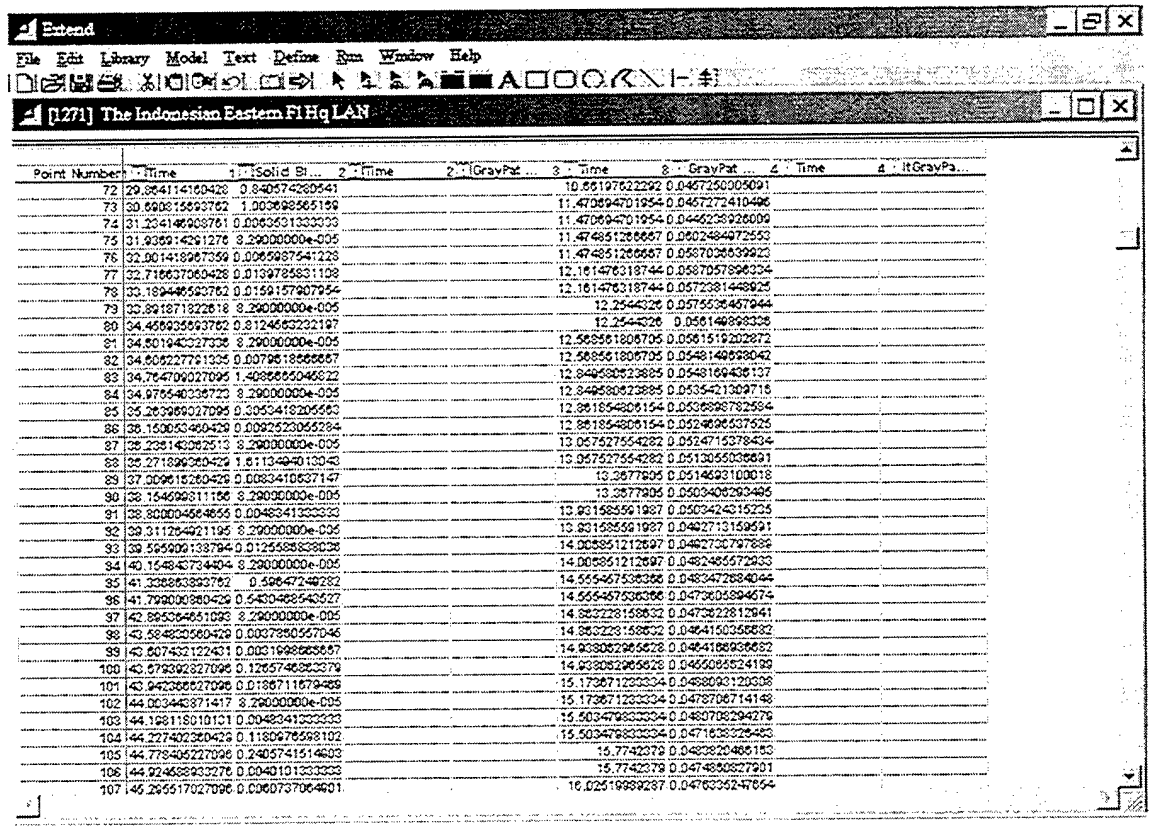


Point Number	Time	Solid Bl...	Time	GrayPat ...	Time	GrayPat ...	Time	ItGrayPa...
0	0.0109998666667	0.0109998666667			0.0109998666667	0.0109998666667		
1	0.0393316666667	0.0393316666667			0.0393316666667	0.0503315333333		
2	0.0604683333333	0.0604683333333			0.0393316666667	0.0251657666667		
3	0.0682695	0.0682695			0.0604683333333	0.0553949333333		
4	0.4507225380872	8.29000000e-005			0.0604683333333	0.0369299555556		
5	0.6955034	0.0223596686028			0.0682695	0.0596864555556		
6	0.7188900666667	0.0037197175835			0.0682695	0.0447648416667		
7	1.2399643107529	8.29000000e-005			0.4507225380872	0.0447855666667		
8	2.1075153232913	0.0410125333333			0.4507225380872	0.0358284633333		
9	2.1778923	0.0467242802607			0.6955034	0.0403003870539		
10	2.9942620333334	0.1210351004786			0.6955034	0.0335836558782		
11	3.2195477101118	8.29000000e-005			0.7188900666667	0.0342036088088		
12	3.2524077632431	0.0048341333333			0.7188900666667	0.029317378979		
13	3.5602101059758	8.29000000e-005			1.2399643107529	0.0293292218361		
14	3.6854413666667	0.0941510122841			1.2399643107529	0.0256630691066		
15	4.4069523787251	8.29000000e-005			1.9606068247253	0.0255734316066		
16	4.9682805	0.0445878807565			1.9606068247253	0.0228208280948		
17	5.0070817286895	8.29000000e-005			2.1075153232913	0.0273777762429		
18	5.1766890333333	0.0093046952873			2.1075153232913	0.0246399986186		
19	5.5703671203747	8.29000000e-005			2.1778923	0.0293124266447		
20	7.5666512666665	0.0710686932809			2.1778923	0.0265476605851		
21	8.2919608205783	8.29000000e-005			2.9942620333334	0.0376508515387		
22	8.3116150666665	0.0950943104933			2.9942620333334	0.0345132805771		
23	8.4901416333332	0.0929096317285			3.2195477101118	0.0345201889105		
24	8.5291951614655	8.29000000e-005			3.2195477101118	0.0318647897635		
25	10.358690333333	0.8643059947466			3.2524077632431	0.0322366461738		
26	10.64099536985	8.29000000e-005			3.2524077632431	0.0299340285899		
27	11.474851266667	0.5975349768652			3.5602101059758	0.0299399500185		
28	12.161476318744	8.29000000e-005			3.5602101059758	0.0279439533506		
29	12.2544326	0.0126200360756			3.643839399889	0.0279494800173		
30	12.568561806705	8.29000000e-005			3.643839399889	0.0262026375162		
31	12.861854806154	0.0063531333333			3.6854413666667	0.0320870757839		
32	13.057527554282	8.29000000e-005			3.6854413666667	0.0301996007378		
33	13.3677905	0.0069212849689			4.4069523787251	0.0302044772084		
34	13.931585591987	8.29000000e-005			4.4069523787251	0.0285264506968		
35	14.555457536366	0.0048341333333			4.7063463888721	0.0285310562524		

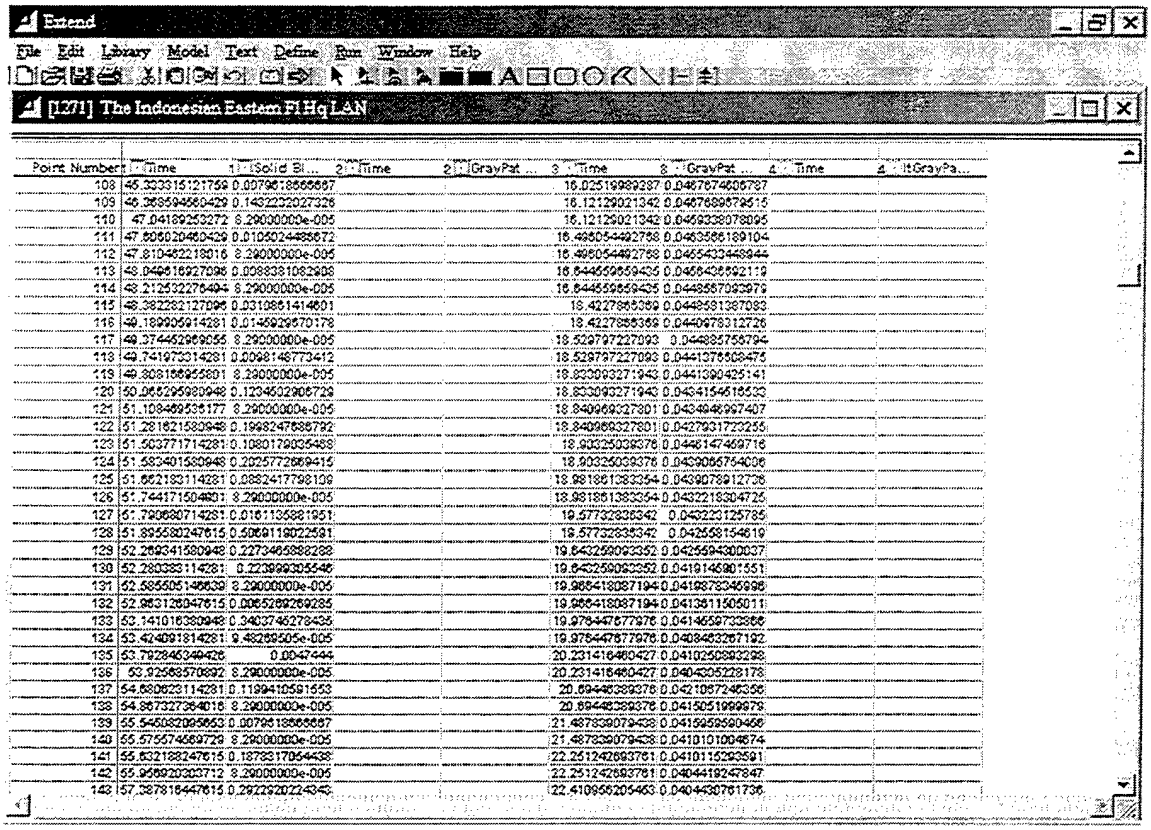
Run 1, Data Delay within the 2nd LAN



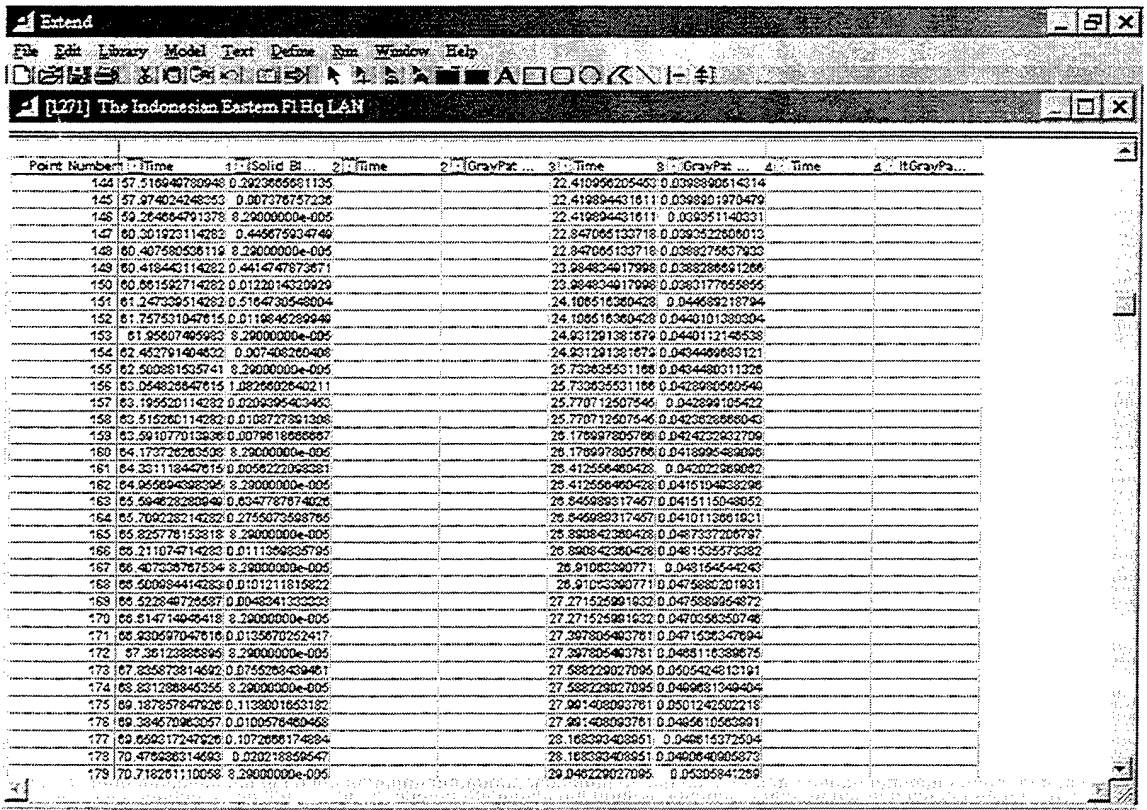
Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ItGrayPa...
36	14.862228158632	8.29000000e-005			4.706044088721	0.027029427128		
37	15.170671223224	0.158440220159			4.9682805	0.029378152278		
38	15.503479823334	0.0104092166804			4.9682805	0.027907344665		
39	15.7742379	0.0546653404119			5.007081728589	0.027911489655		
40	16.025199899287	0.007961856667			5.007081728589	0.026592371109		
41	16.12129021342	8.29000000e-005			5.108039035782	0.026585187285		
42	16.495054492768	0.0235774216498			5.108039035782	0.025377849654		
43	16.844659559435	0.0057184669998			5.176689033333	0.025807903903		
44	18.4227865389	8.29000000e-005			5.176689033333	0.024579018951		
45	18.529797227093	0.046487505758			5.570067120074	0.024568212429		
46	18.833093271943	8.29000000e-005			5.570067120074	0.023564178911		
47	18.840659927891	0.0048341333333			6.064704225974	0.023657632857		
48	18.93025039276	0.112997556564			6.064704225974	0.022711275435		
49	18.981861283054	8.29000000e-005			6.637952195979	0.022719645435		
50	19.985418087194	0.0048341333333			6.637952195979	0.021841003472		
51	19.979447677676	0.0062531333333			7.566551266666	0.024574414872		
52	20.201418460427	0.121555579293			7.566551266666	0.023564251188		
53	20.694468089076	0.115667954272			8.291960805783	0.023567001607		
54	21.487639079438	0.0062531333333			8.291960805783	0.022822660867		
55	22.251242693761	0.0001014613071			8.311515056665	0.022621828544 15		
56	22.410956205463	8.29000000e-005			8.311515056665	0.025314206833 1		
57	24.106516260428	0.476630445844 8			8.480141603332	0.026517987037 6		
58	24.931291281679	8.29000000e-005			8.480141603332	0.027567374896		
59	26.175997805766	0.0048341333333			8.529195151465 5	0.027570150803		
60	26.412556460428	0.0099970923514			8.529195151465 5	0.026680790997		
61	25.646289317457	8.29000000e-005			9.035396835192 94	0.026663465249 2		
62	25.890842260428	0.640955422387 1			9.035396835192 94	0.025496070028		
63	26.910663290771	8.29000000e-005			9.208805634547 3	0.025652197527 8		
64	27.397805493751	0.0101479737581			9.208805634547 3	0.025068779297		
65	27.588229027095	0.341983284875			9.462328146594	0.026071309820 9		
66	27.991408093761	0.013738144769 3			9.462328146594	0.024639189656		
67	28.168393403951	0.0048341333333			10.35686903333 3	0.049754683906 9		
68	29.046229027095	0.259488992457			10.35686903333 3	0.048203126538 2		
69	29.219463727095	8.30642569e-005			10.64099535985	0.048035489109 6		
70	29.565192827095	0.256564876015 1			10.64099535985	0.046992365343		
71	29.649952421346	8.29000000e-005			10.65197622292	0.048965139412 1		



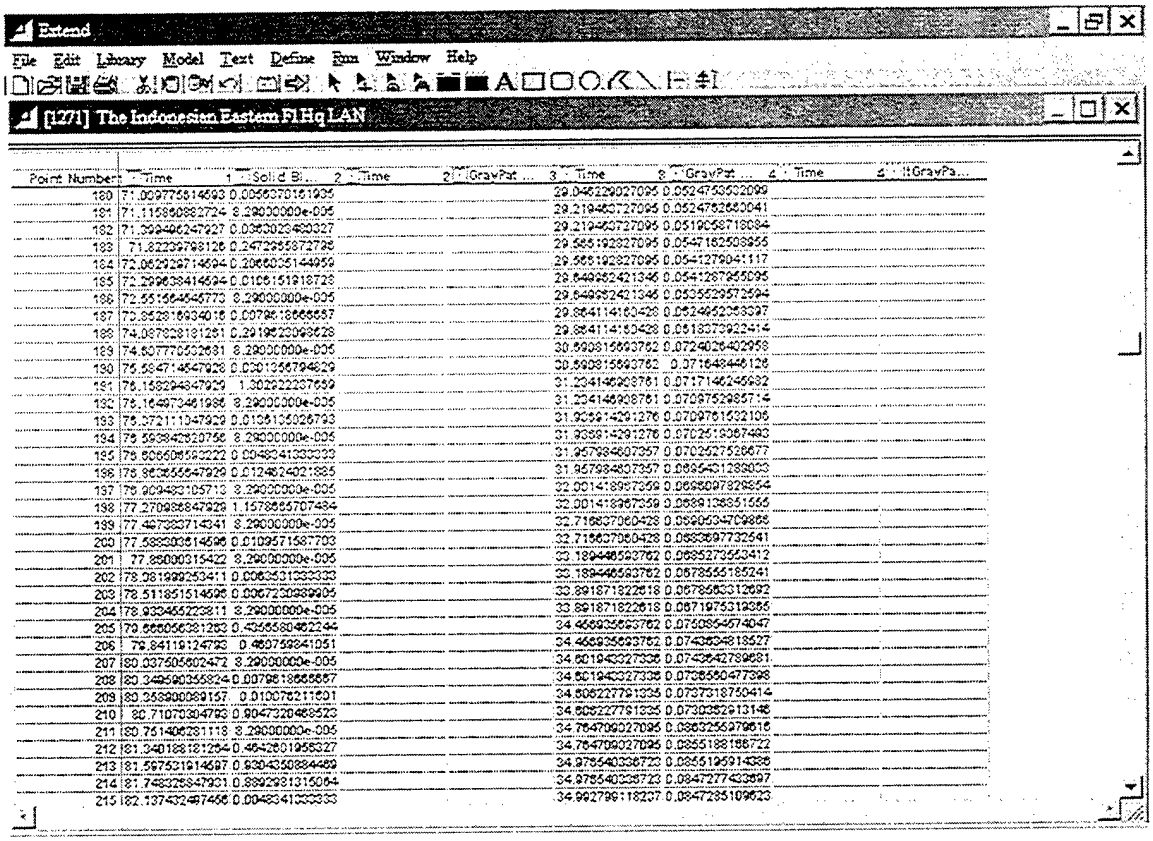
Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ItGrayPa...
72	29.864114160428	0.840574265541			10.65197622292	0.046725005091		
73	30.690815693762	1.003698565199			11.470694701954	0.046727241049 6		
74	31.234148908761	0.0062531333333			11.470694701954	0.044623926009		
75	31.936514261276	8.29000000e-005			11.474851266667	0.060248497255 3		
76	32.001418967259	0.0065987541223			11.474851266667	0.058703589923		
77	32.716637060428	0.013978583110 8			12.161476318744	0.058705789634		
78	33.189446593762	0.0159157907956			12.161476318744	0.057238144892 5		
79	33.891871922618	8.29000000e-005			12.2544326	0.057556467944		
80	34.456935593762	0.812466232197			12.2544326	0.056149893308		
81	34.601942027095	8.29000000e-005			12.568561806705	0.056151920287 2		
82	34.606227791335	0.007961856667			12.568561806705	0.054814959842		
83	34.764709027095	1.498656504622			12.946580623685	0.054816943613 7		
84	34.976540336723	8.29000000e-005			12.946580623685	0.053542139371 5		
85	35.263959027095	0.305341820656 0			12.961854806154	0.053689876259 4		
86	36.150053460429	0.0092523065284			12.961854806154	0.052469653752 5		
87	36.236140262513	8.29000000e-005			13.067527554282	0.052471537843 4		
88	36.271899060429	1.611349401304 3			13.067527554282	0.051305536691		
89	37.009615260429	0.0083410637147			13.3577805	0.051469310001 8		
90	38.154699311166	8.29000000e-005			13.3577805	0.050940602934 6		
91	38.800005464655	0.0048341333333			13.931585591987	0.050342451523 5		
92	39.311264921195	8.29000000e-005			13.931585591987	0.049271315959 1		
93	39.565909138794	0.012558882802 8			14.005851212697	0.049270079788 6		
94	40.154840794404	8.29000000e-005			14.005851212697	0.048246557293 3		
95	41.336863893762	0.59647248282			14.555467536366	0.048347268404 4		
96	41.799000980429	0.643046840527			14.555467536366	0.047360589467 4		
97	42.895364651093	8.29000000e-005			14.963223158632	0.047362281294 1		
98	43.584600560429	0.0037850557046			14.963223158632	0.046415035568 2		
99	43.607432122431	0.0031998565657			14.938062965628	0.046418869565 62		
100	43.679392827095	0.126574685379			14.938062965628	0.045506552419 9		
101	43.942366527095	0.018671167948 9			15.173671293304	0.048809312030 8		
102	44.003442871417	8.29000000e-005			15.173671293304	0.047870671418		
103	44.198118010101	0.0048341333333			15.503479833304	0.048070829427 9		
104	44.227402360429	0.118967698102			15.503479833304	0.047163825480		
105	44.779406227095	0.240574151460 3			15.7742379	0.048382046515 3		
106	44.924468933276	0.0040101333333			15.7742379	0.047486827901		
107	46.295517027095	0.0060737064601			16.025199899287	0.047633524764		



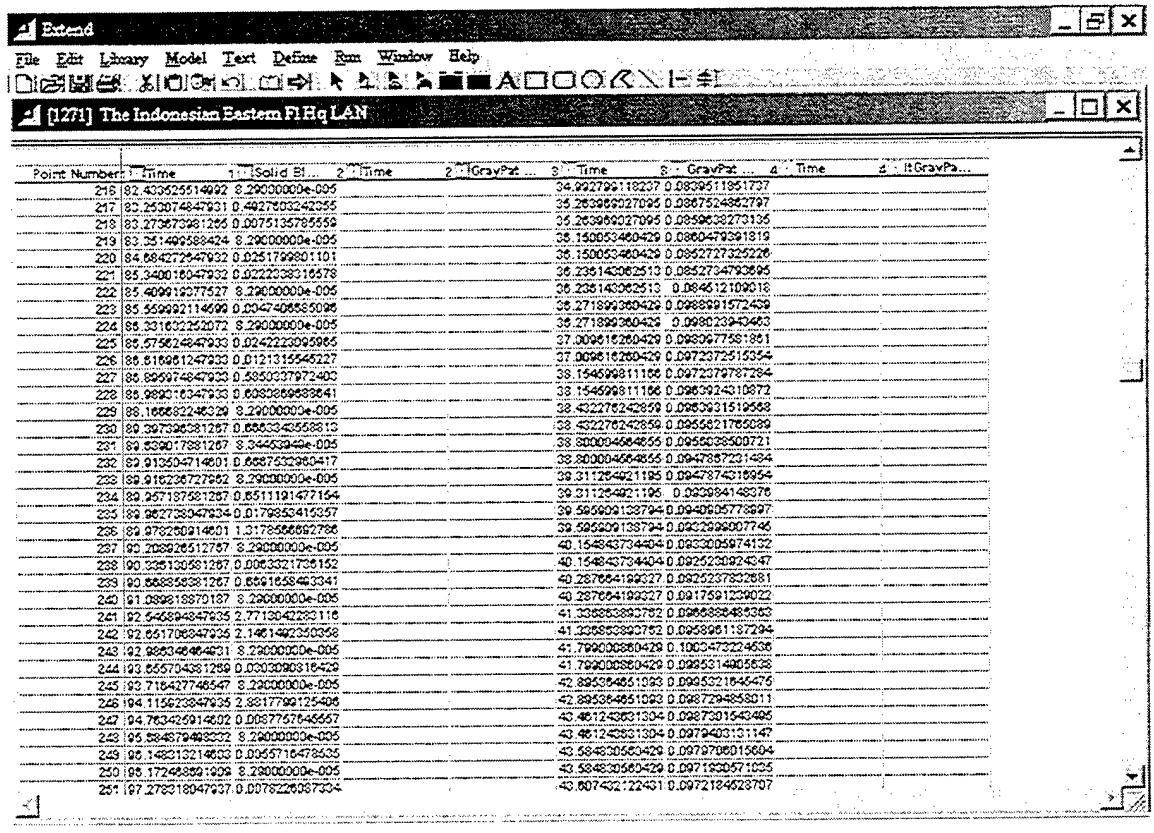
Point Number	Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ItGrayPa...
108	46.303315121759	0.007961866667			16.02519989287	0.0467674606787		
109	46.368594660429	0.1432232027326			16.12129021342	0.0467689679515		
110	47.04189253272	8.290000000e-005			16.12129021342	0.0469338078095		
111	47.506020460429	0.1050244866672			16.49505449276	0.0463566189104		
112	47.810462218016	8.290000000e-005			16.49505449276	0.0465403448944		
113	48.046616927096	0.0088381082808			16.64459659405	0.0465406892119		
114	48.212532276494	8.290000000e-005			16.64459659405	0.0448587092979		
115	48.382282127095	0.0310865414601			18.42278565369	0.0449581387083		
116	49.189906914281	0.0145929570178			18.42278565369	0.0440978312726		
117	49.374452969056	8.290000000e-005			18.5297972270 93	0.0448857556794		
118	49.741972014281	0.0098148773412			18.5297972270 93	0.0441378508475		
119	49.808156955601	8.290000000e-005			18.830093271943	0.0441390425141		
120	50.065295980948	0.1234502906729			18.830093271943	0.0434154618533		
121	51.108469336177	8.290000000e-005			18.840969327801	0.0434948997407		
122	51.281621580948	0.1998247686792			18.840969327801	0.0427931720255		
123	51.503771714281	0.1080179035468			18.903256039376	0.0446147469716		
124	51.583401580948	0.2025772669415			18.903256039376	0.0429066754006		
125	51.662132114281	0.0882417798109			18.981861383054	0.0439078912726		
126	51.744171504801	8.290000000e-005			18.981861383054	0.0432218304725		
127	51.790680714281	0.0161135881951			19.57732936342	0.043223125785		
128	51.895580247615	0.5069119022591			19.57732936342	0.0425581546 19		
129	52.259341580948	0.2273465888288			19.643259093052	0.0425594300037		
130	52.280388114281	0.2239993055546			19.643259093052	0.0419146901551		
131	52.585505146539	8.290000000e-005			19.965418087194	0.0419876345996		
132	52.963126047615	0.0065269269285			19.965418087194	0.0413611505011		
133	52.141016380948	0.3403746278435			19.978447677976	0.0414659733866		
134	53.424091814281	9.482859505e-005			19.978447677976	0.0408463267192		
135	53.792845349426	0.0047444			20.231416460427	0.0410250893298		
136	53.925683576992	8.290000000e-005			20.231416460427	0.0404205228176		
137	54.680623114281	0.1199410591653			20.69448389376	0.0421067246356		
138	54.867327364016	8.290000000e-005			20.69448389376	0.0415051999979		
139	55.546082095653	0.007961866667			21.487839079498	0.0415959580456		
140	55.575574059729	8.290000000e-005			21.487839079498	0.0410101004674		
141	55.632188247615	0.1878317064436			22.251242693761	0.0410115293591		
142	55.956920303712	8.290000000e-005			22.251242693761	0.0404492478847		
143	57.387816447615	0.2922920224346			22.410956205463	0.0404430761736		



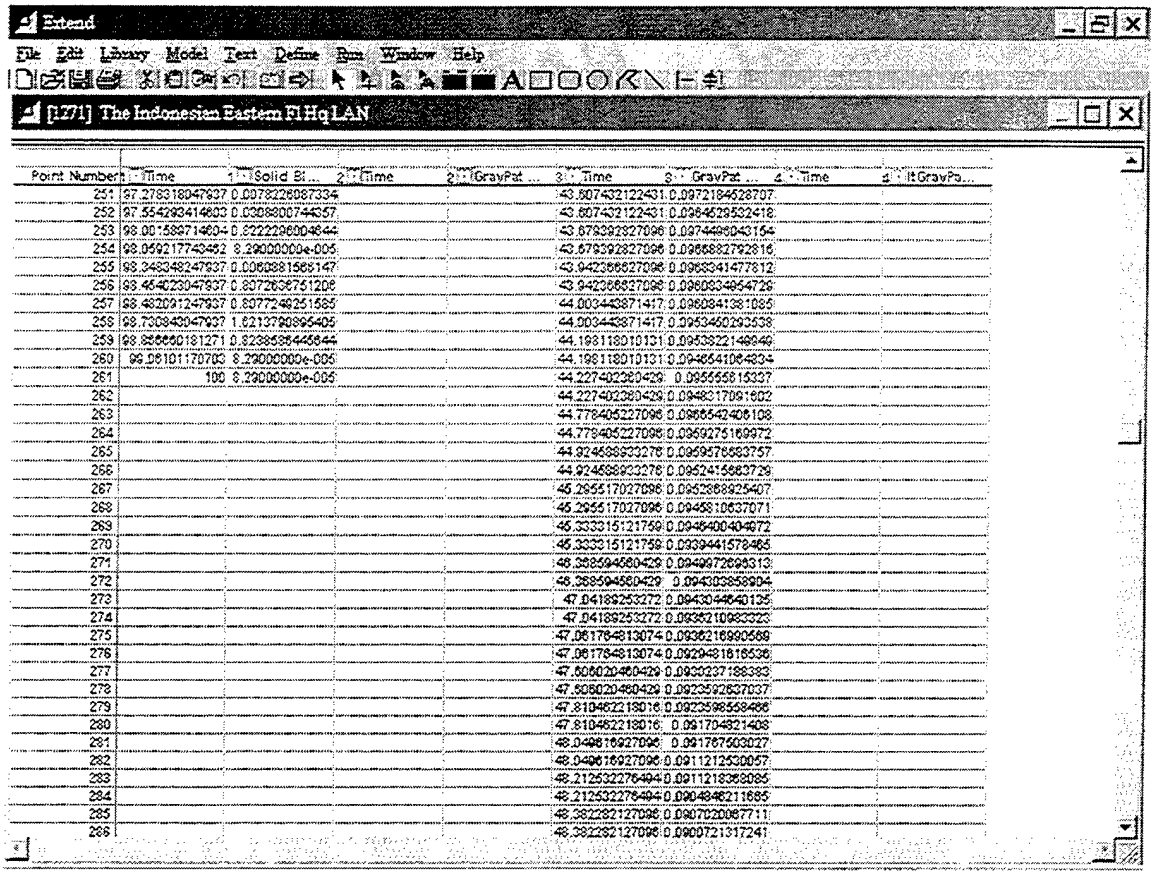
Point Number	Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ItGrayPa...
144	57.516940780948	0.2923665681135			22.410956205463	0.0398990514314		
145	57.974024248353	0.0070776757326			22.419894431611	0.0398901970479		
146	59.264664791378	8.29000000e-005			22.419894431611	0.039951140331		
147	60.201923114282	0.4456759347 49			22.947065133718	0.0393528686013		
148	60.407580536119	8.29000000e-005			22.947065133718	0.0388275837933		
149	60.418443114282	0.4414747873671			23.984834917998	0.0388286591266		
150	60.861592714282	0.0122014320929			23.984834917998	0.0383177655955		
151	61.247339514282	0.5164730548004			24.106516360428	0.0446892187944		
152	61.757531047615	0.0119846289949			24.106516360428	0.0440101380304		
153	61.95607495923	8.29000000e-005			24.931291381679	0.0440112148538		
154	62.452791404522	0.007408260408			24.931291381679	0.0434486683121		
155	62.500881535741	8.29000000e-005			25.733635531166	0.0434480311326		
156	63.054826847615	1.082660264021 1			25.733635531166	0.0428985605549		
157	63.195520114282	0.0209395403463			25.7707125075 46	0.0428991054 22		
158	63.515260114282	0.0108727891308			25.7707125075 46	0.0423626568040		
159	63.591077013936	0.007961866667			26.176997805766	0.0424232932709		
160	64.173726263936	8.29000000e-005			26.176997805766	0.0418995489095		
161	64.331118447615	0.0056222093381			26.412556460428	0.0420229690 62		
162	64.956594398395	8.29000000e-005			26.412556460428	0.0415194838298		
163	65.594628280949	0.6347787874026			26.545989317467	0.0415115048052		
164	65.709228214282	0.2755073598766			26.545989317467	0.0410113691901		
165	65.825776153818	8.29000000e-005			26.890842360428	0.0407337205797		
166	66.211074714282	0.0111399335795			26.890842360428	0.0401505573282		
167	66.407338767534	8.29000000e-005			26.910853907 71	0.0401545442 43		
168	66.500894414283	0.0101211815822			26.910853907 71	0.0475880201931		
169	66.522846729587	0.0048341332203			27.271525991932	0.0475889954872		
170	66.514714965418	8.29000000e-005			27.271525991932	0.0470056350746		
171	66.939697047616	0.0135670252417			27.397805493761	0.0471563647694		
172	67.35123885895	8.29000000e-005			27.397805493761	0.0465116389675		
173	67.825870814692	0.0755263439461			27.588229027095	0.0505424812191		
174	68.831288445355	8.29000000e-005			27.588229027095	0.0499631349404		
175	69.187657847926	0.1138001863182			27.991408093761	0.0501242502218		
176	69.384570962057	0.0100578460468			27.991408093761	0.0495610563991		
177	69.659317247926	0.1072656174284			28.168393408951	0.0496153725 04		
178	70.476936314693	0.020218859547			28.168393408951	0.0490640905873		
179	70.718261110058	8.29000000e-005			29.046229027095	0.0503584 1259		

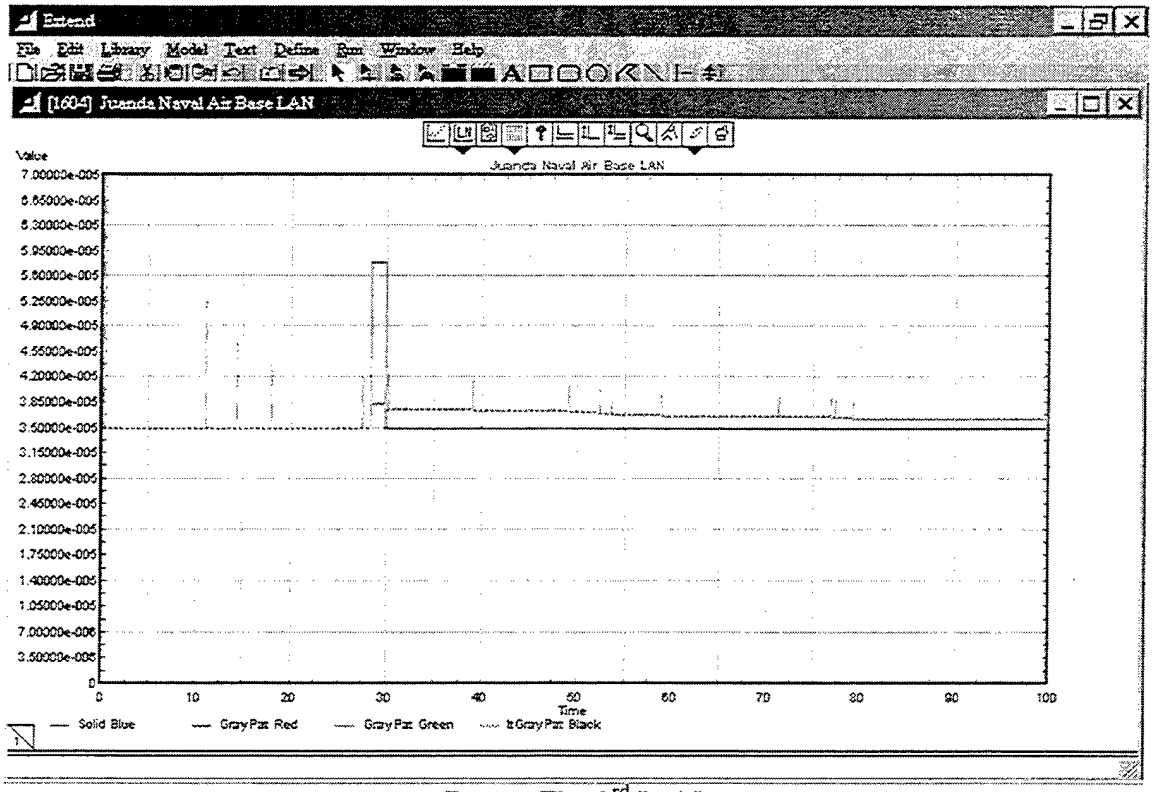


Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GravPat ...	3 : Time	3 : GravPat ...	4 : Time	4 : GravPa...
180	71.009775814693	0.0956370151935			29.046229027095	0.0524758602099		
181	71.115869882724	8.29000000e-005			29.219463727095	0.0524762660041		
182	71.099496247927	0.0960023460327			29.219463727095	0.0519058718084		
183	71.82239798126	0.2472955872728			29.565192827095	0.0541825083955		
184	72.062926714694	0.2066035144959			29.565192827095	0.0541279041117		
185	72.299638416694	0.0105151918723			29.648952421346	0.0541287855095		
186	72.551564545773	8.29000000e-005			29.648952421346	0.0535529572594		
187	72.9528169340615	0.007961866657			29.864114160428	0.0524662368397		
188	74.067028181251	0.2919620998628			29.864114160428	0.0518373922414		
189	74.607770502681	8.29000000e-005			30.590815693762	0.0724026402958		
190	75.59471454792B	0.0201356794629			30.590815693762	0.071648446128		
191	76.15829484794291	1.3022222376591			31.204146908761	0.0717146245982		
192	76.164497461986	8.29000000e-005			31.204146908761	0.0709752985714		
193	76.572111047929	0.0196135026793			31.905914291276	0.0709761502105		
194	76.593842820756	8.29000000e-005			31.905914291276	0.0702519357483		
195	76.606508582222	0.0048413333333			31.957984607957	0.0702527526677		
196	76.962656547929	0.0124624021885			31.957984607957	0.0695401288033		
197	76.909483105713	8.29000000e-005			32.001418967359	0.0695097829554		
198	77.270988647929	1.1578655707484			32.001418967359	0.0688138851555		
199	77.467983714341	8.29000000e-005			32.716827060428	0.0690934709866		
200	77.589300514696	0.0109571587703			32.716827060428	0.0683697332541		
201	77.850003154221	8.29000000e-005			33.189446593762	0.0683270553412		
202	78.081999253411	0.0066351333333			33.189446593762	0.0678555185241		
203	78.511851514696	0.0067230899905			33.891871822618	0.0678553312692		
204	78.933455223811	8.29000000e-005			33.891871822618	0.0671975319356		
205	79.665056381283	0.4256580462244			34.466935693762	0.0760854574047		
206	79.84119124793	0.4607598410051			34.466935693762	0.0743604818527		
207	80.037505602472	8.29000000e-005			34.601943027306	0.0743642799681		
208	80.349590355824	0.0079818666667			34.601943027306	0.0736560477398		
209	80.569900989157	0.0100762116901			34.506227791335	0.0737318750414		
210	80.710703804793	0.9047320468523			34.506227791335	0.0730352913146		
211	80.751406281118	8.29000000e-005			34.764709027095	0.0863256979616		
212	81.340188181264	0.464268195832?			34.764709027095	0.0855188186722		
213	81.597531914697	0.9304308884469			34.978540336723	0.0855195914366		
214	81.748325847931	0.8992981315064			34.978540336723	0.0847277433897		
215	82.137432467456	0.0048341333333			34.992799118237	0.0847285109623		

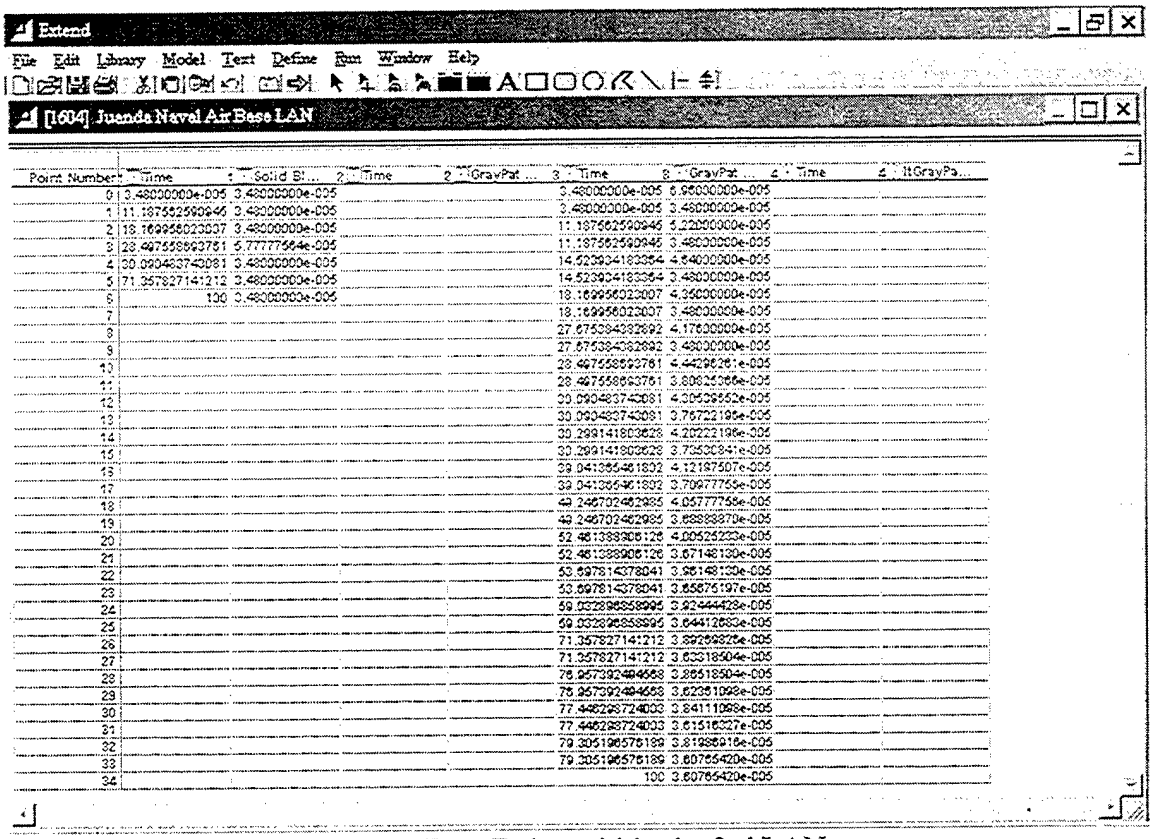


Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GravPat ...	3 : Time	3 : GravPat ...	4 : Time	4 : GravPa...
216	82.403625514992	8.29000000e-005			34.992799118237	0.0839511951737		
217	83.263074847931	0.4927503242055			35.263969027095	0.0867524962797		
218	83.273673981265	0.0075135785559			35.263969027095	0.0859638273135		
219	83.351499588424	8.29000000e-005			35.150053460429	0.0860479391819		
220	84.684272547932	0.0251799801101			35.150053460429	0.0852727325226		
221	85.340018047932	0.0222038316578			35.235143062513	0.0852734793695		
222	85.409919077527	8.29000000e-005			35.235143062513	0.0846121090318		
223	85.559992114699	0.0047406666096			35.271899360429	0.0868991572499		
224	85.331632252072	8.29000000e-005			35.271899360429	0.0860239403463		
225	85.575624847933	0.0242223095965			37.009616260429	0.0860977581861		
226	86.616961247933	0.0121315545227			37.009616260429	0.0872372515354		
227	86.829974847933	0.585003797240?			38.154599811166	0.0872379787264		
228	86.989016047933	0.6083869683641			38.154599811166	0.0863924310872		
229	88.166682246329	8.29000000e-005			38.432276242859	0.0863931519568		
230	89.397396581267	0.6663342555813			38.432276242859	0.0855621765089		
231	89.539017681267	8.3446294e-005			38.800004664655	0.0855628509721		
232	89.913504714601	0.6687532960417			38.800004664655	0.0847887231484		
233	89.916236727662	8.29000000e-005			39.311264921195	0.0847874316954		
234	89.957187581267	0.6511191477164			39.311264921195	0.0839841468376		
235	89.962736047934	0.0179853415357			39.585909138794	0.0840805778997		
236	89.978256914601	1.0178566692766			39.585909138794	0.0832299007746		
237	90.208926512767	8.29000000e-005			40.154843734404	0.0833005974152		
238	90.335130581267	0.0063321736152			40.154843734404	0.0825220924347		
239	90.558858381267	0.6691658463341			40.287664199227	0.0825237802681		
240	91.089918870187	8.29000000e-005			40.287664199227	0.0817591239022		
241	92.546894847935	2.7713042283116			41.336863893762	0.0966388485362		
242	92.651706847935	2.1461492360358			41.336863893762	0.0958961187294		
243	92.985346464931	8.29000000e-005			41.799000860429	0.1000473224636		
244	93.655704381269	0.0030909816429			41.799000860429	0.0992531490539		
245	93.716427746547	8.29000000e-005			42.895364651093	0.0992521646476		
246	94.115623847935	2.9817799125406			42.895364651093	0.0987294658011		
247	94.763425914602	0.0987757646557			43.461240631304	0.0987391543496		
248	95.584579483002	8.29000000e-005			43.461240631304	0.0979403131147		
249	96.148313214603	0.0055716478635			43.584830560429	0.0979796015604		
250	96.172468891009	8.29000000e-005			43.584830560429	0.0971920571025		
251	97.278218047937	0.0078226987304			43.607432122431	0.0972184523707		



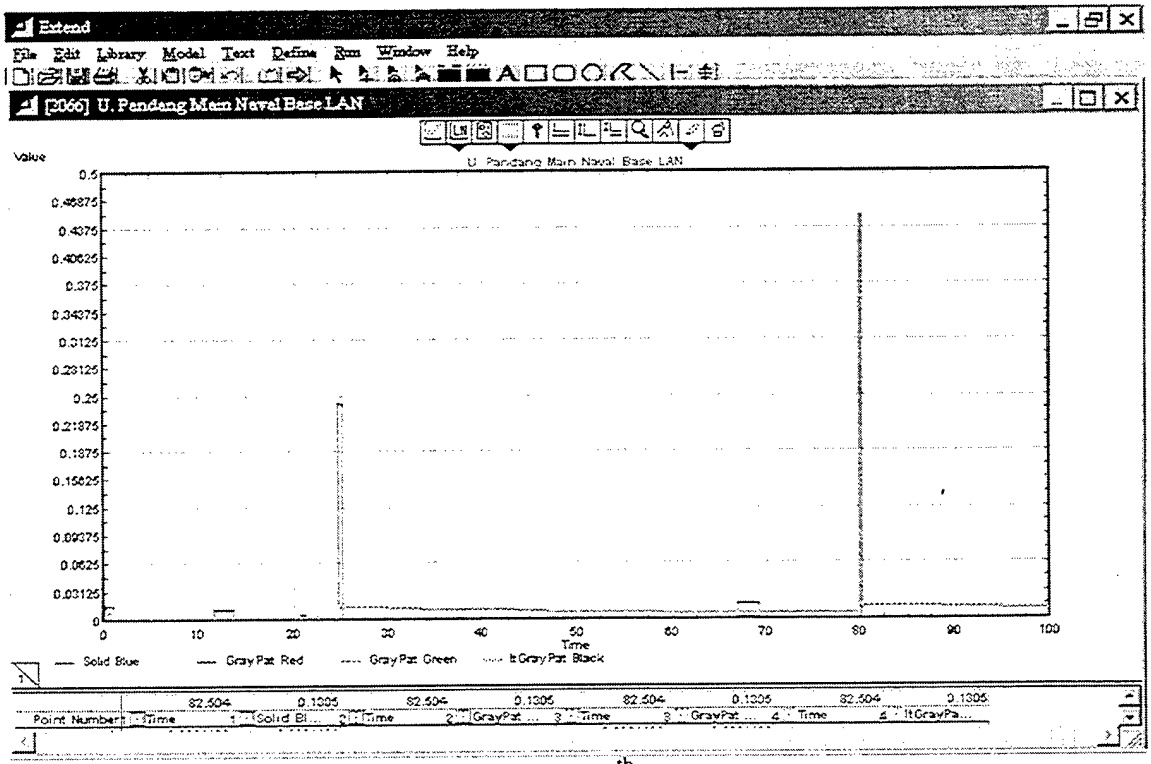


Run 1, The 3rd LAN

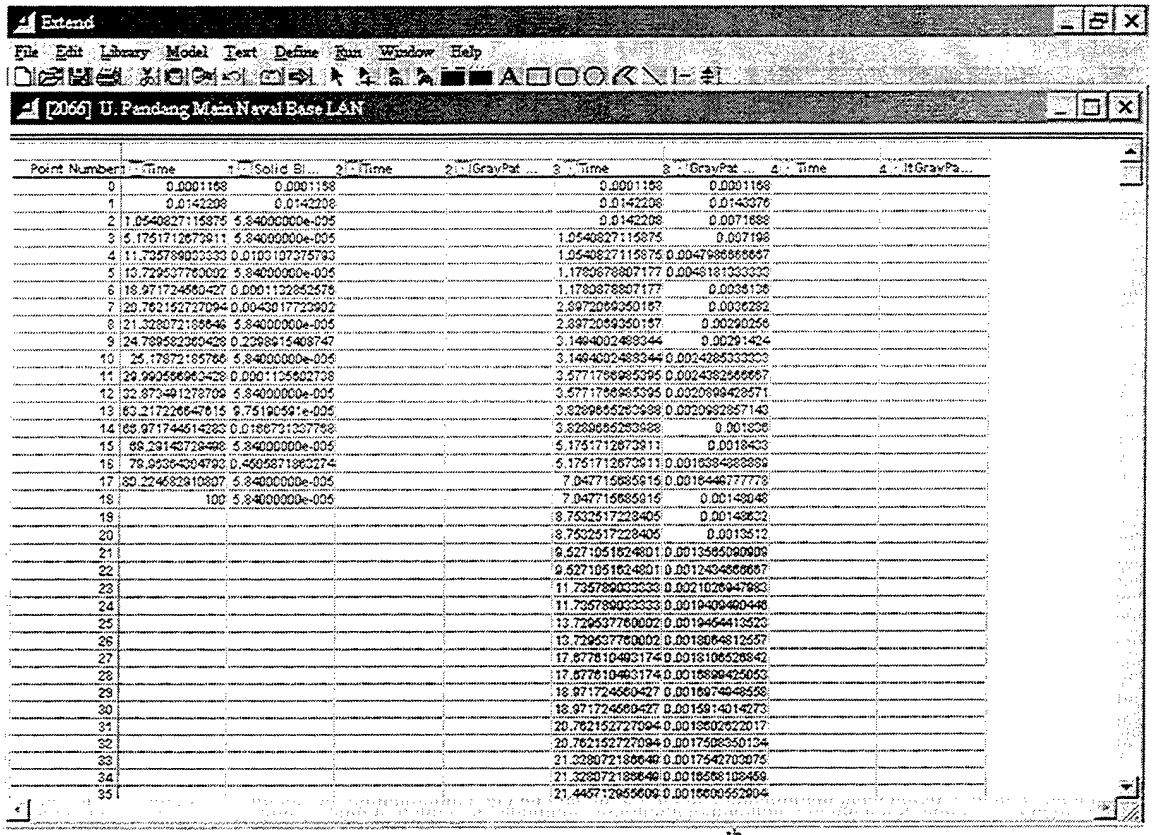


Point Number	0 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ltGrayPa...
0	3.48000000e-005	3.48000000e-005			3.48000000e-005	6.96000000e-005		
1	11.1875625899645	3.48000000e-005			3.48000000e-005	3.48000000e-005		
2	18.1699560230037	3.48000000e-005			11.1875625899645	5.22000000e-005		
3	23.4975586937611	5.77777564e-005			11.1875625899645	3.48000000e-005		
4	30.0904837430081	3.48000000e-005			14.5239041833564	4.64000000e-005		
5	71.3578271412123	3.48000000e-005			14.5239041833564	3.48000000e-005		
6	100	3.48000000e-005			18.1699560230037	4.35000000e-005		
7					18.1699560230037	3.48000000e-005		
8					27.6753943932692	4.17600000e-005		
9					27.6753943932692	3.48000000e-005		
10					23.4975586937611	4.44296261e-005		
11					23.4975586937611	3.80625066e-005		
12					30.0904837430081	4.30539552e-005		
13					30.0904837430081	3.76722196e-005		
14					30.2991418803628	4.20222196e-005		
15					30.2991418803628	3.75500841e-005		
16					39.0413664616802	4.12187507e-005		
17					39.0413664616802	3.70977756e-005		
18					49.2467024629851	4.05777756e-005		
19					49.2467024629851	3.65888870e-005		
20					52.4613889065126	4.00525220e-005		
21					52.4613889065126	3.67148130e-005		
22					53.6978143788041	3.96148130e-005		
23					53.6978143788041	3.65875197e-005		
24					59.0328968589951	3.92444428e-005		
25					59.0328968589951	3.64412680e-005		
26					71.3578271412123	3.89268826e-005		
27					71.3578271412123	3.62318504e-005		
28					76.9573924946583	3.86518504e-005		
29					76.9573924946583	3.62351098e-005		
30					77.4462897240033	3.84111098e-005		
31					77.4462897240033	3.61516027e-005		
32					79.3051965761899	3.81989186e-005		
33					79.3051965761899	3.60765420e-005		
34					100	3.60765420e-005		

Run 1, Data Delay within the 3rd LAN

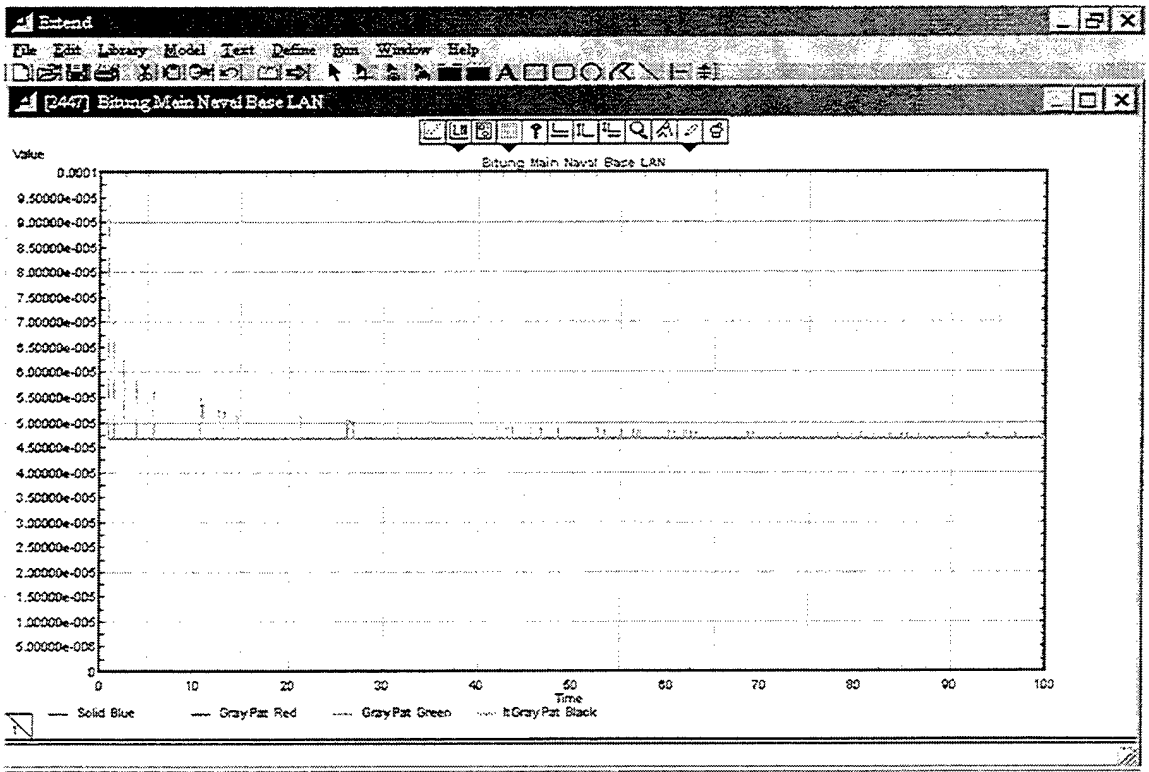


Run 1, The 4th LAN

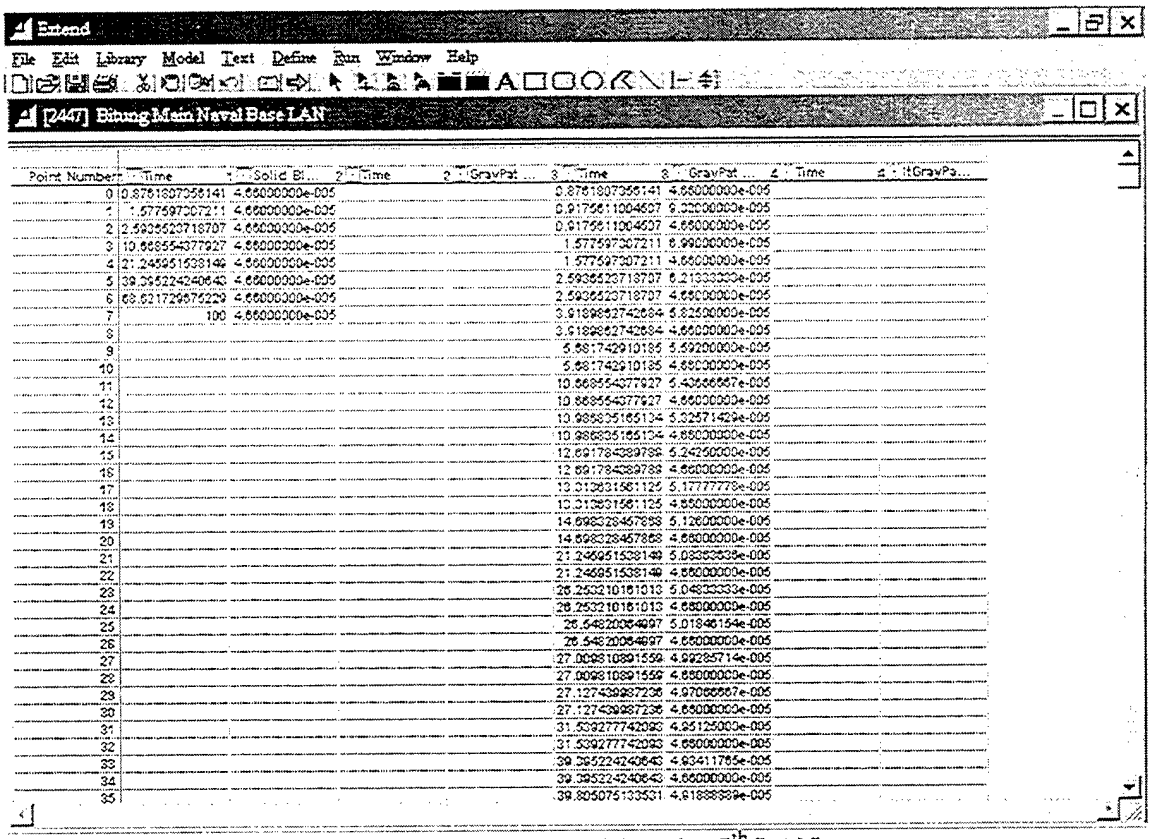


Point Number	1 Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ItGrayPa...
0	0.0001168	0.0001168			0.0001168	0.0001168		
1	0.0142208	0.0142208			0.0142208	0.0143376		
2	1.0540827115875	5.84000000e-005			0.0142208	0.0071688		
3	5.1751712673911	5.84000000e-005			1.0540827115875	0.007198		
4	11.735789033333	0.0103107375793			1.0540827115875	0.0047986666667		
5	13.729537760002	5.84000000e-005			1.1780878807177	0.0048181333333		
6	18.971724560427	0.0001132852576			1.1780878807177	0.0036136		
7	20.762152727094	0.0043017723902			2.8972069350167	0.0036282		
8	21.328072186649	5.84000000e-005			2.8972069350167	0.00290256		
9	24.789582360428	0.2298915408747			3.1494002488344	0.00291424		
10	25.17872185766	5.84000000e-005			3.1494002488344	0.0024285333333		
11	29.990566963428	0.0001135602738			3.5771766985395	0.0024382666667		
12	32.873491278709	5.84000000e-005			3.5771766985395	0.0020899428571		
13	63.217226647615	9.75190591e-005			3.8289655263988	0.0020982857143		
14	66.971744514283	0.0166731337768			3.8289655263988	0.001836		
15	69.29143729498	5.84000000e-005			5.1751712673911	0.0018433		
16	79.96364304793	0.4605871863274			5.1751712673911	0.0016384888889		
17	80.224582910807	5.84000000e-005			7.047715685915	0.0016449777778		
18	100	5.84000000e-005			7.047715685915	0.00148048		
19					8.7532517228405	0.00148632		
20					8.7532517228405	0.0013512		
21					9.5271051624801	0.0013565090909		
22					9.5271051624801	0.0012434666667		
23					11.735789033333	0.0021026947983		
24					11.735789033333	0.0019409490446		
25					13.729537760002	0.0019454413523		
26					13.729537760002	0.0018064812557		
27					17.677610493174	0.0018106526842		
28					17.677610493174	0.0016899425053		
29					18.971724560427	0.0016974948558		
30					18.971724560427	0.0015914014273		
31					20.762152727094	0.0018602622017		
32					20.762152727094	0.0017508350134		
33					21.328072186649	0.0017542703075		
34					21.328072186649	0.0016568108459		
35					21.445712955609	0.0016600552904		

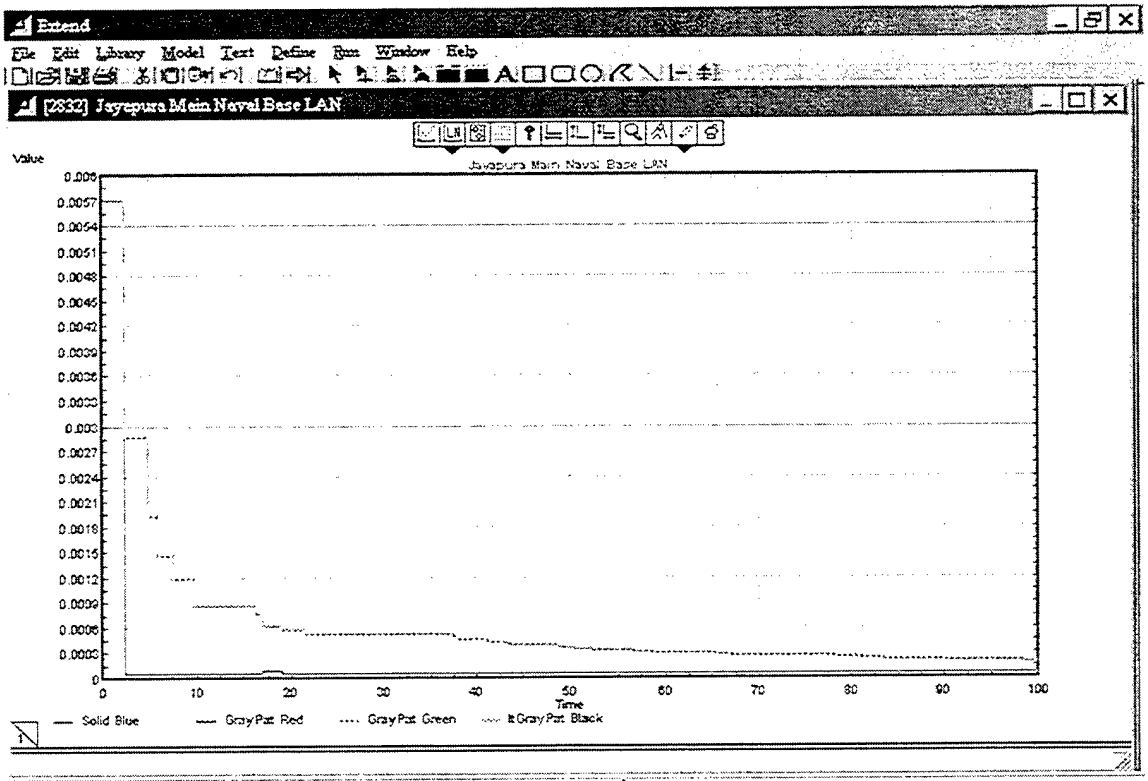
Run 1, Data Delay within the 4th LAN



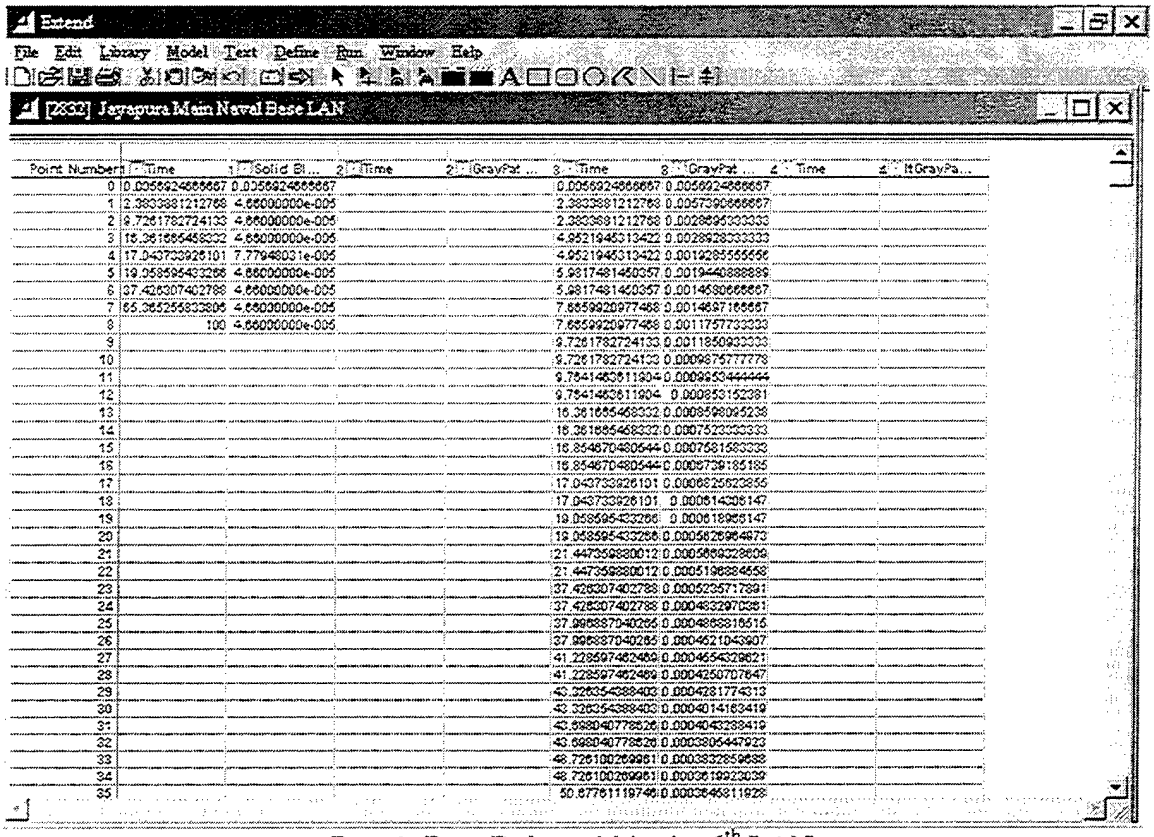
Run 1, The 5th LAN



Run 1, Data Delay within the 5th LAN

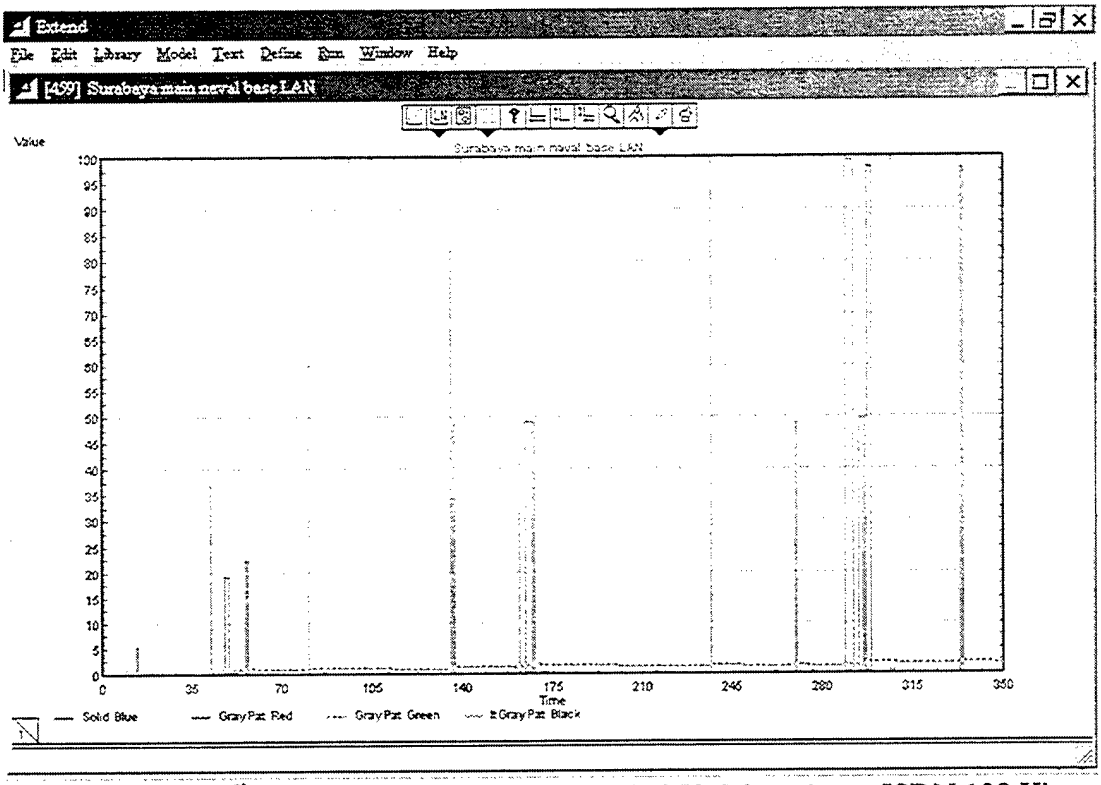


Run 1, The 6th LAN

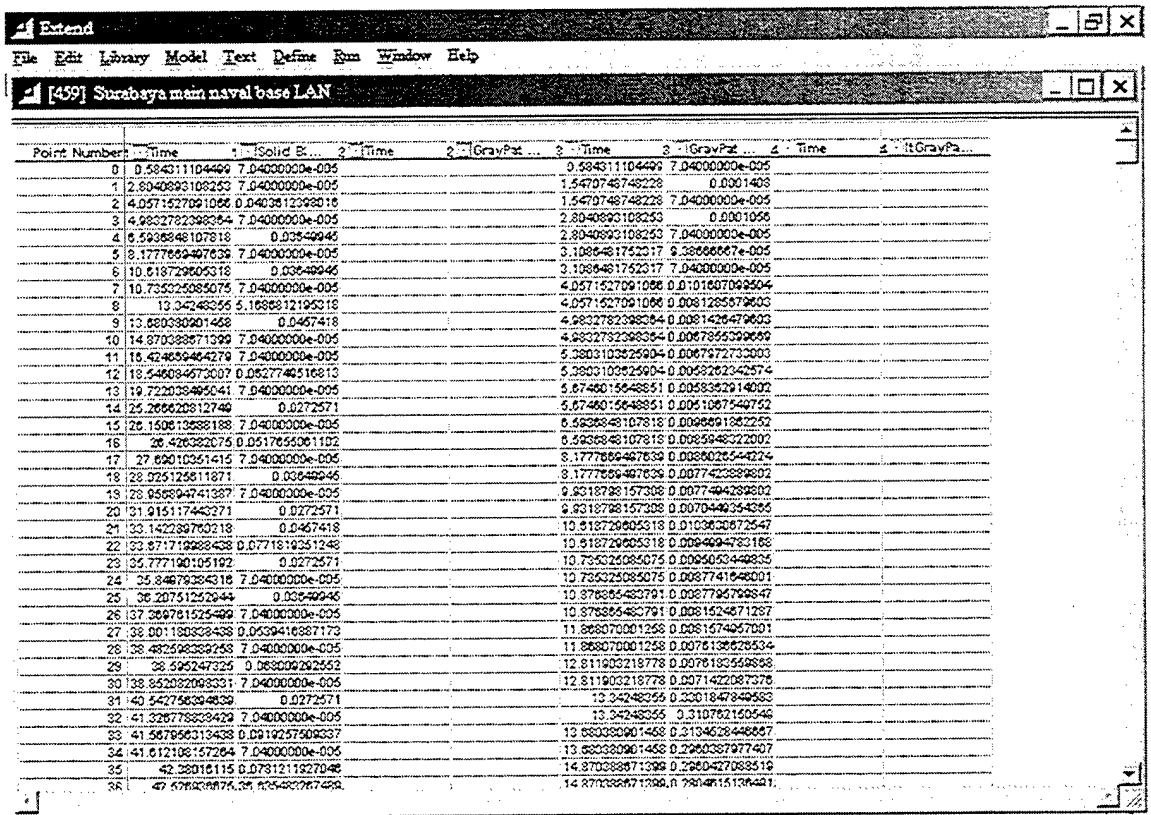


Point Number	0 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : MGrayPa...
0	0.0056924666667	0.0056924666667			0.0056924666667	0.0056924666667		
1	2.3803881212768	4.660000000e-005			2.3803881212768	0.0057390666667		
2	9.7261782724133	4.660000000e-005			2.3803881212768	0.0028895333333		
3	16.361665468332	4.660000000e-005			4.8521945313422	0.0028928333333		
4	17.043733926101	7.77948031e-005			4.8521945313422	0.0019285555556		
5	19.058595433266	4.660000000e-005			5.9317481460357	0.0019440888889		
6	37.425307402788	4.660000000e-005			5.9317481460357	0.0014580666667		
7	65.365255833806	4.660000000e-005			7.6559920977468	0.0014697166667		
8	100	4.660000000e-005			7.6559920977468	0.0011757733333		
9					9.7261782724133	0.0011850933333		
10					9.7261782724133	0.0009875777778		
11					9.7541460611904	0.0009630444444		
12					9.7541460611904	0.0008853152381		
13					16.361665468332	0.0008598095238		
14					16.361665468332	0.0007523333333		
15					16.854670480544	0.0007581666333		
16					16.854670480544	0.0006739185185		
17					17.043733926101	0.0006825623855		
18					17.043733926101	0.0006514206147		
19					19.058595433266	0.0006518965147		
20					19.058595433266	0.0005626964873		
21					21.447359880012	0.0005869228609		
22					21.447359880012	0.0005196884558		
23					37.425307402788	0.0005235717891		
24					37.425307402788	0.0004832970381		
25					37.995887040265	0.0004868816516		
26					37.995887040265	0.0004521043907		
27					41.228597462469	0.0004554329821		
28					41.228597462469	0.0004250707647		
29					43.326354388403	0.0004281774313		
30					43.326354388403	0.0004014163419		
31					43.998040778526	0.0004043289419		
32					43.998040778526	0.0003805447923		
33					48.726100269961	0.0003832859688		
34					48.726100269961	0.0003619923039		
35					50.677611197461	0.0003646811928		

Run 1, Data Delay within the 6th LAN

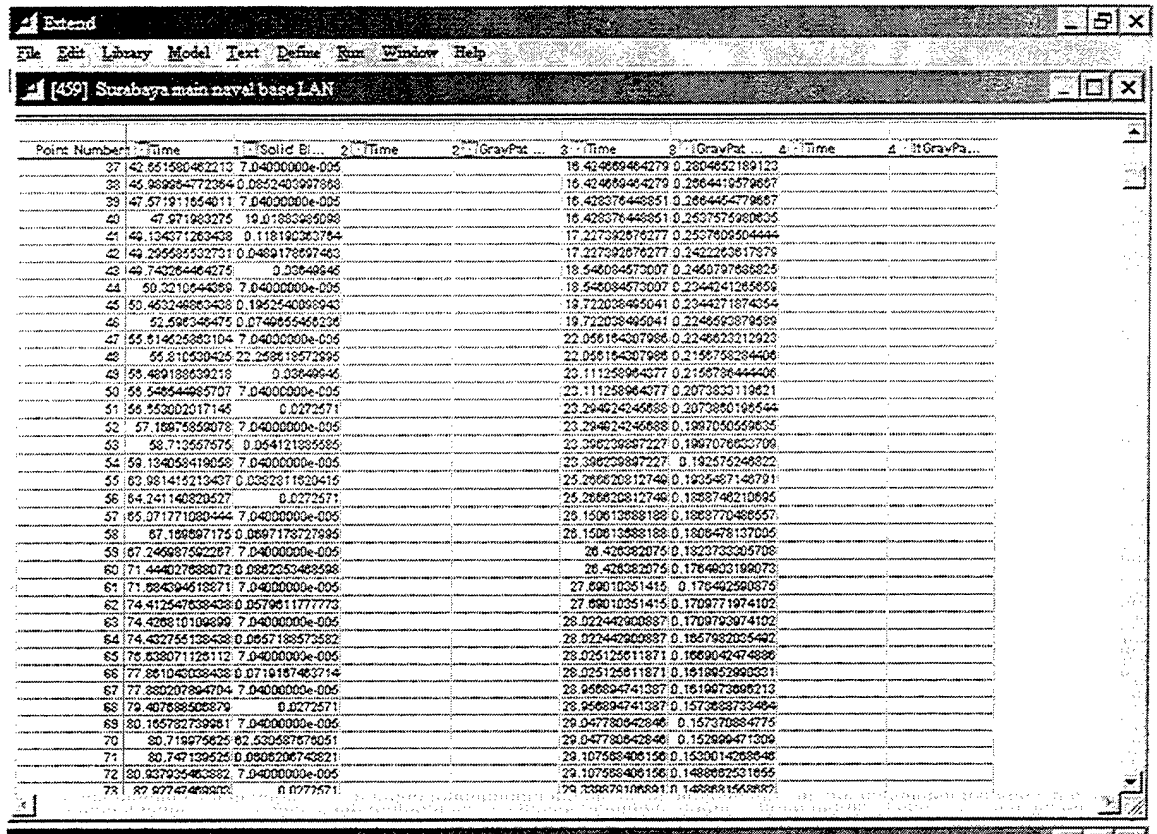


Run 2, The 1st LAN, Using Simulation Set Up 350, Mean 1 sec, ISDN 128 Kbps



Point Number	1 Time	1 Solid B...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ltGrayPa...
0	0.5843111044499	7.04000000e-005			0.5843111044499	7.04000000e-005		
1	2.80408993108253	7.04000000e-005			1.5479748748228	0.0001408		
2	4.05715270910656	0.00351233938018			1.5479748748228	7.04000000e-005		
3	4.98327823988364	7.04000000e-005			2.80408993108253	0.0001056		
4	6.593684107818	0.03549946			2.80408993108253	7.04000000e-005		
5	8.17776594976839	7.04000000e-005			3.1086481752017	9.38666667e-005		
6	10.619729505318	0.03549946			3.1086481752017	7.04000000e-005		
7	10.735325085075	7.04000000e-005			4.0571527091066	0.0101607099504		
8	13.342483555	5.16868121955318			4.0571527091066	0.00812855679603		
9	13.580380901468	0.0467418			4.98327823988364	0.00814264479603		
10	14.870388671399	7.04000000e-005			4.98327823988364	0.00678955399669		
11	18.424659464279	7.04000000e-005			5.3803103525904	0.00679727033003		
12	18.546084573007	0.05277405516813			5.3803103525904	0.00582342342574		
13	19.722038495041	7.04000000e-005			5.67460156448851	0.00583529140002		
14	25.266620812748	0.0272571			5.67460156448851	0.00510675497752		
15	26.150613688188	7.04000000e-005			6.593684107818	0.00866918622252		
16	26.426382075	0.05176550611102			6.593684107818	0.00859483222002		
17	27.690103611415	7.04000000e-005			8.17776594976839	0.00860265442274		
18	28.025125811871	0.03549946			8.17776594976839	0.00774238898802		
19	28.956894741387	7.04000000e-005			9.9318798157308	0.00774942898802		
20	31.915117443271	0.0272571			9.9318798157308	0.00704492954356		
21	33.142289760218	0.0467418			10.619729505318	0.01036308725547		
22	33.871719988438	0.07718193511248			10.619729505318	0.00949094780168		
23	35.777190105192	0.0272571			10.735325085075	0.00956534498835		
24	35.846793843316	7.04000000e-005			10.735325085075	0.00877416466001		
25	36.207512522444	0.03549946			10.876865483791	0.00877957998847		
26	37.369761525499	7.04000000e-005			10.876865483791	0.00815248471287		
27	38.001180338438	0.05394168871173			11.868070001258	0.00816748457801		
28	38.482598339258	7.04000000e-005			11.868070001258	0.00761386628534		
29	38.595247325	0.05809292552			12.811903218778	0.00761935698568		
30	38.652082093331	7.04000000e-005			12.811903218778	0.00714220873776		
31	40.542758394839	0.0272571			13.342483555	0.00018478949583		
32	41.326778839429	7.04000000e-005			13.342483555	0.3107821605446		
33	41.567956313438	0.09192575093337			13.580380901468	0.21040284486657		
34	41.612108157264	7.04000000e-005			13.580380901468	0.29503879774O7		
35	42.28016115	0.07812119270946			14.870388671399	0.29504270885519		
36	42.526826875	0.05548021674499			14.870388671399	0.29048151284491		

Run 2, Data Delay within the 1st LAN

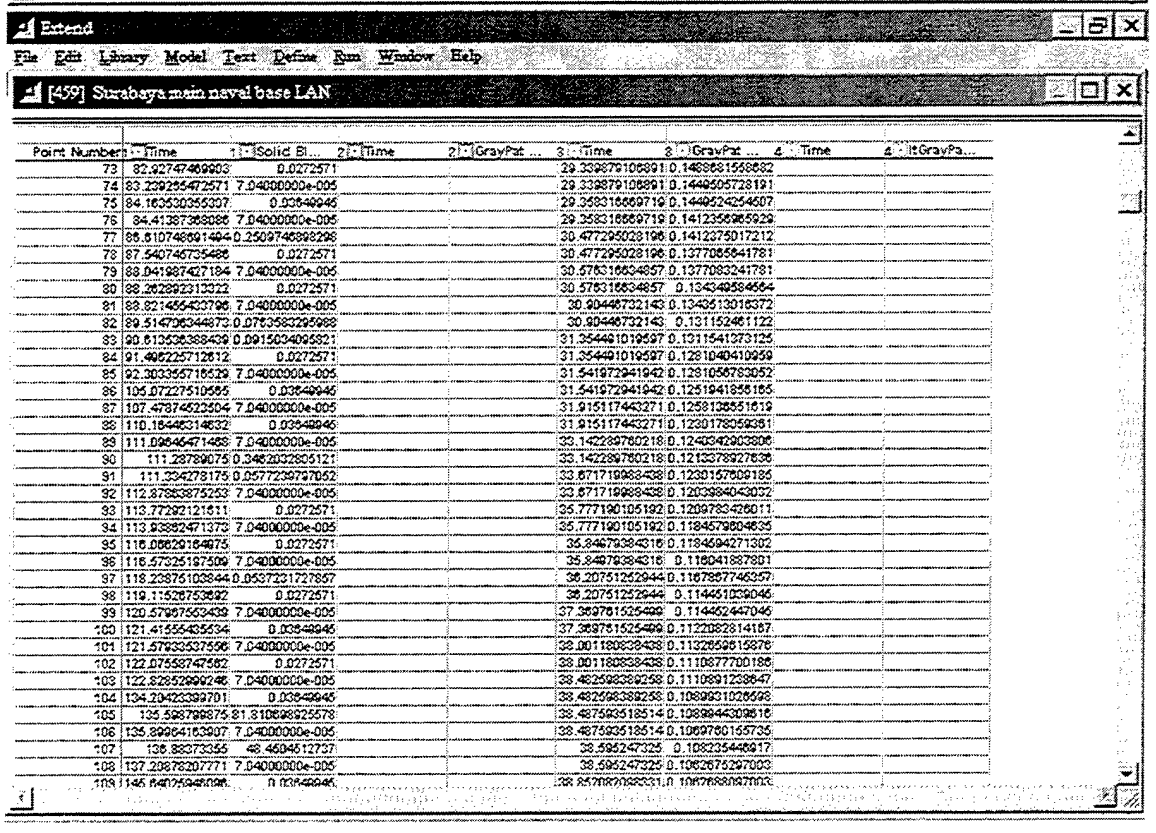


Extend

File Edit Library Model Text Define Run Window Help

[459] Surabaya main naval base LAN

Point Number	Time	1	Solid Bl...	2	Time	2	GravPat ...	3	Time	3	GravPat ...	4	Time	4	GravPa...
37	42.6515804622[illegible]		7.040000000e-005						18.424659464279		0.280465218912[illegible]				
38	46.98995477220[illegible]		0.0852403997868						18.424659464279		0.256441045796[illegible]				
39	47.57191165401[illegible]		7.040000000e-005						18.428376446851		0.256441045796[illegible]				
40	47.971983275		19.01883965098						18.428376446851		0.253757598060[illegible]				
41	49.134371263438		0.118190363764						17.227392576277		0.253760650444[illegible]				
42	49.295635532731		0.048917859746[illegible]						17.227392676277		0.249226508179[illegible]				
43	49.740264464275		0.03549946						18.546084573007		0.246079768[illegible]				
44	50.32105443[illegible]		7.040000000e-005						18.546084573007		0.234424126565[illegible]				
45	50.463246863438		0.195254009894[illegible]						19.722038495041		0.234427187[illegible]				
46	52.598345475		0.074955546523[illegible]						19.722038495041		0.224669[illegible]				
47	55.614625383104		7.040000000e-005						22.056164207986		0.224662321292[illegible]				
48	55.810539425		22.25861857[illegible]						22.056154207986		0.215[illegible]				
49	58.4891886392[illegible]		0.03549946						23.111258964377		0.215[illegible]				
50	58.54554496570[illegible]		7.040000000e-005						23.111258964377		0.207383[illegible]				
51	58.553002017145		0.0272571						23.294024246688		0.207385[illegible]				
52	57.189758592078		7.040000000e-005						23.294024246688		0.199705[illegible]				
53	58.7125575[illegible]		0.054121395585						23.396239897227		0.199707[illegible]				
54	59.134059419[illegible]		7.040000000e-005						23.396239897227		0.192575[illegible]				
55	60.981415213437		0.038231820415						25.266620812749		0.193548[illegible]				
56	64.241140820527		0.0272571						25.266620812749		0.188874[illegible]				
57	65.071771080444		7.040000000e-005						25.150613588188		0.188877[illegible]				
58	67.1698971[illegible]		0.059717872[illegible]						26.150613588188		0.180647[illegible]				
59	67.246987592267		7.040000000e-005						26.426382075		0.182373[illegible]				
60	71.444027688072		0.088225348[illegible]						26.426382075		0.176490[illegible]				
61	71.684094618671		7.040000000e-005						27.690103514[illegible]		0.176492[illegible]				
62	74.412547638438		0.0579611777773						27.690103514[illegible]		0.170977[illegible]				
63	74.426810109899		7.040000000e-005						28.022442900887		0.170979[illegible]				
64	74.432755138438		0.0557189573582						28.022442900887		0.165798[illegible]				
65	76.638071125112		7.040000000e-005						28.025125611871		0.165904[illegible]				
66	77.861040038438		0.071915463714						28.025125611871		0.161[illegible]				
67	77.880207894704		7.040000000e-005						28.956894741387		0.161[illegible]				
68	79.407688505879		0.0272571						28.956894741387		0.157[illegible]				
69	80.165782739981		7.040000000e-005						29.047780642846		0.157[illegible]				
70	80.719775625		62.530587876051						29.047780642846		0.152[illegible]				
71	80.742139525		0.050620674[illegible]						29.107588406156		0.153001[illegible]				
72	80.937935463882		7.040000000e-005						29.107588406156		0.148[illegible]				
73	82.927474[illegible]		0.0272571						29.[illegible]		0.148[illegible]				

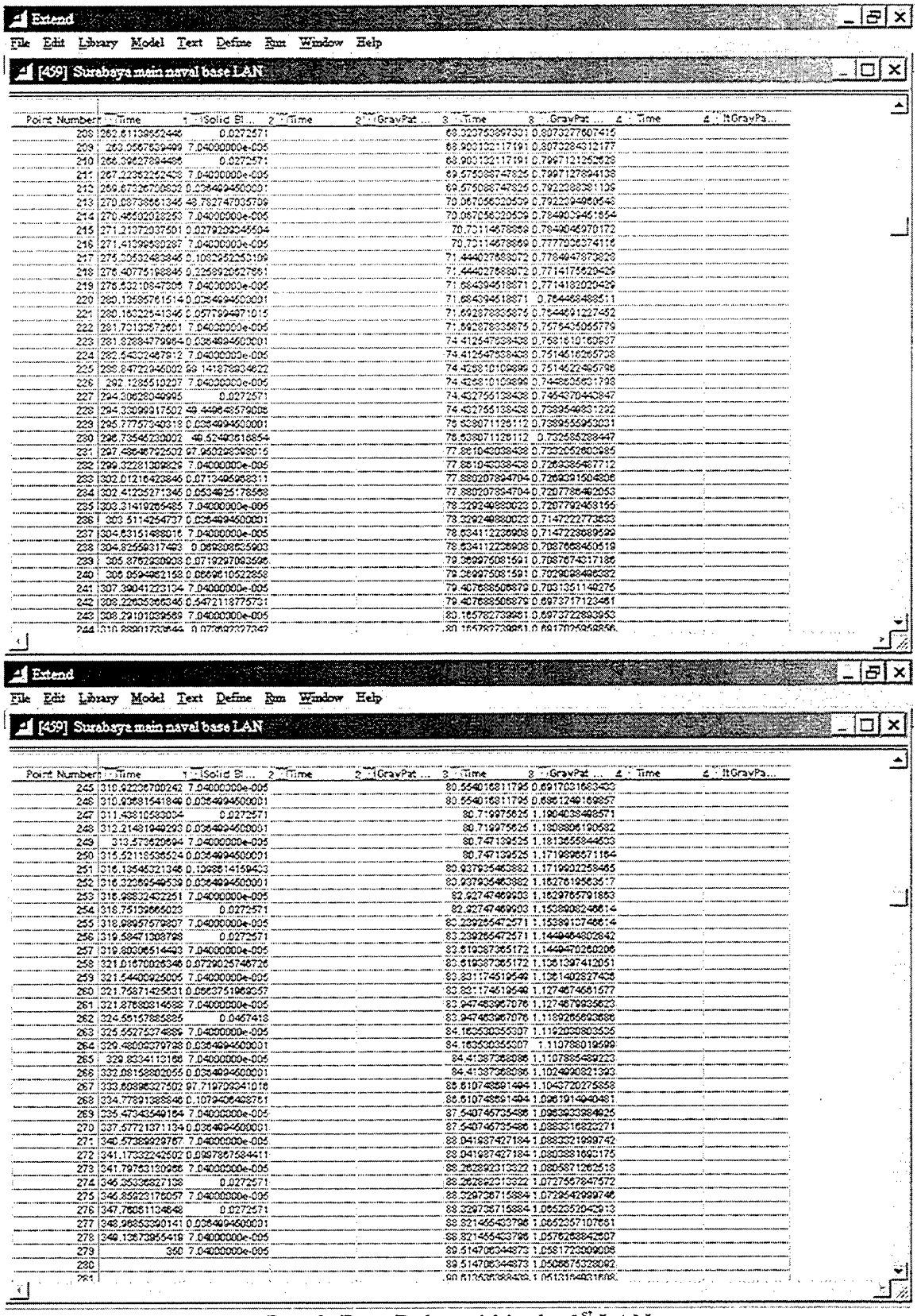


Extend

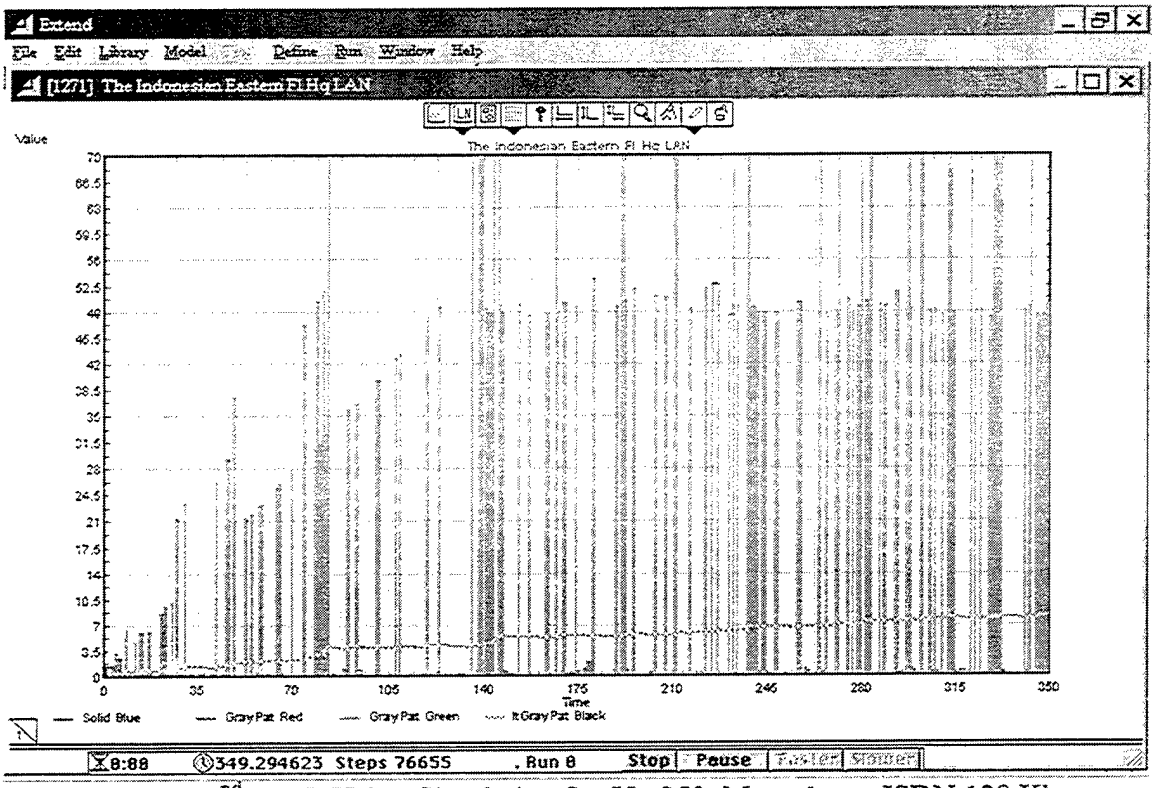
File Edit Library Model Text Define Run Window Help

[459] Surabaya main naval base LAN

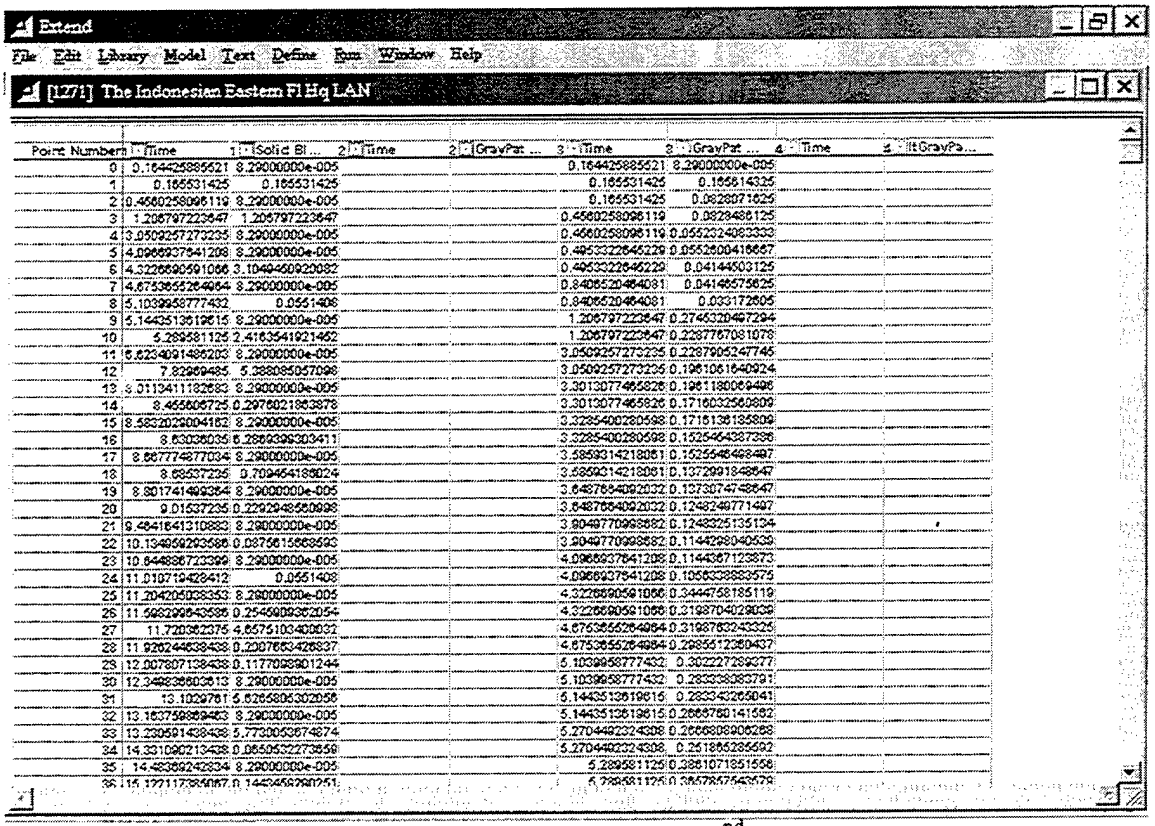
Point Number	Time	1	Solid Bl...	2	Time	2	GravPat ...	3	Time	3	GravPat ...	4	Time	4	GravPa...
73	82.927474[illegible]		0.0272571						29.339879106891		0.148[illegible]				
74	83.229255472571		7.040000000e-005						29.339879106891		0.144[illegible]				
75	84.163530355007		0.03549946						29.358316669719		0.144[illegible]				
76	84.413873668[illegible]		7.040000000e-005						29.358316669719		0.141[illegible]				
77	86.610748691494		0.250974689[illegible]						30.477295028196		0.141[illegible]				
78	87.5407467[illegible]		0.0272571						30.477295028196		0.137[illegible]				
79	88.041987427184		7.040000000e-005						30.576316634657		0.137[illegible]				
80	88.[illegible]		0.0272571						30.576316634657		0.134[illegible]				
81	88.821456403796		7.040000000e-005						30.904467321[illegible]		0.134[illegible]				
82	89.514706344873		0.07[illegible]						30.904467321[illegible]		0.131[illegible]				
83	90.613536388439		0.091503409[illegible]						31.354491019[illegible]		0.131[illegible]				
84	91.[illegible]		0.0272571						31.354491019[illegible]		0.128[illegible]				
85	92.303355718[illegible]		7.040000000e-005						31.541972941942		0.128[illegible]				
86	105.07227510[illegible]		0.03549946						31.541972941942		0.125[illegible]				
87	107.47874623504		7.040000000e-005						31.915117443271		0.125[illegible]				
88	110.1644631[illegible]		0.03549946						31.915117443271		0.123[illegible]				
89	111.0964647[illegible]		7.040000000e-005						33.142289760218		0.124[illegible]				
90	111.28789075		0.348200286[illegible]						33.142289760218		0.121[illegible]				
91	111.294278175		0.0577239737[illegible]						33.671719968438		0.123[illegible]				
92	112.378853875253		7.040000000e-005						33.671719968438		0.120[illegible]				
93	113.7729212[illegible]		0.0272571						35.777190105192		0.120[illegible]				
94	113.936824713[illegible]		7.040000000e-005						35.777190105192		0.118[illegible]				
95	116.08629184975		0.0272571						35.84679384316		0.118[illegible]				
96	116.57925197509		7.040000000e-005						35.84679384316		0.116[illegible]				
97	118.208751008[illegible]		0.0537231727857						36.207512529[illegible]		0.116[illegible]				
98	119.1152675[illegible]		0.0272571						36.207512529[illegible]		0.114[illegible]				
99	120.5796756[illegible]		7.040000000e-005						37.[illegible]		0.114[illegible]				
100	121.41555435[illegible]		0.03549946						37.[illegible]		0.112[illegible]				
101	121.57939537[illegible]		7.040000000e-005						38.[illegible]		0.113[illegible]				
102	122.07558747[illegible]		0.0272571						38.[illegible]		0.111[illegible]				
103	122.8[illegible]		7.040000000e-005						38.[illegible]		0.111[illegible]				
104	134.20422399701		0.03549946						38.[illegible]		0.109[illegible]				
105	135.[illegible]		81.810698925578						38.[illegible]		0.109[illegible]				
106	135.89964163907		7.040000000e-005						38.[illegible]		0.106[illegible]				
107	136.88073355		48.4604512737						38.5952473[illegible]		0.108[illegible]				
108	137.20678207771		7.040000000e-005						38.5952473[illegible]		0.106[illegible]				
109	1[illegible]		0.03549946						38.[illegible]		0.106[illegible]				



Run 2, Data Delay within the 1st LAN

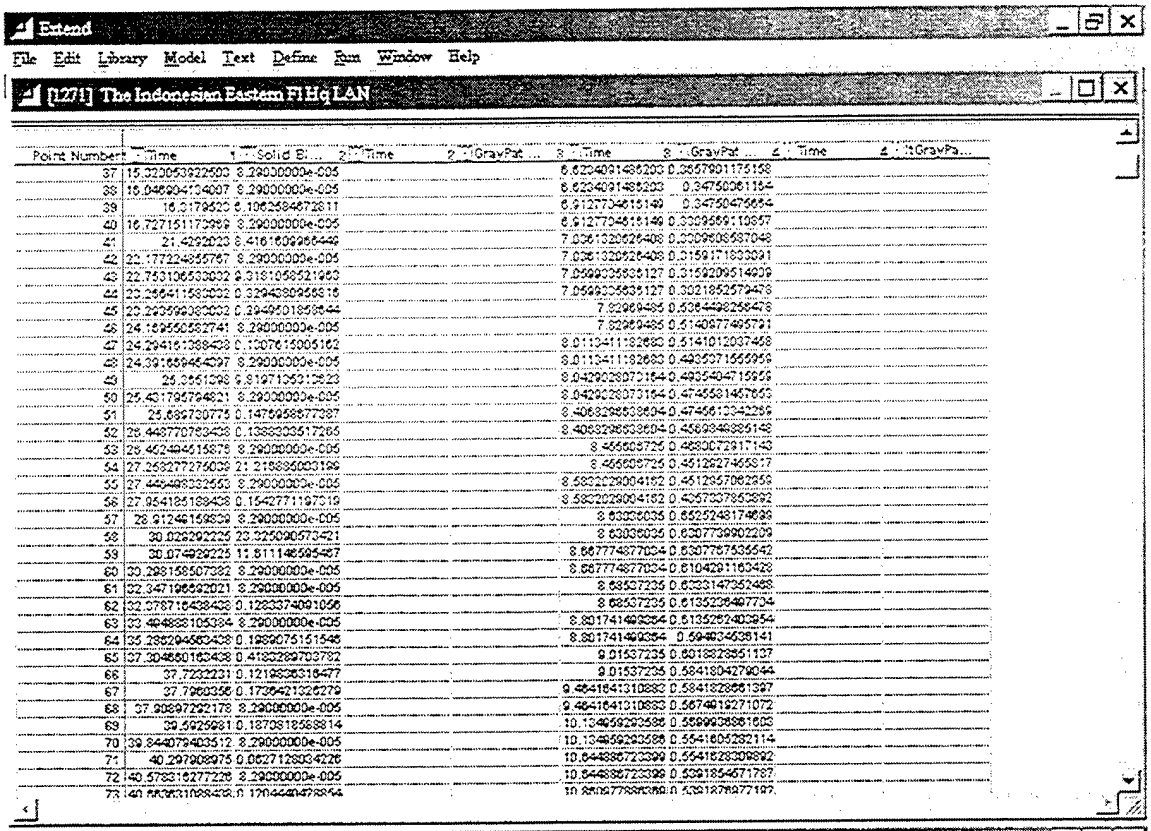


Run 2, the 2nd LAN, Using Simulation Set Up 350, Mean 1 sec, ISDN 128 Kbps

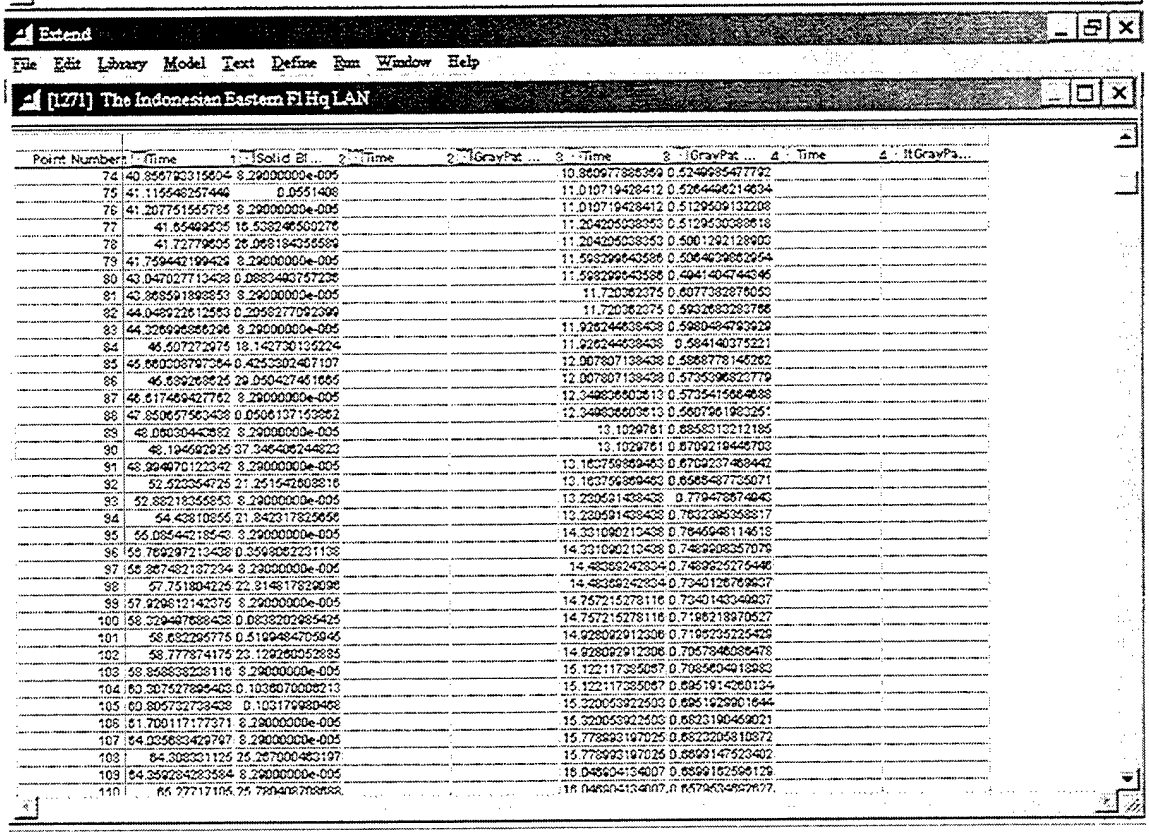


Point Number	Time	Solid Bl...	Time	GrayPat ...	Time	GrayPat ...	Time	ItGrayPa...
0	0.164425885521	8.29000000e-005			0.164425885521	8.29000000e-005		
1	0.165531425	0.165531425			0.165531425	0.165614325		
2	0.4560258096119	8.29000000e-005			0.165531425	0.0828071625		
3	1.206797223647	1.206797223647			0.4560258096119	0.0828486125		
4	3.0509257273235	8.29000000e-005			0.4560258096119	0.0552324083333		
5	4.0966937641208	8.29000000e-005			0.4953322645229	0.0552600416667		
6	4.3226690591066	3.1049450920082			0.4953322645229	0.04144503125		
7	4.6753655264964	8.29000000e-005			0.8406520464081	0.04146575625		
8	5.1039958777432	0.0551408			0.8406520464081	0.033172605		
9	5.1443513619615	8.29000000e-005			1.206797223647	0.2745320497294		
10	5.289581125	2.4163541921452			1.206797223647	0.2287767081078		
11	6.6234091486203	8.29000000e-005			3.0509257273235	0.2287905247745		
12	7.82969485	5.388085057098			3.0509257273235	0.1961061640924		
13	8.0113411182683	8.29000000e-005			3.3013077465826	0.1961180069496		
14	8.455606725	0.2976021863878			3.3013077465826	0.1716032560809		
15	8.5832029004162	8.29000000e-005			3.3285400280598	0.1716136185809		
16	8.63036035	6.2869399303411			3.3285400280598	0.1525464387386		
17	8.667774877034	8.29000000e-005			3.5859314218061	0.1525546498497		
18	8.68537235	0.709454186024			3.5859314218061	0.1372991848647		
19	8.801741499364	8.29000000e-005			3.6487664092032	0.1373074748647		
20	9.01537235	0.2292948560998			3.6487664092032	0.1248249771497		
21	9.4641641310883	8.29000000e-005			3.9049770998682	0.1248325135134		
22	10.134959293586	0.0875615668593			3.9049770998682	0.1144298040539		
23	10.644886723399	8.29000000e-005			4.0966937641208	0.1144367123873		
24	11.010719428412	0.0551408			4.0966937641208	0.1056338883575		
25	11.204205038353	8.29000000e-005			4.3226690591066	0.3444758185119		
26	11.598299643586	0.2545909362054			4.3226690591066	0.3198704029039		
27	11.720362375	4.6575103400032			4.6753655264964	0.3198763243325		
28	11.926244638438	0.2007653426837			4.6753655264964	0.2985512360437		
29	12.007807138438	0.1177098901244			5.1039958777432	0.302227289377		
30	12.349836603613	8.29000000e-005			5.1039958777432	0.283338083791		
31	13.1029761	5.6265805302056			5.1443513619615	0.283343265041		
32	13.163759869463	8.29000000e-005			5.1443513619615	0.2666760141562		
33	13.230591438438	5.7730053674874			5.2704492324308	0.2666808906268		
34	14.331090213438	0.0650532273659			5.2704492324308	0.251865285592		
35	14.48369242834	8.29000000e-005			5.289581125	0.3861071851556		
36	15.122117385067	0.1443458290251			5.289581125	0.3857857543579		

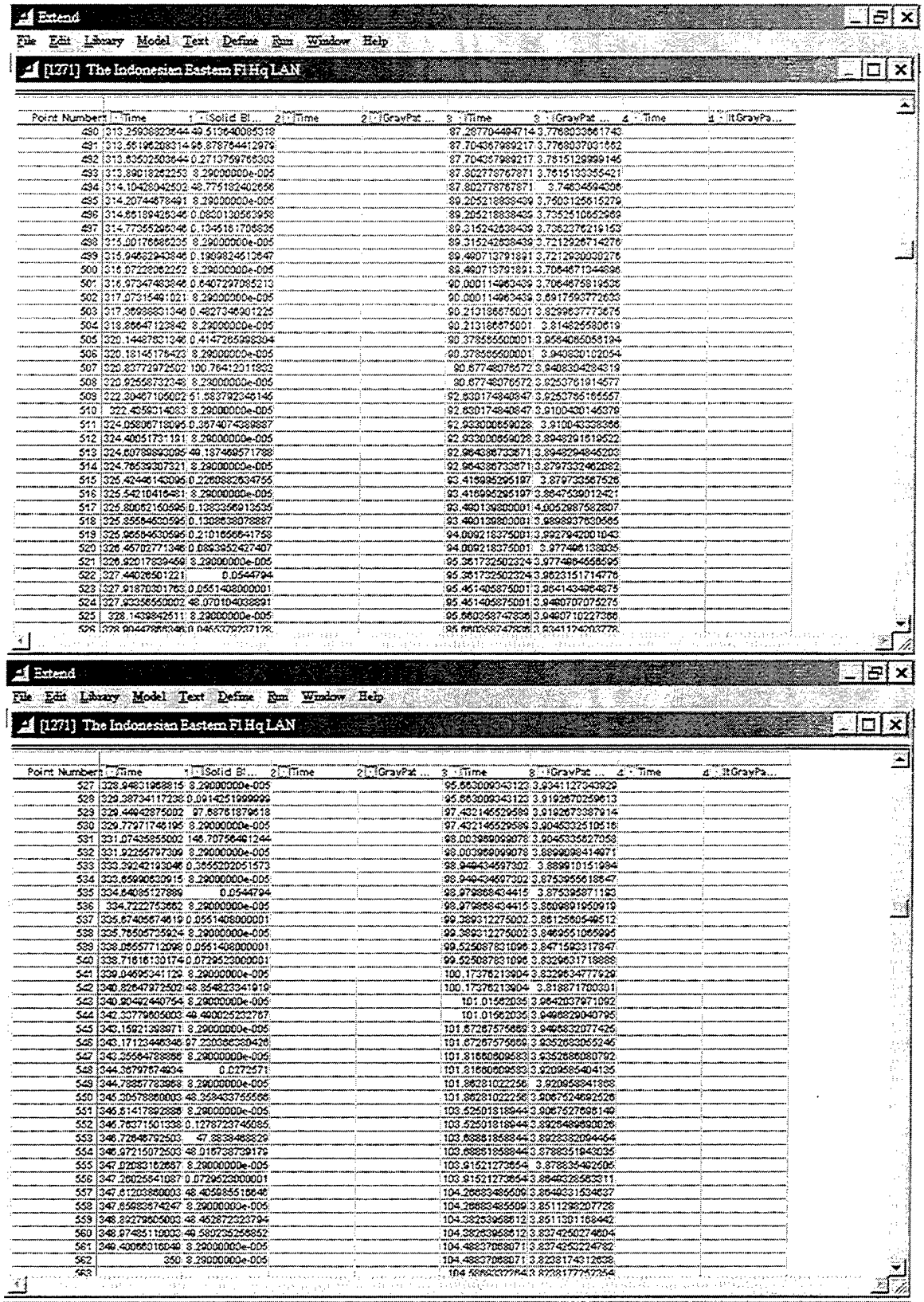
Run 2, Data Delay within the 2nd LAN



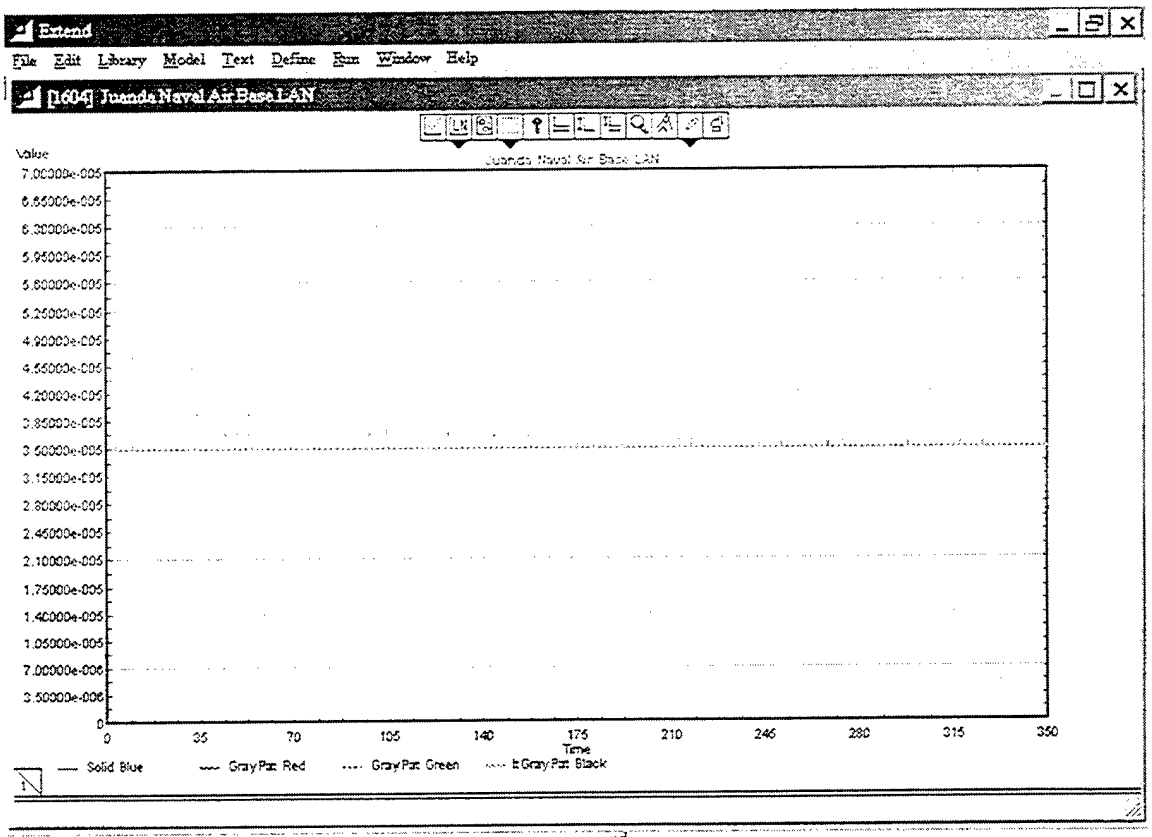
Point Number	Time 1	Solid Bl... 2	Time 2	GravPat ...	Time 3	GravPat ...	Time 4	GravPa...
37	15.223053922503	8.290000000e-005			6.623409148620	0.3557991175158		
38	15.946904724007	8.290000000e-005			6.623409148620	0.347500611564		
39	16.01179620	6.106258467281			6.912770461514	0.347504756544		
40	16.727151173999	8.290000000e-005			6.912770461514	0.300956911095		
41	21.42920220	8.416169286444			7.036132052640	0.300956087048		
42	22.177224855767	8.290000000e-005			7.036132052640	0.315917833091		
43	22.753106503032	8.318105521960			7.059900356351	0.315920951490		
44	23.256411583032	8.329408956516			7.059900356351	0.302195257947		
45	23.293599283032	8.394901858644			7.92969485	0.508449825847		
46	24.169560582741	8.290000000e-005			7.92969485	0.514087749572		
47	24.294161388428	0.1007615005162			8.011341182680	0.514101209746		
48	24.391659464097	8.290000000e-005			8.011341182680	0.449527155595		
49	25.0551098	8.819713512623			8.042902873154	0.449540471595		
50	25.401796794821	8.290000000e-005			8.042902873154	0.474558146765		
51	25.689730775	0.1475956877287			8.406829853904	0.474561204229		
52	26.449770760438	0.1388230051765			8.406829853904	0.458934838514		
53	26.462446415875	8.290000000e-005			8.466508725	0.468067291743		
54	27.258277276039	21.215856003199			8.466508725	0.451262746517		
55	27.449486202553	8.290000000e-005			8.580202900416	0.451295708295		
56	27.954185189438	0.1542771197019			8.580202900416	0.450753785289		
57	28.912461598639	8.290000000e-005			8.63036035	0.652524817468		
58	30.026292225	23.925090573421			8.63036035	0.630773902209		
59	30.074926225	11.811146595467			8.667774877004	0.630778753565		
60	30.298158507382	8.290000000e-005			8.667774877004	0.619429116342		
61	32.347196592021	8.290000000e-005			8.685372356	0.623314736246		
62	32.578716438438	0.1283374091096			8.685372356	0.613523497704		
63	32.464888105394	8.290000000e-005			8.801741493564	0.613526240954		
64	35.285294563438	0.1999075151546			8.801741493564	0.594834638141		
65	37.304550160438	0.4183289703782			9.015372356	0.601882851127		
66	37.72222231	0.1219836316477			9.015372356	0.584180429044		
67	37.7969356	0.1736421226279			9.464184310883	0.584182866397		
68	37.998972921781	8.290000000e-005			9.464184310883	0.567491271072		
69	39.59259681	0.1870818568814			10.104659293586	0.558993686603		
70	39.844079403512	8.290000000e-005			10.104659293586	0.554180652114		
71	40.297908975	0.0627128034226			10.644886723399	0.554182809892		
72	40.578816277226	8.290000000e-005			10.644886723399	0.509185467178		
73	40.660831088438	0.1704484978844			10.859677885369	0.509187897197		



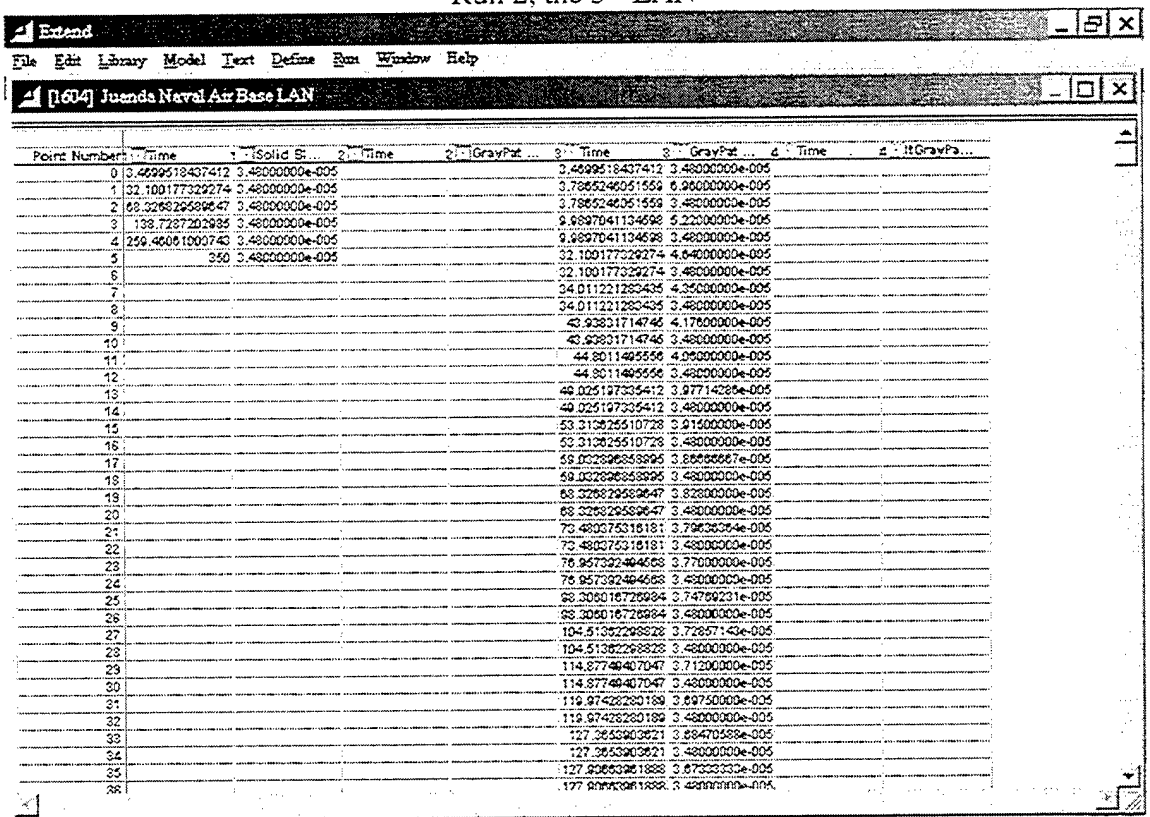
Point Number	Time 1	Solid Bl... 2	Time 2	GravPat ...	Time 3	GravPat ...	Time 4	GravPa...
74	40.956793315604	8.290000000e-005			10.859977885369	0.524998547792		
75	41.115548257446	0.0551408			11.010719428412	0.526449621463		
76	41.207751555765	8.290000000e-005			11.010719428412	0.512950932208		
77	41.65499505	15.538246500276			11.204205038053	0.512953038618		
78	41.727796905	26.068184355589			11.204205038053	0.500129212890		
79	41.759442199405	8.290000000e-005			11.593299540586	0.506402986294		
80	43.047027710438	0.0883480757236			11.593299540586	0.494140474496		
81	43.965591898853	8.290000000e-005			11.720362375	0.607738287605		
82	44.049922612553	0.2058277092399			11.720362375	0.593268328766		
83	44.226996566296	8.290000000e-005			11.925244638438	0.598048479392		
84	46.507272975	18.142730135224			11.925244638438	0.584140375221		
85	46.660088797364	0.4253202407107			12.007807138438	0.588877814262		
86	46.689268625	29.050427461655			12.007807138438	0.573539823779		
87	46.617469427762	8.290000000e-005			12.349836605613	0.573541664688		
88	47.650657563438	0.0506137153952			12.349836605613	0.560796190251		
89	48.0803044552	8.290000000e-005			13.1029761	0.685831212185		
90	48.194592925	37.346406244823			13.1029761	0.670921946703		
91	48.994470122342	8.290000000e-005			13.162759869463	0.670923748442		
92	52.522554725	21.251542608316			13.162759869463	0.656548772507		
93	52.882185563853	8.290000000e-005			13.220591438438	0.7794768748463		
94	54.43810855	21.842317825656			13.220591438438	0.765239535837		
95	55.0854421854	8.290000000e-005			14.331090210438	0.764694811461		
96	55.769297210438	0.3598052231138			14.331090210438	0.748990835707		
97	55.867482187294	8.290000000e-005			14.483692429304	0.748992527549		
98	57.751804225	22.814817520096			14.483692429304	0.734012567693		
99	57.929812142375	8.290000000e-005			14.757215278116	0.734014334937		
100	58.329497688438	0.0838202985425			14.757215278116	0.719621897052		
101	58.682296775	0.5199484705945			14.928092912306	0.719623525245		
102	58.777874175	23.129226052885			14.928092912306	0.705794608547		
103	58.868838238116	8.290000000e-005			15.122117385057	0.708560491893		
104	60.307527895403	0.1036700008213			15.122117385057	0.695191426013		
105	60.805732738438	0.1031799804688			15.320053922503	0.695192990164		
106	61.700117177371	8.290000000e-005			15.320053922503	0.682319045902		
107	64.035683429797	8.290000000e-005			15.778993197025	0.682320051887		
108	64.308331125	25.267000463197			15.778993197025	0.668914752340		
109	64.359284283584	8.290000000e-005			16.046904134007	0.668916259612		
110	65.777171105	25.790409788588			16.046904134007	0.655903497677		



Run 2, Data Delay within the 2nd LAN

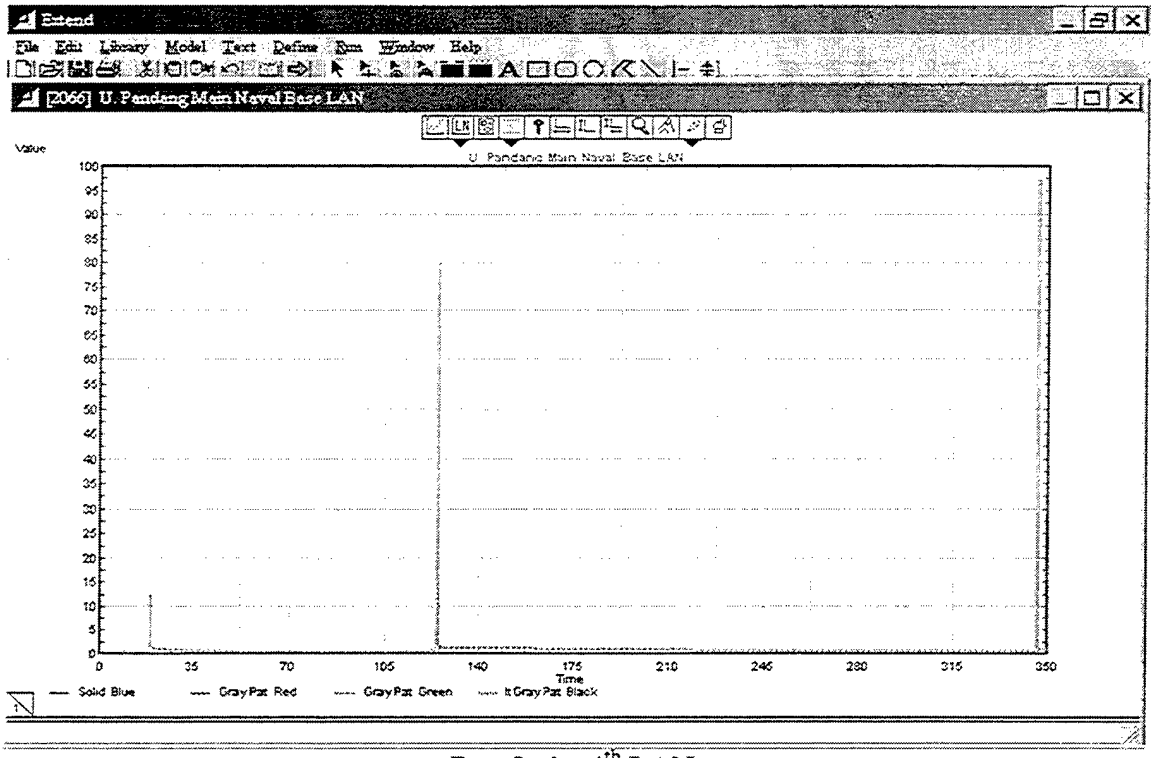


Run 2, the 3rd LAN

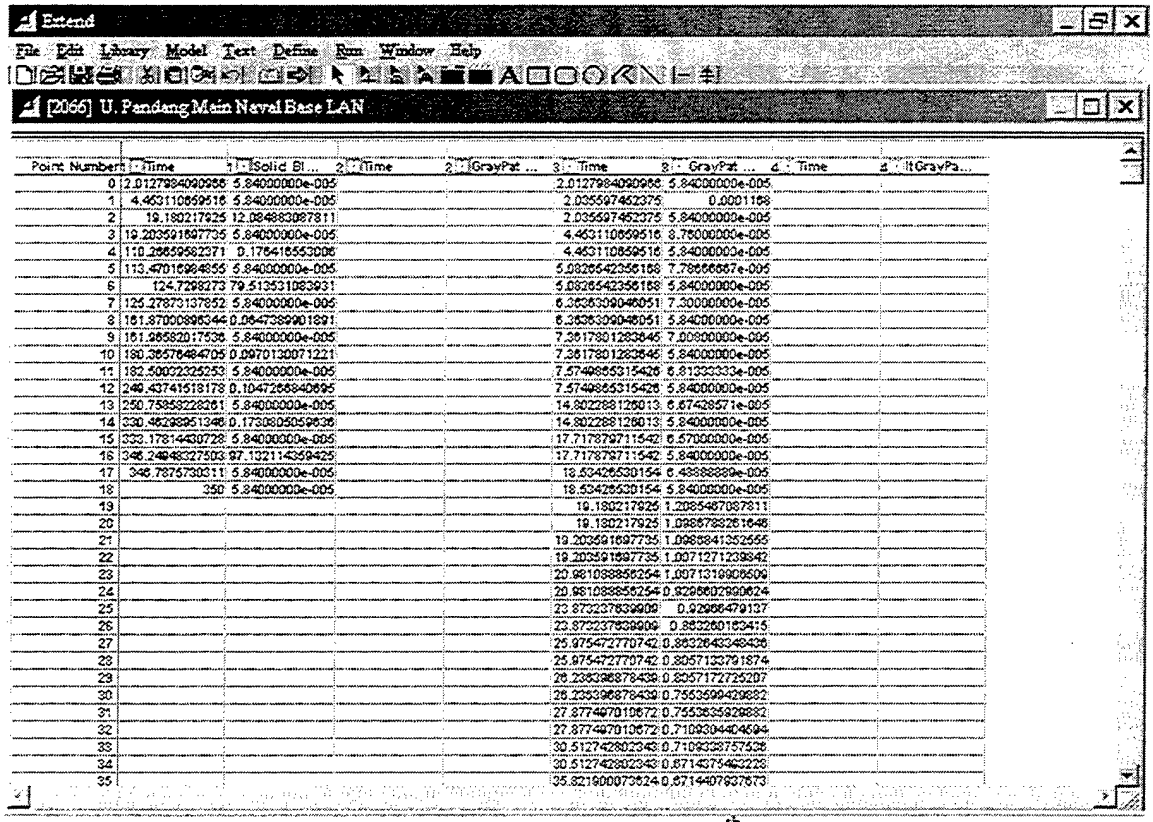


Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ltGrayPa...
0	3.46995184374	3.48000000e-005			3.46995184374	3.48000000e-005		
1	32.1001773292	3.48000000e-005			3.78652460515	6.96000000e-005		
2	68.3268295896	3.48000000e-005			3.78652460515	3.48000000e-005		
3	138.728720298	3.48000000e-005			9.98970411346	5.22000000e-005		
4	259.460651000	3.48000000e-005			9.98970411346	3.48000000e-005		
5	350	3.48000000e-005			32.1001773292	4.64000000e-005		
6					32.1001773292	3.48000000e-005		
7					34.0112212834	4.35000000e-005		
8					34.0112212834	3.48000000e-005		
9					43.938317147	4.17600000e-005		
10					43.938317147	3.48000000e-005		
11					44.8011495556	4.06000000e-005		
12					44.8011495556	3.48000000e-005		
13					49.0251973354	3.97714286e-005		
14					49.0251973354	3.48000000e-005		
15					53.3136255107	3.91500000e-005		
16					53.3136255107	3.48000000e-005		
17					59.0328968589	3.86666667e-005		
18					59.0328968589	3.48000000e-005		
19					68.3268295896	3.82800000e-005		
20					68.3268295896	3.48000000e-005		
21					75.4800753161	3.79636364e-005		
22					75.4800753161	3.48000000e-005		
23					76.9573924946	3.77000000e-005		
24					76.9573924946	3.48000000e-005		
25					88.3060167269	3.74769231e-005		
26					88.3060167269	3.48000000e-005		
27					104.513622988	3.72857143e-005		
28					104.513622988	3.48000000e-005		
29					114.877494070	3.71200000e-005		
30					114.877494070	3.48000000e-005		
31					119.974282801	3.69750000e-005		
32					119.974282801	3.48000000e-005		
33					127.365390362	3.68470588e-005		
34					127.365390362	3.48000000e-005		
35					127.906639618	3.67333333e-005		
36					127.906639618	3.48000000e-005		

Run 2, Data Delay within the 3rd LAN

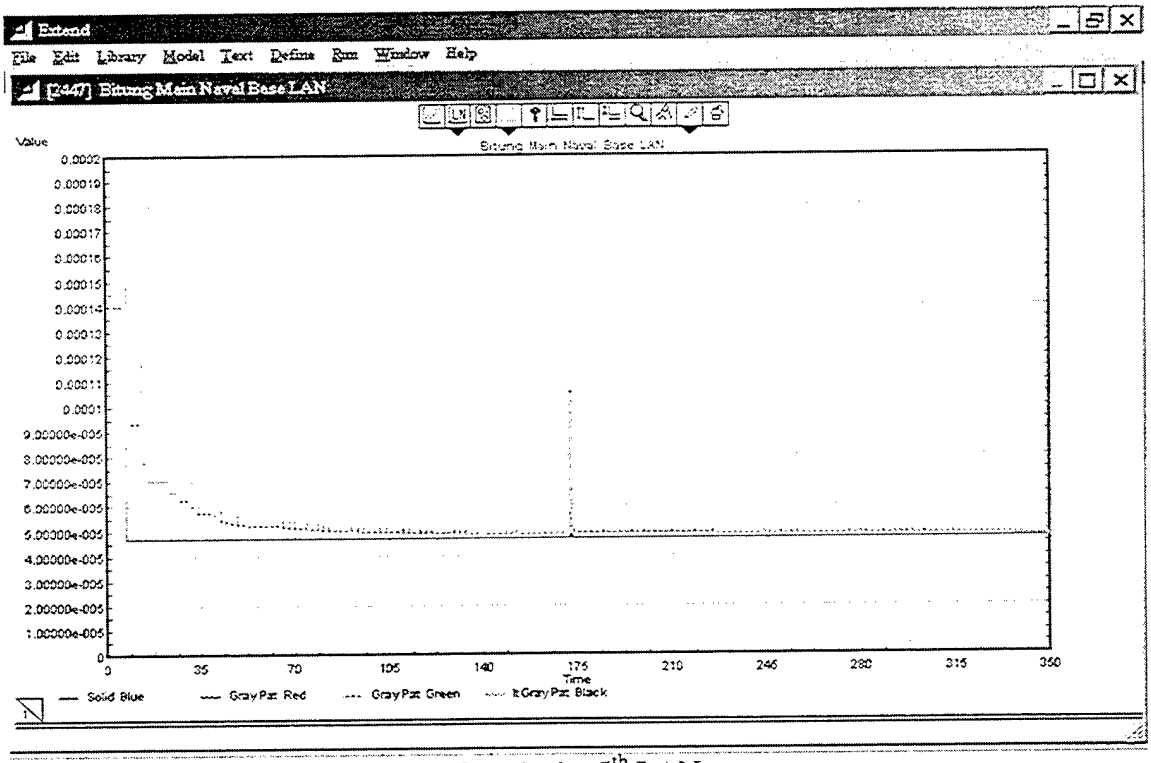


Run 2, the 4th LAN

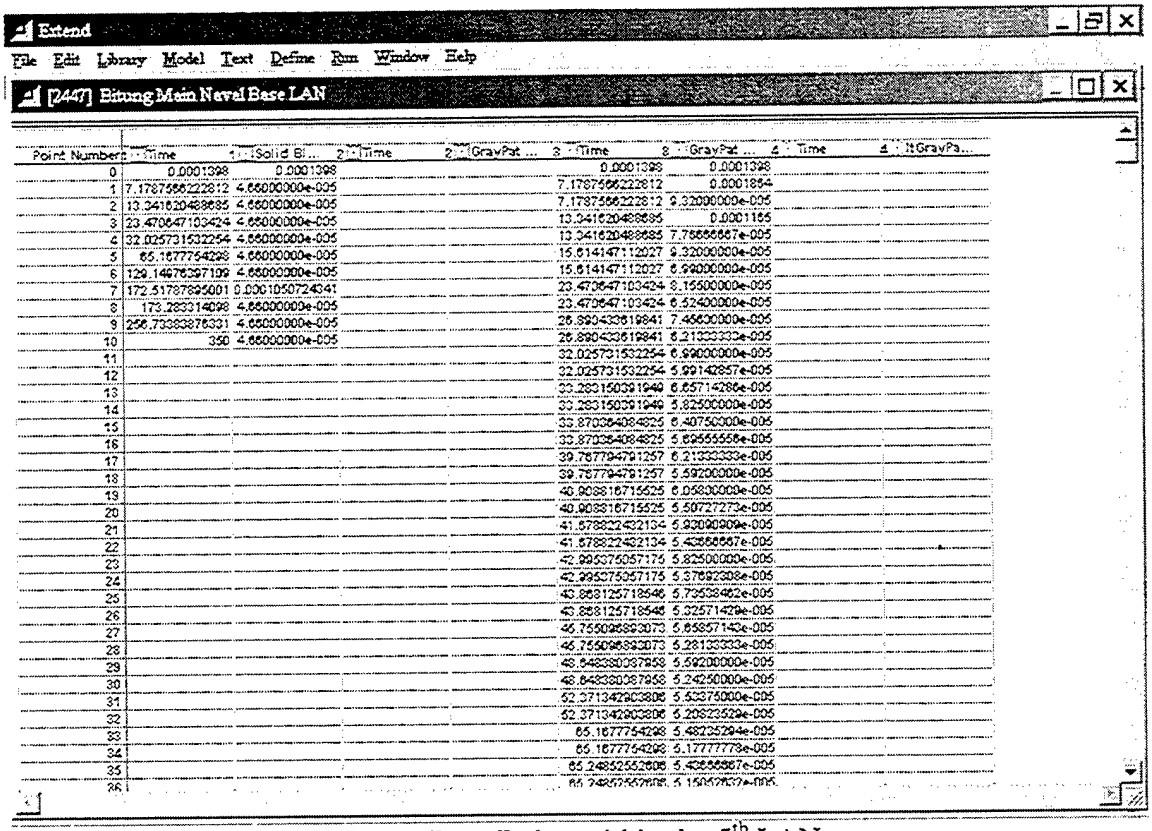


Point Number	Time	Solid Bl...	Time	GrayPat ...	Time	GrayPat ...	Time	ltGrayPa...
0	2.012798409056	5.840000000e-005			2.012798409056	5.840000000e-005		
1	4.463110659516	5.840000000e-005			2.035597452375	0.0001168		
2	19.180217925	12.084883987811			2.035597452375	5.840000000e-005		
3	19.200591697735	5.840000000e-005			4.463110659516	8.750000000e-005		
4	110.26659582371	0.1764165533006			4.463110659516	5.840000000e-005		
5	113.47016964655	5.840000000e-005			5.082654235615	7.786666670e-005		
6	124.7298273	79.513531983931			5.082654235615	5.840000000e-005		
7	125.27870137852	5.840000000e-005			6.353630946051	7.300000000e-005		
8	151.87000895344	0.064738990189			6.353630946051	5.840000000e-005		
9	151.96582017535	5.840000000e-005			7.361780126364	7.000000000e-005		
10	180.36576484705	0.097013097122			7.361780126364	5.840000000e-005		
11	182.50002235253	5.840000000e-005			7.574985531542	6.813333330e-005		
12	246.43741519178	0.104726594069			7.574985531542	5.840000000e-005		
13	250.75858228261	5.840000000e-005			14.802288126013	6.674285710e-005		
14	280.46299951346	0.173080505963			14.802288126013	5.840000000e-005		
15	332.17814430728	5.840000000e-005			17.717879711542	6.570000000e-005		
16	346.24848227503	97.132114359425			17.717879711542	5.840000000e-005		
17	346.78757930311	5.840000000e-005			18.534265301564	6.488888890e-005		
18	350	5.840000000e-005			18.534265301564	5.840000000e-005		
19					19.180217925	1.208546708781		
20					19.180217925	1.098878826164		
21					19.200591697735	1.098884135255		
22					19.200591697735	1.097127123984		
23					20.981088856264	1.097131990650		
24					20.981088856264	0.929660299062		
25					23.870237639909	0.92966479137		
26					23.870237639909	0.863260163415		
27					25.975472770742	0.863264334842		
28					25.975472770742	0.805713379187		
29					26.236396878439	0.805717272520		
30					26.236396878439	0.755359942969		
31					27.877497010672	0.755363592989		
32					27.877497010672	0.710930440459		
33					30.512742802343	0.710933975753		
34					30.512742802343	0.671437546222		
35					35.821900073524	0.671440763767		

Run 2, Data Delay within the 4th LAN

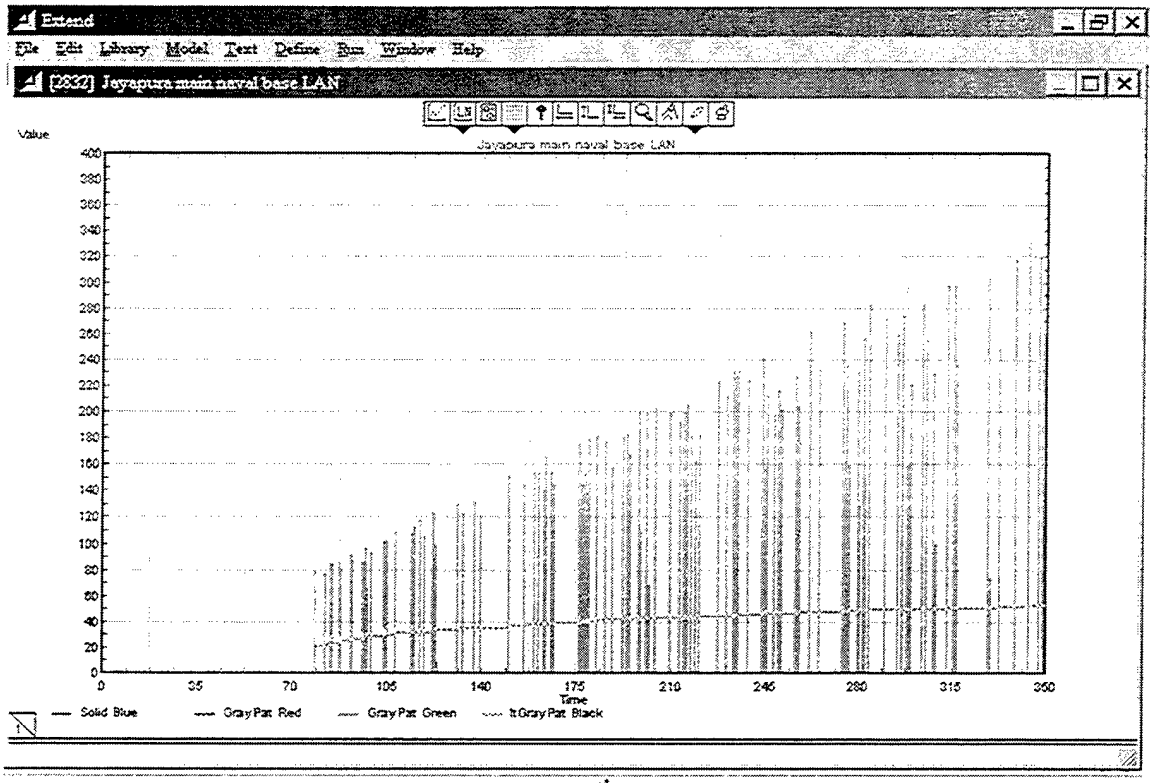


Run 2, the 5th LAN

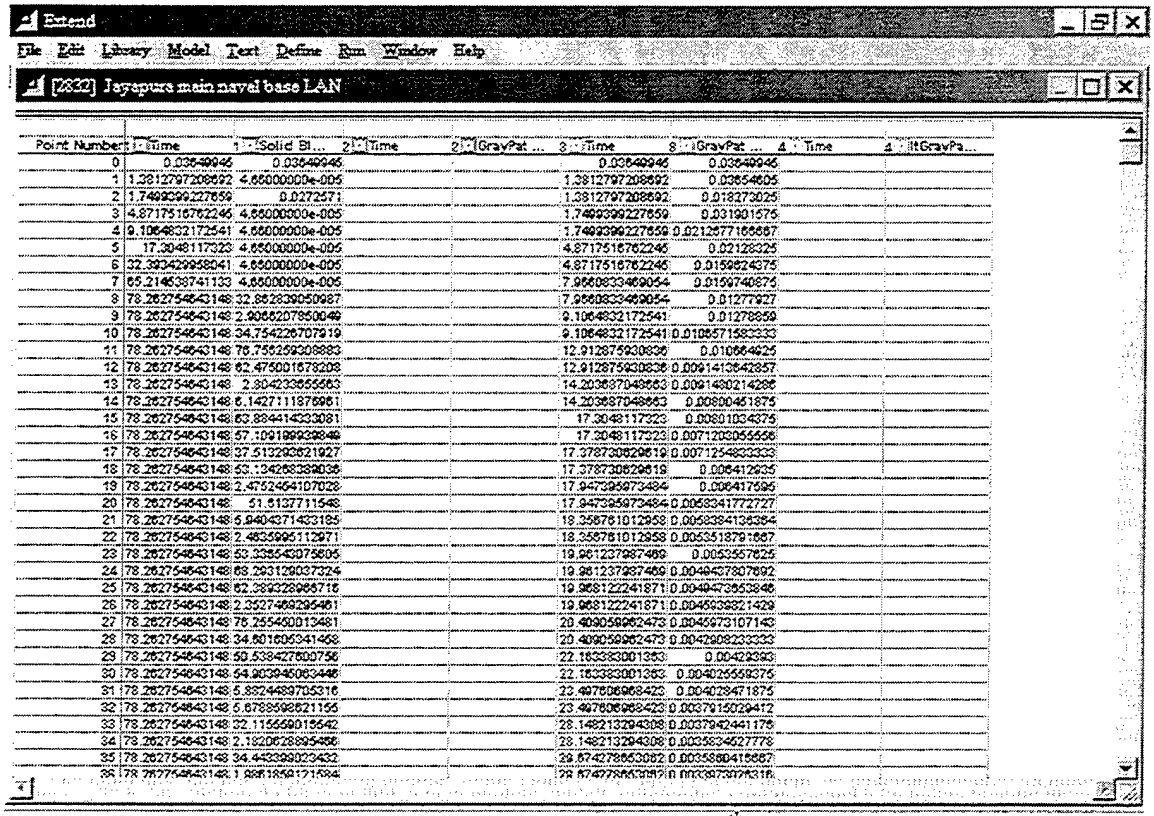


Point Number	0 : Time	1 : Solid Bl...	2 : Time	3 : GrayPat ...	8 : Time	8 : GrayPat ...	4 : Time	4 : GrayPa...
0	0.0001398	0.0001398			0.0001398	0.0001398		
1	7.178756622812	4.660000e-005			7.178756622812	0.0001864		
2	13.34162048685	4.660000e-005			7.178756622812	9.320000e-005		
3	23.47064710424	4.660000e-005			13.34162048685	0.0001165		
4	32.02573153225	4.660000e-005			13.34162048685	7.786666e-005		
5	65.16777542981	4.660000e-005			15.61414711202	9.320000e-005		
6	129.1467639710	4.660000e-005			15.61414711202	6.990000e-005		
7	172.5178789500	0.0001050724341			23.47064710424	8.155000e-005		
8	173.2833140981	4.660000e-005			23.47064710424	6.524000e-005		
9	256.7338387633	4.660000e-005			26.89043361984	7.465000e-005		
10	350	4.660000e-005			26.89043361984	6.213333e-005		
11					32.02573153225	6.990000e-005		
12					32.02573153225	5.991428e-005		
13					33.28015039194	6.657142e-005		
14					33.28015039194	5.825000e-005		
15					33.87036408492	6.465000e-005		
16					33.87036408492	5.695555e-005		
17					39.76779479125	6.213333e-005		
18					39.76779479125	5.592000e-005		
19					40.90881671552	6.058000e-005		
20					40.90881671552	5.507272e-005		
21					41.67882249213	5.930909e-005		
22					41.67882249213	5.426666e-005		
23					42.99537505717	5.825000e-005		
24					42.99537505717	5.576923e-005		
25					43.86812571854	5.725384e-005		
26					43.86812571854	5.525714e-005		
27					46.75509689307	5.658571e-005		
28					46.75509689307	5.281333e-005		
29					48.64838008795	5.592000e-005		
30					48.64838008795	5.242500e-005		
31					52.37134290380	5.503750e-005		
32					52.37134290380	5.208235e-005		
33					65.16777542981	5.482352e-005		
34					65.16777542981	5.177777e-005		
35					65.24852552606	5.426666e-005		
36					65.24852552606	5.150526e-005		

Run 2, Data Delay within the 5th LAN

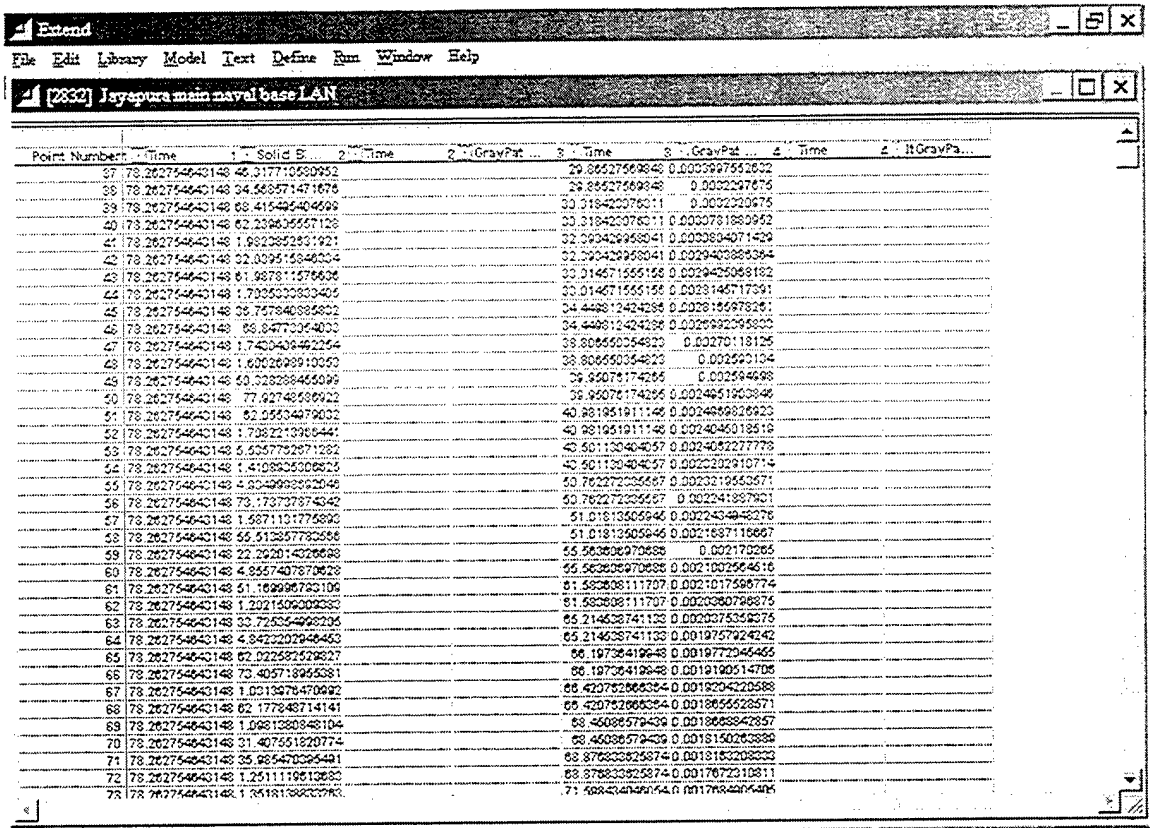


Run 2, the 6th LAN

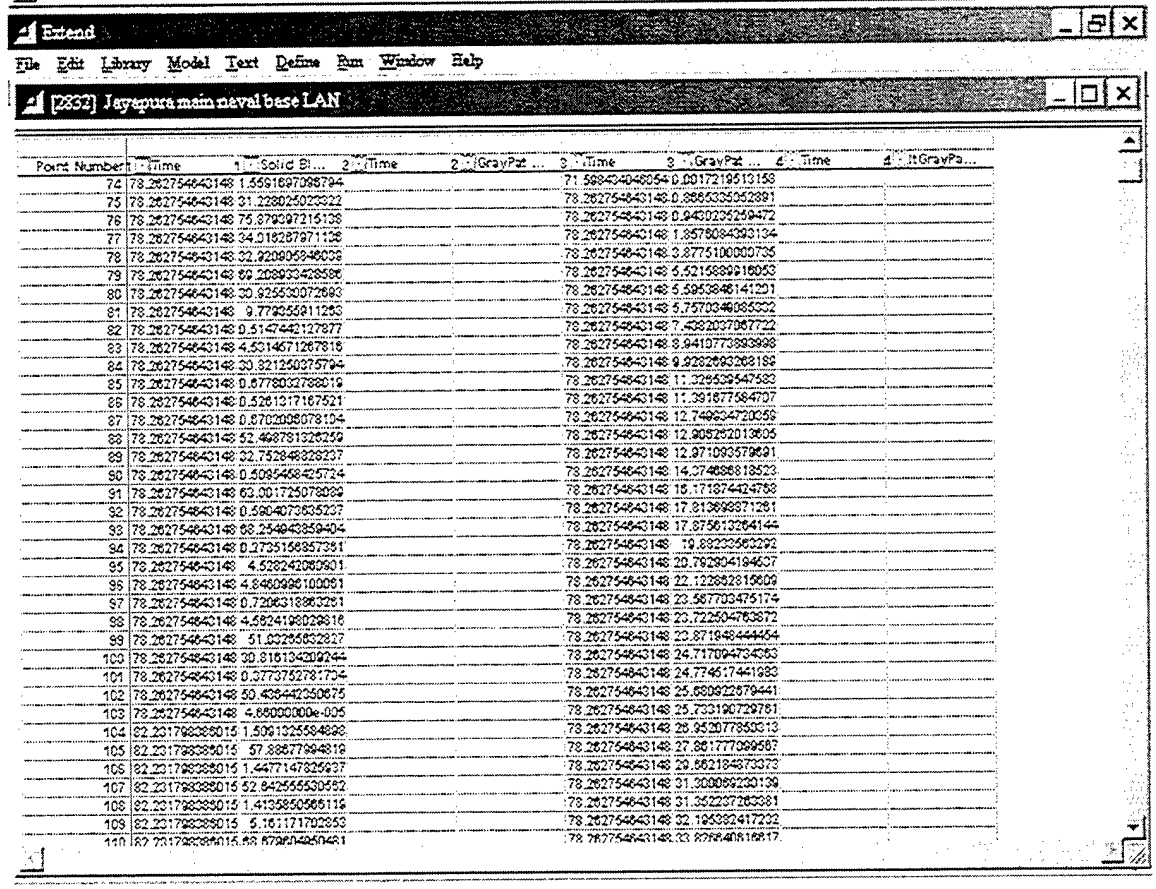


Point Number	1 Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ItGrayPa...
0	0.03649946	0.03649946			0.03649946	0.03649946		
1	1.3812797208692	4.66000000e-005			1.3812797208692	0.03654605		
2	1.7499399227659	0.0272571			1.3812797208692	0.018273025		
3	4.8717516762245	4.66000000e-005			1.7499399227659	0.031901575		
4	9.1064832172541	4.66000000e-005			1.7499399227659	0.0212677166667		
5	17.3048117323	4.66000000e-005			4.8717516762245	0.02128325		
6	32.393429958041	4.66000000e-005			4.8717516762245	0.0159624375		
7	65.214538741133	4.66000000e-005			7.9660833469054	0.0159740875		
8	78.262754643148	32.862839050987			7.9660833469054	0.01277927		
9	78.262754643148	2.9066207850049			9.1064832172541	0.01278859		
10	78.262754643148	34.754226707919			9.1064832172541	0.0106571583333		
11	78.262754643148	76.755259308883			12.912875930836	0.010664925		
12	78.262754643148	62.475001678208			12.912875930836	0.0091413642857		
13	78.262754643148	2.304233655563			14.203687048663	0.0091480214286		
14	78.262754643148	6.1427111876961			14.203687048663	0.00800451875		
15	78.262754643148	63.884414333081			17.3048117323	0.00801034375		
16	78.262754643148	57.109199939849			17.3048117323	0.0071203055556		
17	78.262754643148	37.513293621927			17.378730629619	0.0071254833333		
18	78.262754643148	53.134268389036			17.378730629619	0.006412935		
19	78.262754643148	2.4752464107028			17.947395973484	0.006417595		
20	78.262754643148	51.6137711548			17.947395973484	0.0058341772727		
21	78.262754643148	5.9404371433185			18.356761012958	0.0058384136364		
22	78.262754643148	2.4635995112971			18.356761012958	0.0053518791667		
23	78.262754643148	53.336543075605			19.961237987469	0.0053557625		
24	78.262754643148	68.293129037324			19.961237987469	0.0049437807692		
25	78.262754643148	62.389328966716			19.968122241871	0.0049473653846		
26	78.262754643148	2.3527469295461			19.968122241871	0.0045939821429		
27	78.262754643148	76.255450013481			20.409059962473	0.0045973107143		
28	78.262754643148	34.601605341458			20.409059962473	0.0042908233333		
29	78.262754643148	50.538427600756			22.163383001363	0.00429393		
30	78.262754643148	54.903945063446			22.163383001363	0.004025559375		
31	78.262754643148	5.8824489705316			23.497606968423	0.004028471875		
32	78.262754643148	5.6788598621155			23.497606968423	0.0037915029412		
33	78.262754643148	32.115559015542			28.148213294308	0.0037942441176		
34	78.262754643148	2.1820628895466			28.148213294308	0.0035834527778		
35	78.262754643148	34.443399023432			29.674278653062	0.0035860416667		
36	78.262754643148	1.9861859121584			29.674278653062	0.0033973026316		

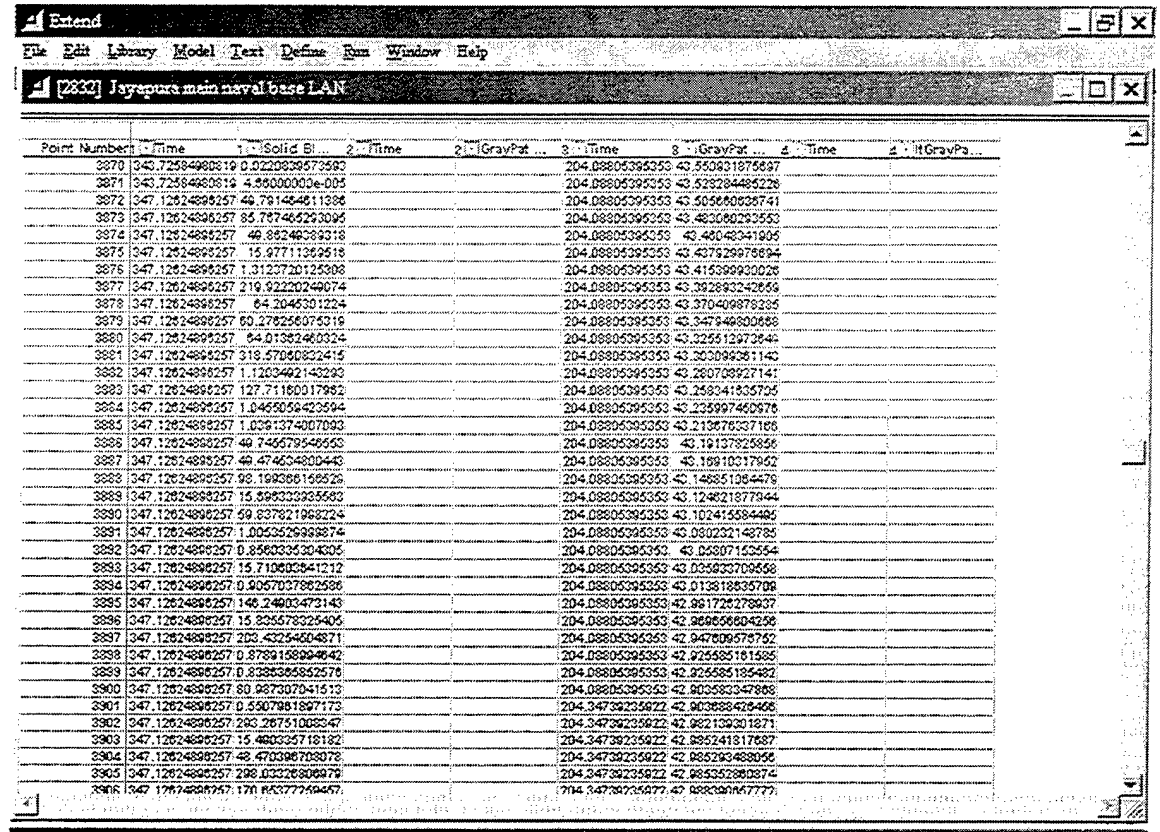
Run 2, Data Delay within the 6th LAN

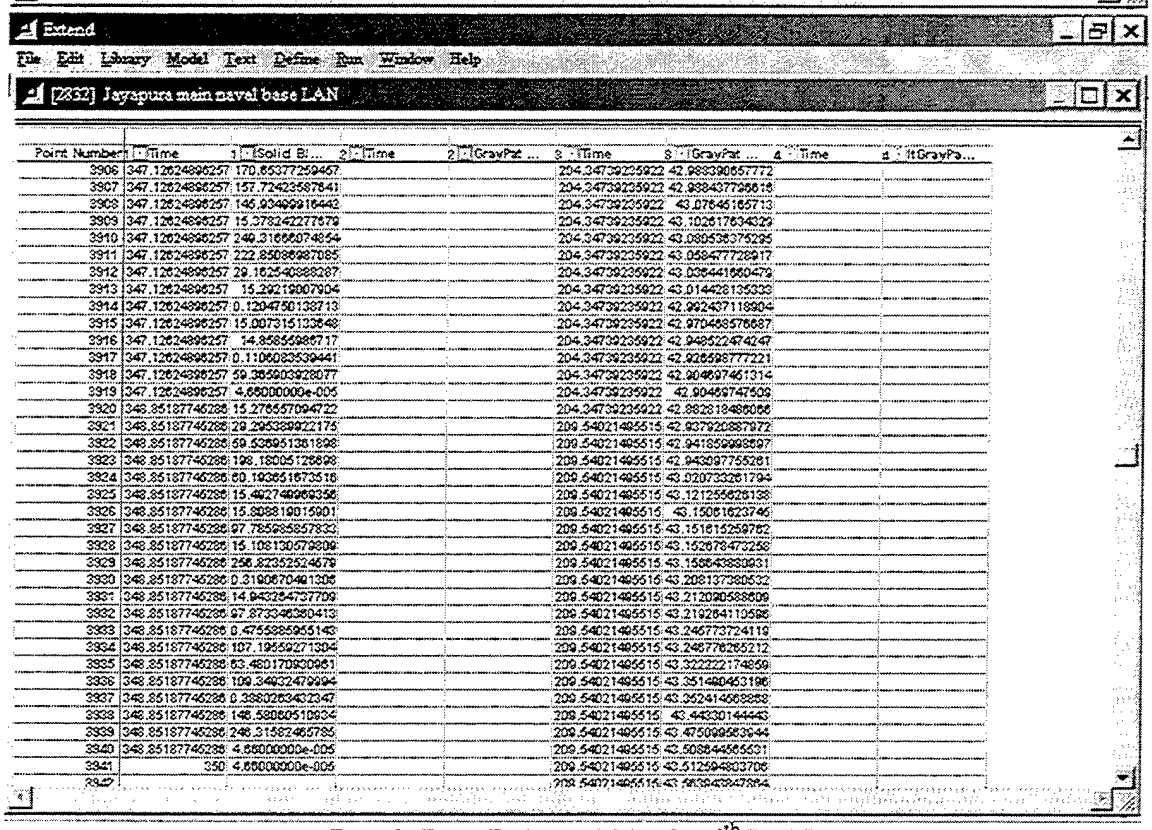


Point Number	0 Time	1 Solid B...	2 Time	2 GrayPat...	3 Time	3 GrayPat...	4 Time	4 GrayPa...
37	78.262754643148	46.3177105830952			29.8652756939848	0.00039975552632		
38	78.262754643148	34.568571471675			29.8652756939848	0.0002297675		
39	78.262754643148	68.4154954046599			30.3184200780211	0.0002320675		
40	78.262754643148	62.2396055571128			30.3184200780211	0.00007818880952		
41	78.262754643148	1.9823852831921			32.0934299958041	0.00038044071429		
42	78.262754643148	32.0095158466004			32.0934299958041	0.00294088886364		
43	78.262754643148	61.987811576606			33.0146715551156	0.00294250681182		
44	78.262754643148	1.7035033833405			33.0146715551156	0.00281457117391		
45	78.262754643148	38.7578408886802			34.4498124242286	0.00281556978261		
46	78.262754643148	66.8477320548033			34.4498124242286	0.00269922095833		
47	78.262754643148	1.7420404942254			38.8066500354823	0.00270118125		
48	78.262754643148	1.6002699910053			38.8066500354823	0.0025901134		
49	78.262754643148	50.0282884656099			39.950761742266	0.002594698		
50	78.262754643148	77.927485886922			39.950761742266	0.00249519038946		
51	78.262754643148	62.05534479003			40.881951911146	0.00248869826923		
52	78.262754643148	1.7382213366441			40.881951911146	0.00240450185918		
53	78.262754643148	5.5057752871282			40.501130404057	0.00240522777778		
54	78.262754643148	1.4108925308525			40.501130404057	0.00220292910714		
55	78.262754643148	4.8048993602049			50.762272055667	0.00233195535571		
56	78.262754643148	73.1737378743042			50.762272055667	0.0022419877901		
57	78.262754643148	1.587110177589			51.018135059946	0.00224349468276		
58	78.262754643148	55.5135577783568			51.018135059946	0.00216971156667		
59	78.262754643148	22.2902143256698			55.563609970688	0.002170265		
60	78.262754643148	4.9557407870628			55.563609970688	0.00210025644516		
61	78.262754643148	51.1699967931099			61.582808111707	0.00210175867742		
62	78.262754643148	1.2921509009383			61.582808111707	0.00203507987875		
63	78.262754643148	32.7255549983295			65.214638741133	0.00200375359375		
64	78.262754643148	4.8422029946453			65.214638741133	0.00197579242424		
65	78.262754643148	62.0225825298027			66.197364196448	0.00197720464655		
66	78.262754643148	73.405718955081			66.197364196448	0.00191905147059		
67	78.262754643148	1.0313978470992			66.420752666354	0.00192042205882		
68	78.262754643148	62.177848714141			66.420752666354	0.00185552528571		
69	78.262754643148	1.0981388048104			68.460866579409	0.00186689842857		
70	78.262754643148	31.4075518209774			68.460866579409	0.00181502653889		
71	78.262754643148	35.9854703954491			68.876833825874	0.00181552088235		
72	78.262754643148	1.2511119513686			68.876833825874	0.00176723101811		
73	78.262754643148	1.2518139882783			71.598404846054	0.00176849054405		

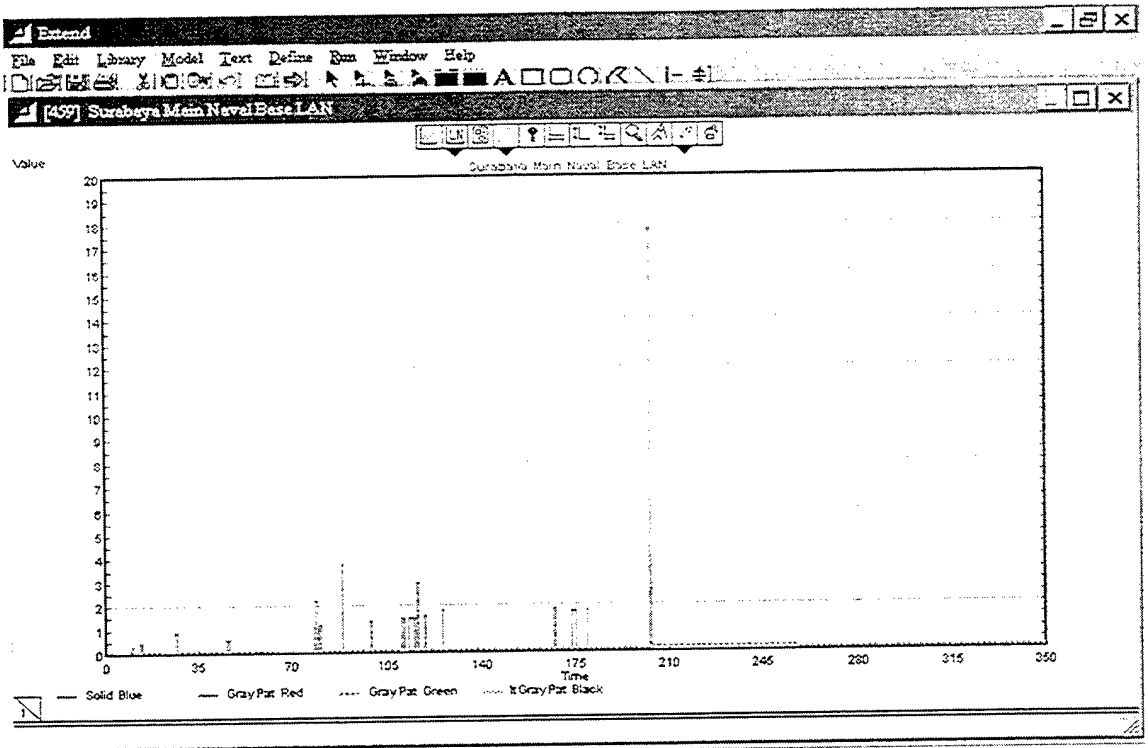


Point Number	0 Time	1 Solid Bl...	2 Time	2 GrayPat...	3 Time	3 GrayPat...	4 Time	4 GrayPa...
74	78.262754643148	1.5691697098794			71.598404846054	0.0017219513158		
75	78.262754643148	31.2288250233522			78.262754643148	0.8666035052891		
76	78.262754643148	75.879397215138			78.262754643148	0.9400235259472		
77	78.262754643148	34.018287971126			78.262754643148	1.857808493134		
78	78.262754643148	32.9209058946036			78.262754643148	3.877510000735		
79	78.262754643148	69.2089334286586			78.262754643148	5.521588916053		
80	78.262754643148	30.9256300726993			78.262754643148	5.595384641201		
81	78.262754643148	9.7795559112359			78.262754643148	5.757034985002		
82	78.262754643148	0.514744127877			78.262754643148	7.4382037967722		
83	78.262754643148	4.5314671267818			78.262754643148	8.941977739998		
84	78.262754643148	30.8212503757944			78.262754643148	9.928269326189		
85	78.262754643148	0.6778032788019			78.262754643148	11.3295395447583		
86	78.262754643148	0.5261217167521			78.262754643148	11.3916775847O7		
87	78.262754643148	0.8702086078104			78.262754643148	12.7496247200S9		
88	78.262754643148	52.4987813226259			78.262754643148	12.9052520213605		
89	78.262754643148	32.752848328237			78.262754643148	12.9710935799691		
90	78.262754643148	0.5085468425724			78.262754643148	14.374686818523		
91	78.262754643148	63.0017250788099			78.262754643148	15.1719744247S8		
92	78.262754643148	0.5904073635237			78.262754643148	17.8136998712S1		
93	78.262754643148	68.2549435894O4			78.262754643148	17.875613264144		
94	78.262754643148	0.2705156857351			78.262754643148	19.892205602292		
95	78.262754643148	4.528242080901			78.262754643148	20.792904194607		
96	78.262754643148	4.8460996100061			78.262754643148	22.122652819609		
97	78.262754643148	0.7206318960261			78.262754643148	23.587700475174		
98	78.262754643148	4.5824198028816			78.262754643148	23.722504763672		
99	78.262754643148	51.0025656832827			78.262754643148	23.871948444464		
100	78.262754643148	30.8161342092944			78.262754643148	24.717094734053		
101	78.262754643148	0.3773752781754			78.262754643148	24.774617441983		
102	78.262754643148	50.4084425206675			78.262754643148	25.680922579441		
103	78.262754643148	4.660000000e-005			78.262754643148	25.733190729761		
104	82.231798386015	1.5061325584888			78.262754643148	26.952077859313		
105	82.231798386015	57.886779948119			78.262754643148	27.861777099567		
106	82.231798386015	1.4477147825937			78.262754643148	29.662184573073		
107	82.231798386015	52.842555530552			78.262754643148	31.300069230139		
108	82.231798386015	1.4135850565119			78.262754643148	31.352237263381		
109	82.231798386015	5.1611717102853			78.262754643148	32.195392417232		
110	82.231798386015	58.879950450481			78.262754643148	33.825640816817		

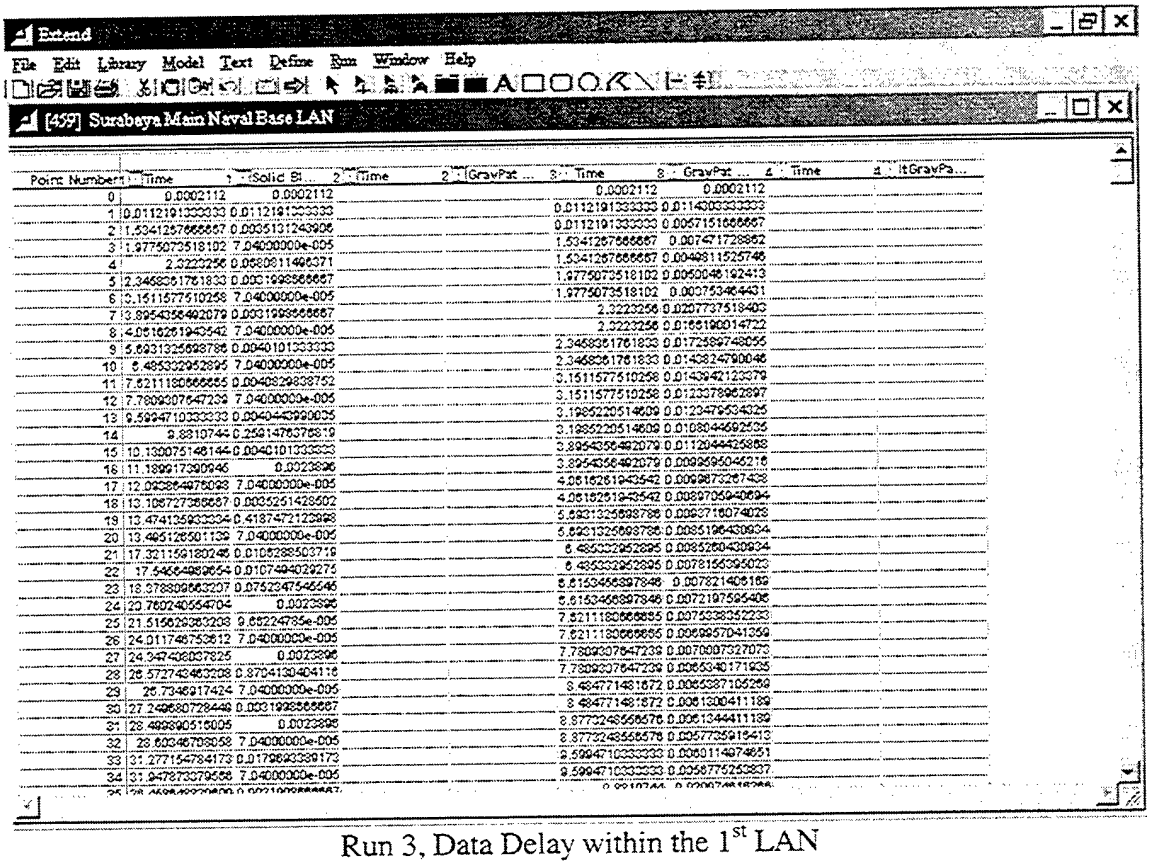




Run 2, Data Delay within the 6th LAN

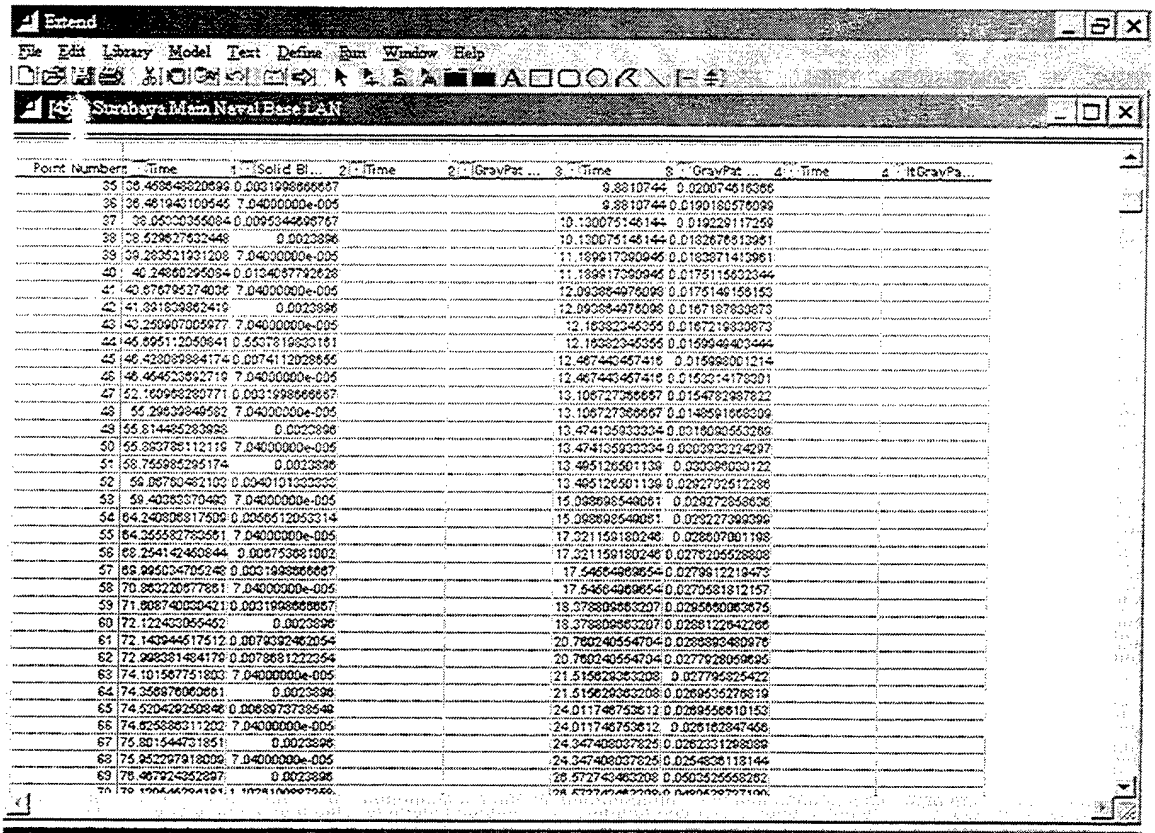


Run 3, The 1st LAN, Using Simulation Set Up 350, Mean 1 sec, T1 Line 1.544 Mbps

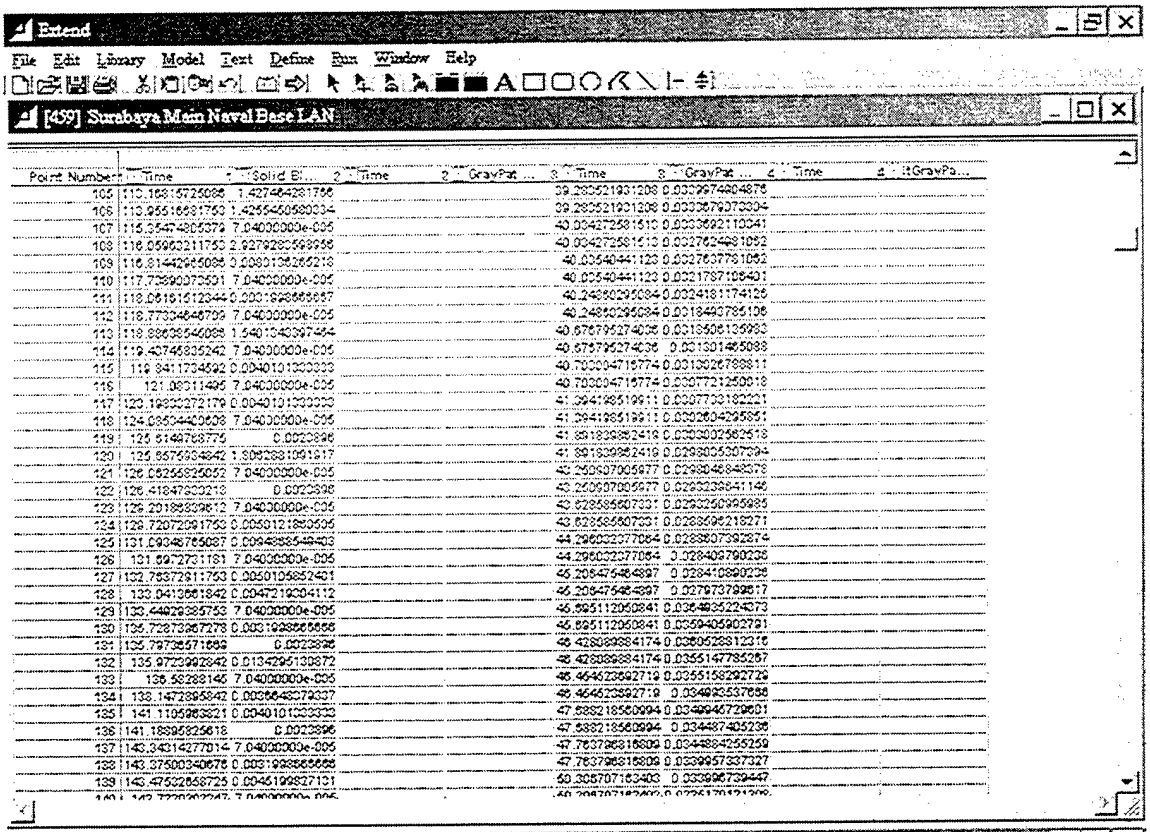


Point Number	Time	Solid Bl...	Time	GrayPat ...	Time	GrayPat ...	Time	ltGrayPa...
0	0.0002112	0.0002112			0.0002112	0.0002112		
1	0.0112191333333	0.0112191333333			0.0112191333333	0.0114303333333		
2	1.5341267666667	0.0035131243906			0.0112191333333	0.0057151666667		
3	1.9775073518102	7.04000000e-005			1.5341267666667	0.007471728862		
4	2.3223256	0.0680811496371			1.5341267666667	0.0049811525746		
5	2.3468361761833	0.0031998666667			1.9775073518102	0.0050046192413		
6	3.1511577510258	7.04000000e-005			1.9775073518102	0.003753464431		
7	3.8954356492079	0.0031998666667			2.3223256	0.0207737518403		
8	4.0616261943542	7.04000000e-005			2.3223256	0.0165190014722		
9	5.6931325698786	0.0040101333333			2.3468361761833	0.0172589748055		
10	6.485332952895	7.04000000e-005			2.3468361761833	0.0143824790046		
11	7.6211180666665	0.0040829838752			3.1511577510258	0.0143942123379		
12	7.7809307647239	7.04000000e-005			3.1511577510258	0.0123378962897		
13	9.5994710333333	0.0040443990035			3.1985220514609	0.0123479534325		
14	9.8810744	0.2591476376819			3.1985220514609	0.0108044692535		
15	10.130075146144	0.0040101333333			3.8954356492079	0.0112044425868		
16	11.189917390946	0.0023896			3.8954356492079	0.0099595046216		
17	12.093864976098	7.04000000e-005			4.0616261943542	0.0099873267438		
18	13.106727366667	0.0035251428502			4.0616261943542	0.0089705940694		
19	13.474135933334	0.4187472123998			5.6931325698786	0.0093716074028		
20	13.495126501139	7.04000000e-005			5.6931325698786	0.0085196430934		
21	17.321159180246	0.0106288503719			6.485332952895	0.0085260430934		
22	17.54564969654	0.0107494029275			6.485332952895	0.0078155395023		
23	18.378809663207	0.0752347545546			6.6153456897846	0.007821406169		
24	20.760240554704	0.0023896			6.6153456897846	0.0072197595406		
25	21.515629363208	9.66224785e-005			7.6211180666665	0.0075338352233		
26	24.011746753612	7.04000000e-005			7.6211180666665	0.0069957041359		
27	24.347408037825	0.0023896			7.7809307647239	0.0070007327073		
28	26.572743463208	0.8704130404116			7.7809307647239	0.0065340171935		
29	26.7346917424	7.04000000e-005			8.484771481672	0.0065387105269		
30	27.249680728449	0.0031998666667			8.484771481672	0.0061300411189		
31	28.499890516005	0.0023896			8.8773248556576	0.0061344411189		
32	28.60346708058	7.04000000e-005			8.8773248556576	0.0057735916413		
33	31.277154784173	0.0179693389173			9.5994710333333	0.0060114974651		
34	31.947873379566	7.04000000e-005			9.5994710333333	0.0056775253837		
35	[illegible]	[illegible]			[illegible]	[illegible]		

Run 3, Data Delay within the 1st LAN



Point Numbers	Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ItGrayPa...
35	36.468648820699	0.0031998666667			9.88107744	0.0200746166366		
36	36.461943109545	7.040000000e-005			9.88107744	0.0190180576099		
37	36.0500355084	0.0095344698767			10.130075146144	0.019229117259		
38	36.529627632448	0.0023896			10.130075146144	0.0182676813951		
39	39.283521931208	7.040000000e-005			11.189917390945	0.0183871413961		
40	40.248560295084	0.0134087792628			11.189917390945	0.0175115632344		
41	40.676795274036	7.040000000e-005			12.093864976098	0.0175149158153		
42	41.041839862419	0.0023896			12.093864976098	0.0167187833873		
43	42.250907005977	7.040000000e-005			12.183823456355	0.0167219333873		
44	46.69511205084	0.5507819833161			12.183823456355	0.0159946403444		
45	46.428089884174	0.0074112028555			12.467443457418	0.015998001214		
46	46.464523692719	7.040000000e-005			12.467443457418	0.0153014178001		
47	52.160958280771	0.0031998666667			13.106727356667	0.0154782987822		
48	55.29539349582	7.040000000e-005			13.106727356667	0.0148591668399		
49	55.814485283988	0.0023896			13.474135933334	0.0018090553289		
50	55.882785112179	7.040000000e-005			13.474135933334	0.0009932004297		
51	58.765985295174	0.0023896			13.495126501139	0.0009900030122		
52	59.057604621103	0.0040101333333			13.495126501139	0.0292702512286		
53	59.403833704403	7.040000000e-005			15.098998549051	0.0292728586636		
54	64.240806817509	0.0056512053214			15.098998549051	0.0292273999096		
55	64.365582780551	7.040000000e-005			17.021159180248	0.028607901198		
56	68.254142450844	0.0067533681002			17.021159180248	0.0276205528808		
57	68.995034705248	0.0031998666667			17.546549696554	0.027961221947		
58	70.860220577661	7.040000000e-005			17.546549696554	0.0270581812157		
59	71.808740030421	0.0031998666667			18.078809863207	0.0295650063675		
60	72.122403056452	0.0023896			18.078809863207	0.028812264266		
61	72.143944617512	0.0079329462054			20.760240554704	0.0288893480976		
62	72.998381484179	0.0078681222354			20.760240554704	0.0277928596496		
63	74.101567751803	7.040000000e-005			21.515629363208	0.027795825422		
64	74.358876060651	0.0023896			21.515629363208	0.0295352776819		
65	74.520429250846	0.0068973738548			24.011746753612	0.0295566810153		
66	74.625888311202	7.040000000e-005			24.011746753612	0.026162847466		
67	75.881544721851	0.0023896			24.347408037625	0.0262331268089		
68	75.952297918009	7.040000000e-005			24.347408037625	0.0254636118144		
69	78.467924652997	0.0023896			26.572743463208	0.0502525558262		
70	78.130545384181	1.1035199887258			26.572743463208	0.0489538737199		
71	78.507518015606	0.0023896			26.7346917424	0.0489558292754		
72	78.842192577651	7.040000000e-005			26.7346917424	0.0476328987545		
73	78.847642317514	2.1508992079077			27.077714719793	0.0476346014672		
74	79.500177047304	7.040000000e-005			27.077714719793	0.0462810593136		
75	80.137318717515	1.1446523514458			27.249680728449	0.0464652563311		
76	80.689032467764	7.040000000e-005			27.249680728449	0.0452739492467		
77	82.351514152005	0.0023896			28.499890516005	0.0453951210406		
78	83.093884230423	7.040000000e-005			28.499890516005	0.0442017430146		
79	86.60721929341	0.0023896			28.603467080558	0.0442035030146		
80	87.020612520603	0.0031998666667			28.603467080558	0.0431253687947		
81	87.021859264696	7.040000000e-005			29.292023238028	0.0431270859679		
82	88.595139784185	3.7718886157588			29.292023238028	0.0421002504901		
83	88.781478263575	0.0040101333333			29.759703879233	0.0421019266805		
84	89.237964732227	7.040000000e-005			29.759703879233	0.0411228121066		
85	92.534666912719	0.0023896			31.277154784173	0.0415407037093		
86	93.569916050635	7.040000000e-005			31.277154784173	0.0405965858068		
87	94.782227884186	0.0044041927326			31.947873379566	0.0405981968068		
88	95.27365661752	0.0084556097035			31.947873379566	0.0398960146555		
89	95.55681035724	7.040000000e-005			33.025002402588	0.039697579		
90	96.082713998844	0.0031998666667			33.025002402588	0.0388348825		
91	96.585023989265	7.040000000e-005			34.37321582708	0.0388361186848		
92	98.852046317522	1.3997697518847			34.37321582708	0.0380098182872		
93	99.259150259213	0.0031998666667			34.769796055066	0.0380113161596		
94	100.02431999376	0.0023896			34.769796055066	0.0372194137398		
95	101.00499020043	7.040000000e-005			36.468648820699	0.0372680776285		
96	101.03473647501	0.0031998666667			36.468648820699	0.0365251372687		
97	104.42909416108	0.0023896			36.461943109546	0.0365265740034		
98	105.26438051731	0.0031998666667			36.461943109546	0.0357980425233		
99	105.553772435557	7.040000000e-005			37.289215952017	0.0357974605233		
100	110.09256887071	0.0023896			37.289215952017	0.0350955397287		
101	110.402198784919	1.3990366061408			38.05330355084	0.0352824801146		
102	111.5778324938	7.040000000e-005			38.05330355084	0.0346039806893		
103	112.670826418171	0.0040101333333			38.529627632448	0.0346489345354		
104	112.93637701056	7.040000000e-005			38.529627632448	0.0339951621657		

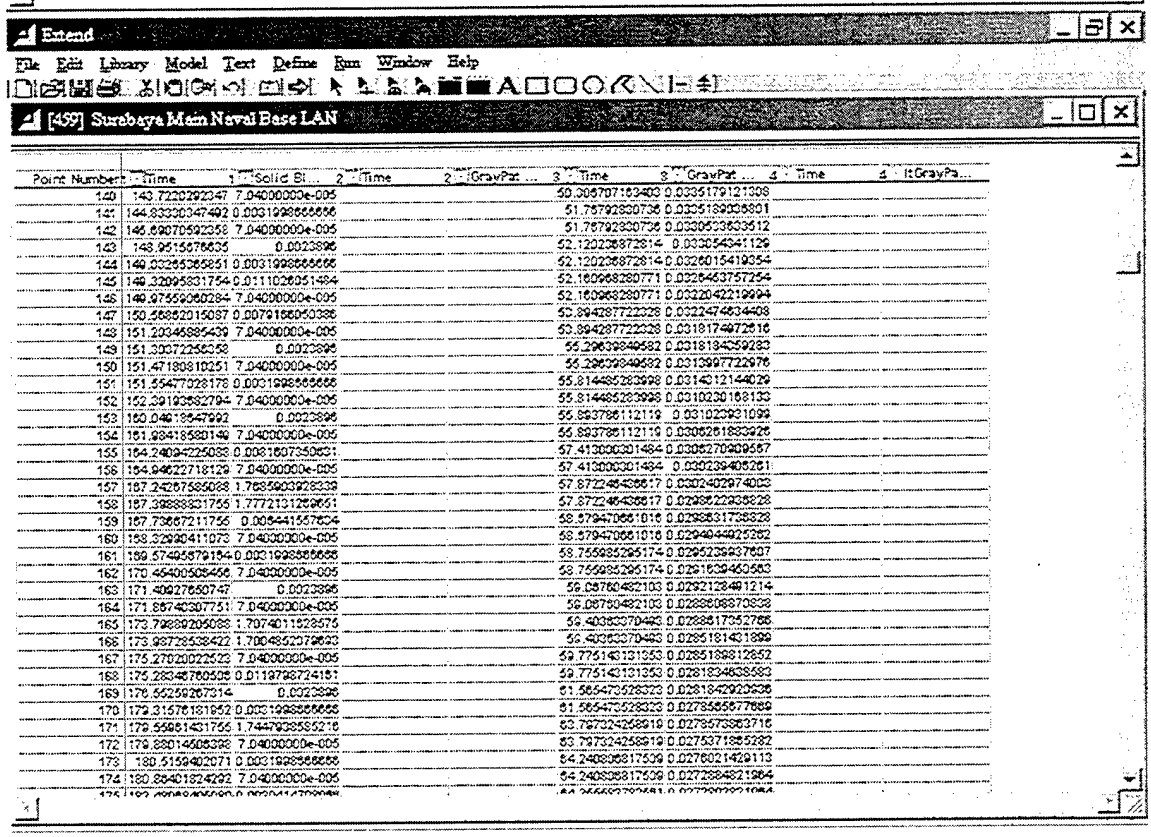


Extend

File Edit Library Model Text Define Run Window Help

[459] Surabaya Main Naval Base LAN

Point Number	Time 1	Solid Bl... 2	Time 2	GravPat ... 3	Time 3	GravPat ... 4	Time 4	ItGravPa...
105	110.1681572508	1.427464281766			39.28052193120	0.033997448048		
106	110.9551668317	1.425545058034			39.28052193120	0.033997973034		
107	115.3547485379	7.040000000e-005			40.00427258161	0.033369211034		
108	116.0596321175	2.927928569856			40.00427258161	0.032762481052		
109	116.8144295086	0.008010565218			40.0054044112	0.032763778105		
110	117.7599007351	7.040000000e-005			40.00540441123	0.032178710640		
111	118.0618151234	0.000199866667			40.24850295094	0.032418117412		
112	118.7730464799	7.040000000e-005			40.24850295094	0.031849078510		
113	119.8963654089	1.540104097464			40.67679527403	0.031950613599		
114	119.4074683524	7.040000000e-005			40.67679527403	0.031301465088		
115	119.8411794592	0.004010133333			40.70000471577	0.031302678881		
116	121.08011495	7.040000000e-005			40.70000471577	0.030772125001		
117	120.1993272179	0.004010133333			41.09419851991	0.030773018222		
118	124.0850444206	7.040000000e-005			41.09419851991	0.030260429585		
119	125.5144768775	0.0023896			41.89189982419	0.030030582513		
120	125.8575934842	1.936288109317			41.89189982419	0.029805307394		
121	126.0826585052	7.040000000e-005			42.25087005977	0.029804884878		
122	126.4184783219	0.0023896			42.25087005977	0.029323864146		
123	126.2918883896	7.040000000e-005			42.62858607031	0.029325099585		
124	128.7207209176	0.005012186059			42.62858607031	0.028860218271		
125	131.0934875508	0.009488548403			44.29602377064	0.028807392874		
126	131.5972731181	7.040000000e-005			44.29602377064	0.028409790235		
127	132.7837291753	0.005010585240			45.20547464997	0.028410890208		
128	133.0413661842	0.004721903411			45.20547464997	0.027973998617		
129	133.4492985753	7.040000000e-005			45.59511205084	0.027496524207		
130	135.7287396778	0.003199866666			45.59511205084	0.027059057911		
131	135.7973857169	0.0023896			46.42808984174	0.026952881231		
132	135.9722992842	0.013429513872			46.42808984174	0.026514785267		
133	136.582881145	7.040000000e-005			46.46452392719	0.026515829272		
134	138.1472956842	0.005664537037			46.46452392719	0.026079537668		
135	141.1105963821	0.004010133333			47.68821856099	0.025949672901		
136	141.1899825618	0.0023896			47.68821856099	0.025497405208		
137	143.3431427701	7.040000000e-005			47.76379616809	0.025486425259		
138	143.3750034067	0.003199866666			47.76379616809	0.025057337327		
139	143.4752268725	0.004519932101			50.30570716340	0.025096739447		



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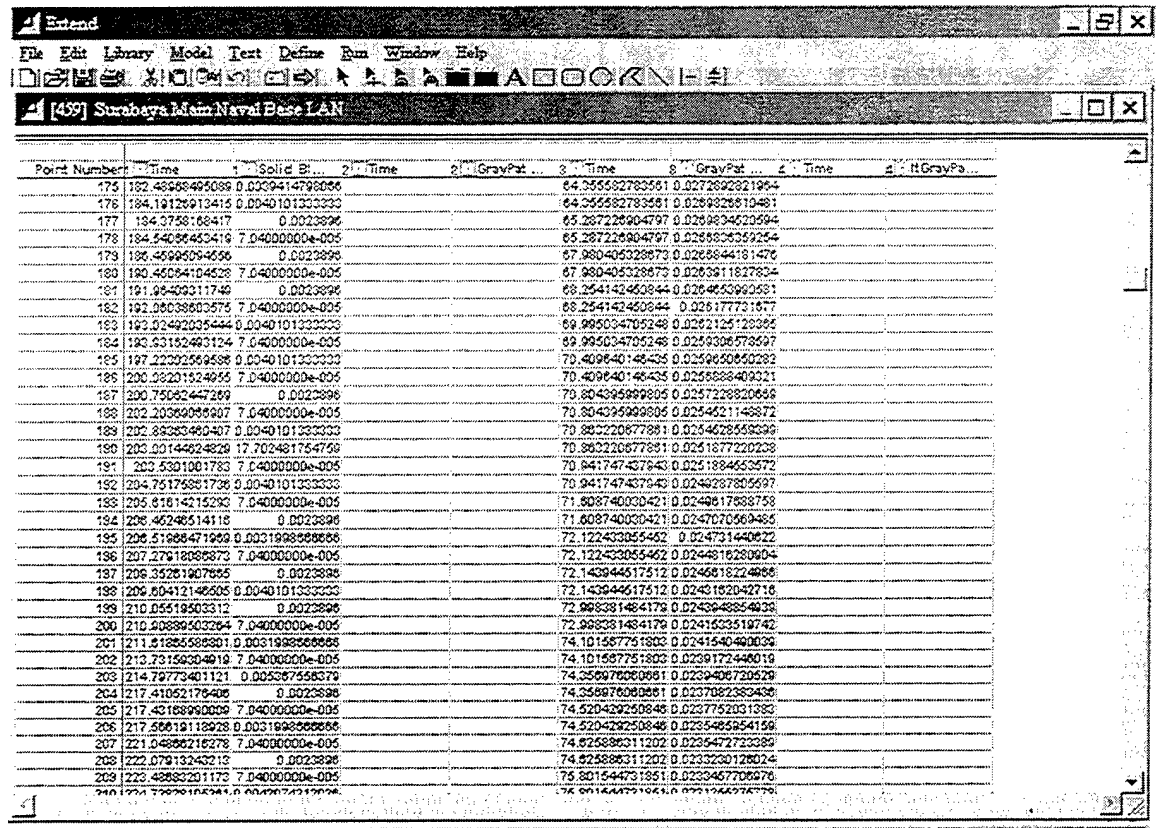
File Edit Library Model Text Define Run Window Help

[459] Surabaya Main Naval Base LAN

Point Number	Time 1	Solid Bl... 2	Time 2	GravPat ... 3	Time 3	GravPat ... 4	Time 4	ItGravPa...
140	143.7220292347	7.040000000e-005			50.30570716340	0.025179121308		
141	144.8330034749	0.003199866666			51.75792830736	0.025189056801		
142	146.6907059235	7.040000000e-005			51.75792830736	0.024805603512		
143	148.9515676635	0.0023896			52.12023687281	0.024554341129		
144	149.0326536851	0.003199866666			52.12023687281	0.024601541905		
145	149.3209583175	0.011102665149			52.16096828077	0.024246375725		
146	149.9755906028	7.040000000e-005			52.16096828077	0.023842219994		
147	150.5685201508	0.007986503386			52.89428772202	0.023474634408		
148	151.2004588543	7.040000000e-005			52.89428772202	0.023181749726		
149	151.3007256058	0.0023896			55.29639849582	0.023181945928		
150	151.4718081025	7.040000000e-005			55.29639849582	0.023099722976		
151	151.5547702817	0.003199866666			55.81448528399	0.023142124402		
152	152.3919358279	7.040000000e-005			55.81448528399	0.023023016813		
153	160.0401954799	0.0023896			56.89378611211	0.023023921099		
154	161.9841858814	7.040000000e-005			56.89378611211	0.023052180392		
155	164.2409422508	0.008160735063			57.41300030148	0.023052709567		
156	164.9462271812	7.040000000e-005			57.41300030148	0.023023405261		
157	167.2425785806	1.768590392833			57.87224640867	0.023024029740		
158	167.3888831755	1.777213129965			57.87224640867	0.024952293852		
159	167.7366721175	0.005441557604			58.57947066106	0.025053178852		
160	168.3289041107	7.040000000e-005			58.57947066106	0.025404425262		
161	169.5749587915	0.003199866666			58.75598529517	0.025423593760		
162	170.4640050546	7.040000000e-005			58.75598529517	0.025163946058		
163	171.4092765074	0.0023896			59.08760482103	0.025212846121		
164	171.8574038775	7.040000000e-005			59.08760482103	0.025686068708		
165	173.7989920508	1.797401152857			59.40353079483	0.025681754527		
166	173.9872853842	1.780485279623			59.40353079483	0.025618140189		
167	175.2702002523	7.040000000e-005			59.77514131353	0.025618981265		
168	175.2834876050	0.011979874151			59.77514131353	0.025184368583		
169	179.5625267314	0.0023896			61.56547528323	0.025184292063		
170	179.3157618195	0.003199866666			61.56547528323	0.027356557669		
171	179.5596143175	1.744793853216			63.79732456919	0.027957383716		
172	179.8801450639	7.040000000e-005			63.79732456919	0.027537185528		
173	180.5159402071	0.003199866666			64.24089617539	0.027602142911		
174	180.8640182429	7.040000000e-005			64.24089617539	0.027298482196		



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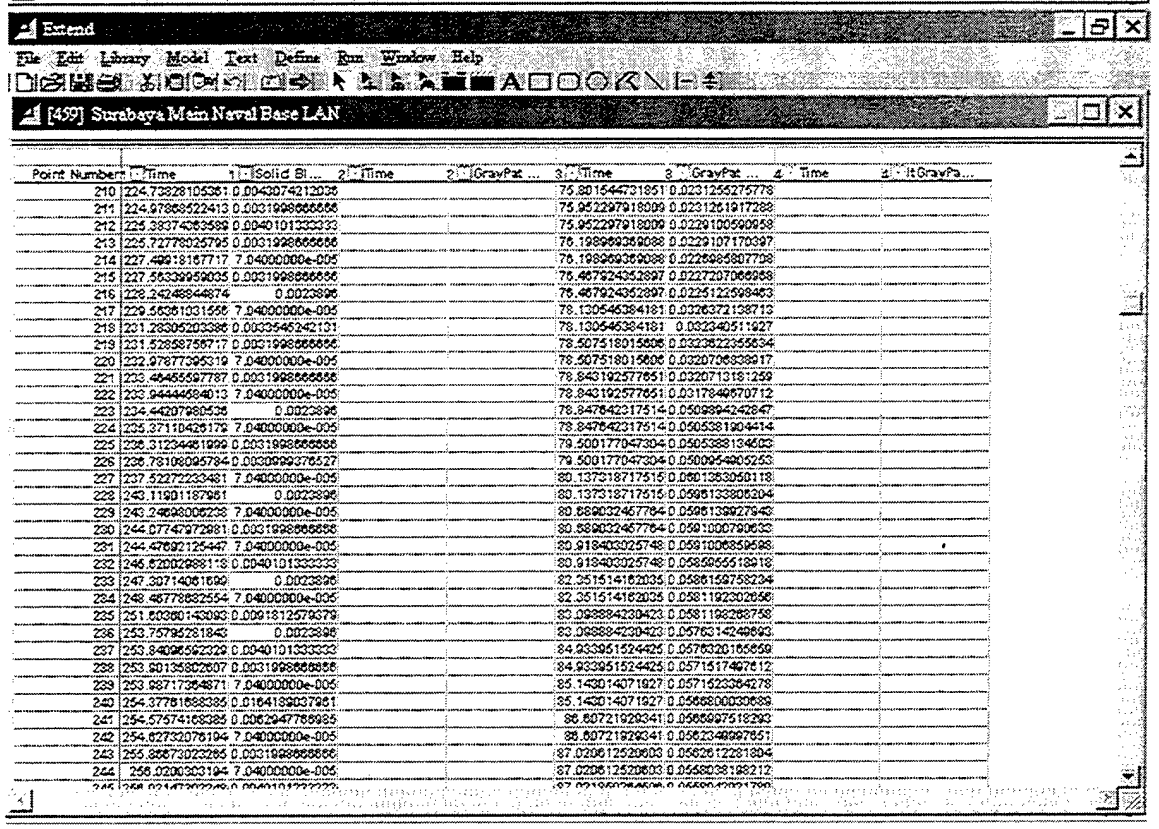
File Edit Library Model Text Define Run Window Help

[459] Surabaya Main Naval Base LAN

Point Number	1 Time	1 Solid Bl...	2 Time	2 GravPat ...	3 Time	3 GravPat ...	4 Time	4 ItGravPa...
175	182.48968495089	0.0039414798656			64.0555827835611	0.0272692821964		
176	184.19126913415	0.0040101333333			64.0555827835611	0.0269326810481		
177	184.2758168417	0.0023896			65.287226904797	0.0269834520594		
178	184.54056453419	7.04000000e-005			65.287226904797	0.0268935359254		
179	186.4599509456	0.0023896			67.9804065328573	0.0268644181476		
180	190.46084104528	7.04000000e-005			67.9804065328573	0.0263911827834		
181	191.99409311749	0.0023896			68.2541424608644	0.0264650993581		
182	192.08038603575	7.04000000e-005			68.2541424608644	0.0261777731617		
183	192.02492035444	0.0040101333333			69.9950947052481	0.0262125720386		
184	192.63152493124	7.04000000e-005			69.9950947052481	0.0259306578597		
185	197.22292569598	0.0040101333333			70.4096401464351	0.0259650650282		
186	200.08201524955	7.04000000e-005			70.4096401464351	0.0256668409321		
187	200.75082447269	0.0023896			70.8043959999805	0.0257228320668		
188	202.20089059907	7.04000000e-005			70.8043959999805	0.0254621146872		
189	202.89383460407	0.0040101333333			70.9822206777851	0.0254628559399		
190	203.00144624829	17.7024817547591			70.9822206777851	0.0251877220238		
191	203.53910017831	7.04000000e-005			70.9417474378431	0.0251884453572		
192	204.75175881736	0.0040101333333			70.9417474378431	0.0249287805697		
193	205.61614215293	7.04000000e-005			71.6087400304211	0.0249617888758		
194	206.4624851411	0.0023896			71.6087400304211	0.0247070569485		
195	206.51966471969	0.0031998666666			72.1224338554621	0.0247314406221		
196	207.27918086873	7.04000000e-005			72.1224338554621	0.0244816280904		
197	208.35261907655	0.0023896			72.1439445175121	0.0246818224956		
198	209.60412146505	0.0040101333333			72.1439445175121	0.0243152042716		
199	210.05519503312	0.0023896			72.9983814841791	0.0243948854939		
200	210.90889503264	7.04000000e-005			72.9983814841791	0.0241653519742		
201	211.51855586801	0.0031998666666			74.1015877518031	0.0241540490029		
202	213.73159304919	7.04000000e-005			74.1015877518031	0.0239172446019		
203	214.79773401121	0.0053575586379			74.2569765068661	0.0239406720529		
204	217.41052176406	0.0023896			74.2569765068661	0.0237082383436		
205	217.43168990009	7.04000000e-005			74.5204292508461	0.0237752031383		
206	217.56619118928	0.0031998666666			74.5204292508461	0.0235485954159		
207	221.04866215278	7.04000000e-005			74.5258963112021	0.0235472733389		
208	222.07913243213	0.0023896			74.5258963112021	0.0233280128024		
209	223.48883201173	7.04000000e-005			75.8015447318511	0.0233467706976		



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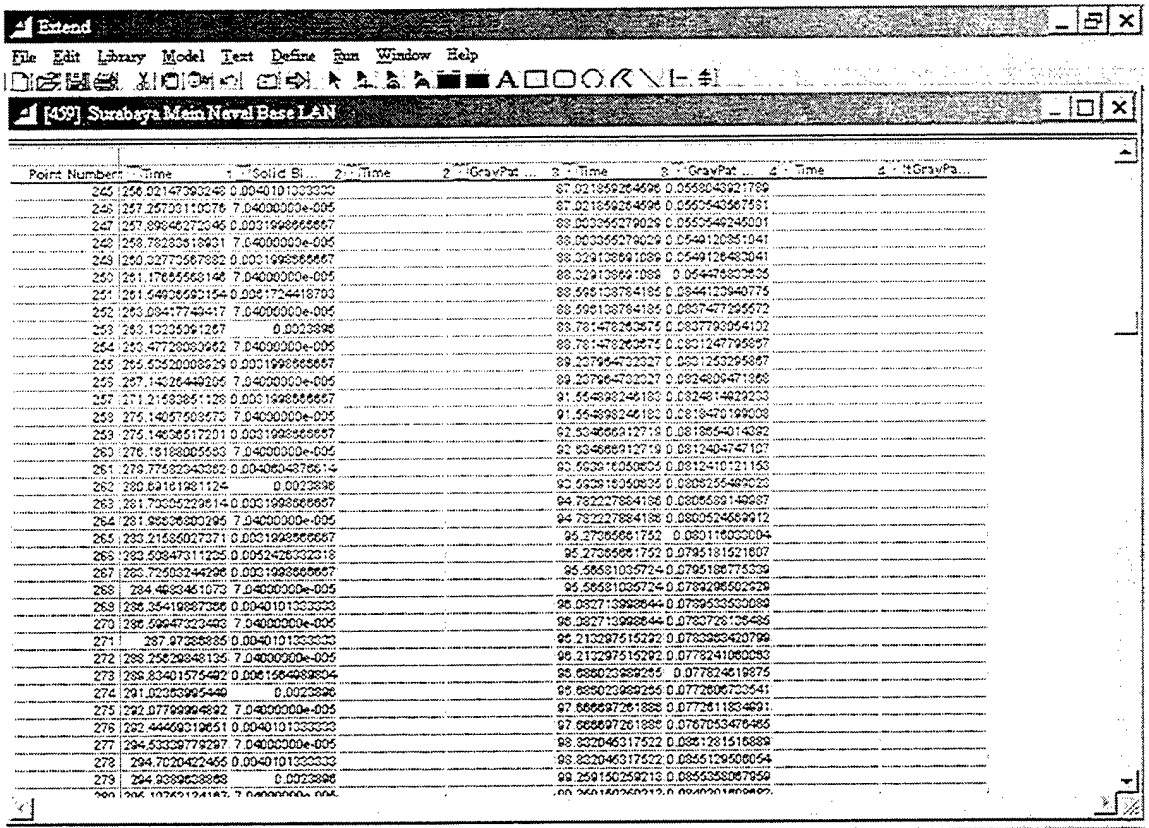
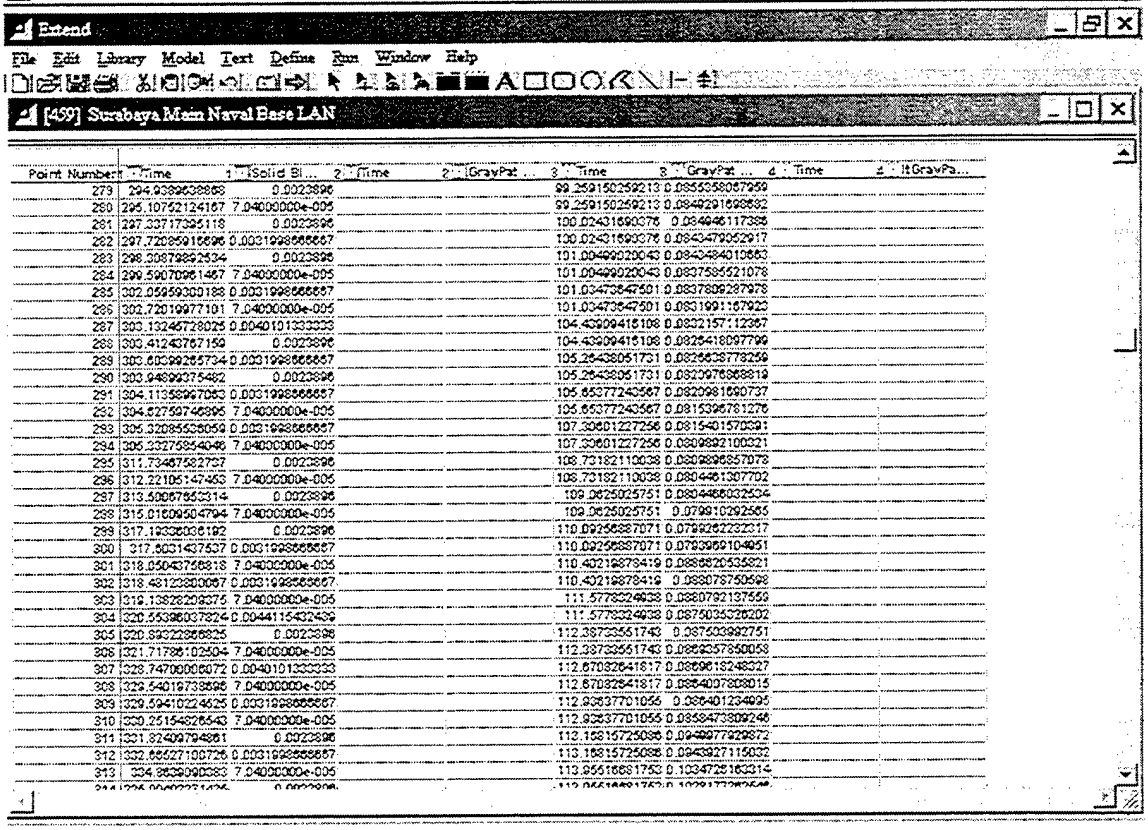
File Edit Library Model Text Define Run Window Help

[459] Surabaya Main Naval Base LAN

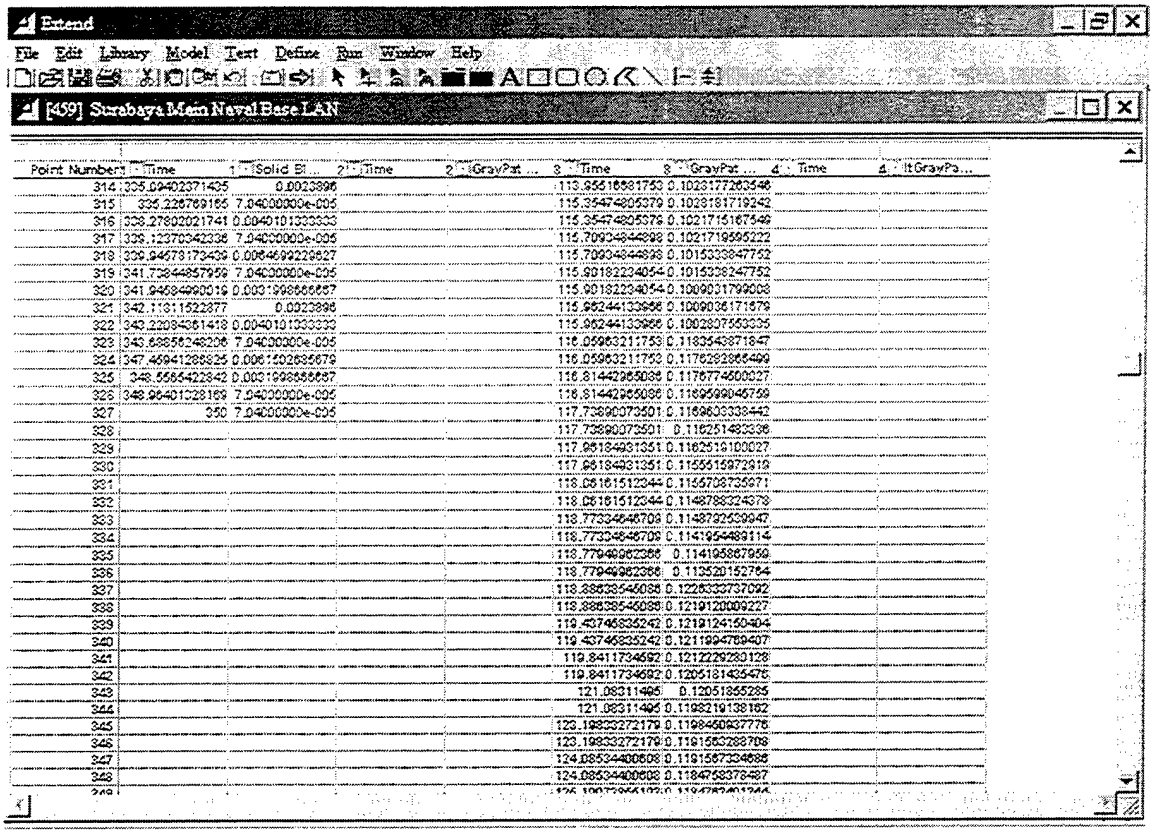
Point Number	1 Time	1 Solid Bl...	2 Time	2 GravPat ...	3 Time	3 GravPat ...	4 Time	4 ItGravPa...
210	224.73828105351	0.0043074212036			75.8015447318511	0.0231255275778		
211	224.97868522413	0.0031998666666			75.9522979189099	0.0231261917288		
212	225.38374063589	0.0040101333333			75.9522979189099	0.0229100590659		
213	225.72778025795	0.0031998666666			76.1989693589088	0.0229107170397		
214	227.4991816717	7.04000000e-005			76.1989693589088	0.0226868807708		
215	227.56339959035	0.0031998666666			76.4679245452897	0.0227207066658		
216	228.24248944874	0.0023896			76.4679245452897	0.0225122598453		
217	229.56361031556	7.04000000e-005			78.1305463841811	0.0226372138713		
218	231.28305203386	0.0033545242131			78.1305463841811	0.0223405111927		
219	231.5285875717	0.0031998666666			78.5075180156061	0.0223622356534		
220	232.97877395319	7.04000000e-005			78.5075180156061	0.0220706338917		
221	233.46485597787	0.0031998666666			78.8431925778511	0.0220713161259		
222	233.94444684013	7.04000000e-005			78.8431925778511	0.0217849670712		
223	234.44207980536	0.0023896			78.8478423175141	0.0509894242847		
224	235.37118425179	7.04000000e-005			78.8478423175141	0.0505381904414		
225	236.31234461999	0.0031998666666			79.5001770473041	0.0505388134603		
226	236.78108095784	0.0030999376527			79.5001770473041	0.0500954805253		
227	237.52272233481	7.04000000e-005			80.1373187175151	0.0501363050118		
228	240.11901187951	0.0023896			80.1373187175151	0.0498133805204		
229	240.24698065238	7.04000000e-005			80.5890324577841	0.0498139927943		
230	244.07749729881	0.0031998666666			80.5890324577841	0.0491000790633		
231	244.47692125447	7.04000000e-005			80.9184030257481	0.0491006859588		
232	246.62002988118	0.0040101333333			80.9184030257481	0.0488595518918		
233	247.30714061699	0.0023896			82.3515141620351	0.0488159758234		
234	248.46778692554	7.04000000e-005			82.3515141620351	0.0481192302656		
235	251.60366143093	0.0091812579379			83.0988842304231	0.0481198268758		
236	253.75795261843	0.0023896			83.0988842304231	0.0476314246893		
237	253.84096592229	0.0040101333333			84.933951524425	0.0476320155659		
238	253.90135802607	0.0031998666666			84.933951524425	0.0471517497612		
239	253.98717354871	7.04000000e-005			85.1430140771927	0.0471523364278		
240	254.37761558385	0.0164185037951			85.1430140771927	0.0466800330689		
241	254.57574168385	0.0062947765985			86.6072192930341	0.0466807518293		
242	254.62732076194	7.04000000e-005			86.6072192930341	0.0462349997651		
243	255.88573023285	0.0031998666666			87.0206125209603	0.0462612261804		
244	256.0200303194	7.04000000e-005			87.0206125209603	0.0458038198212		



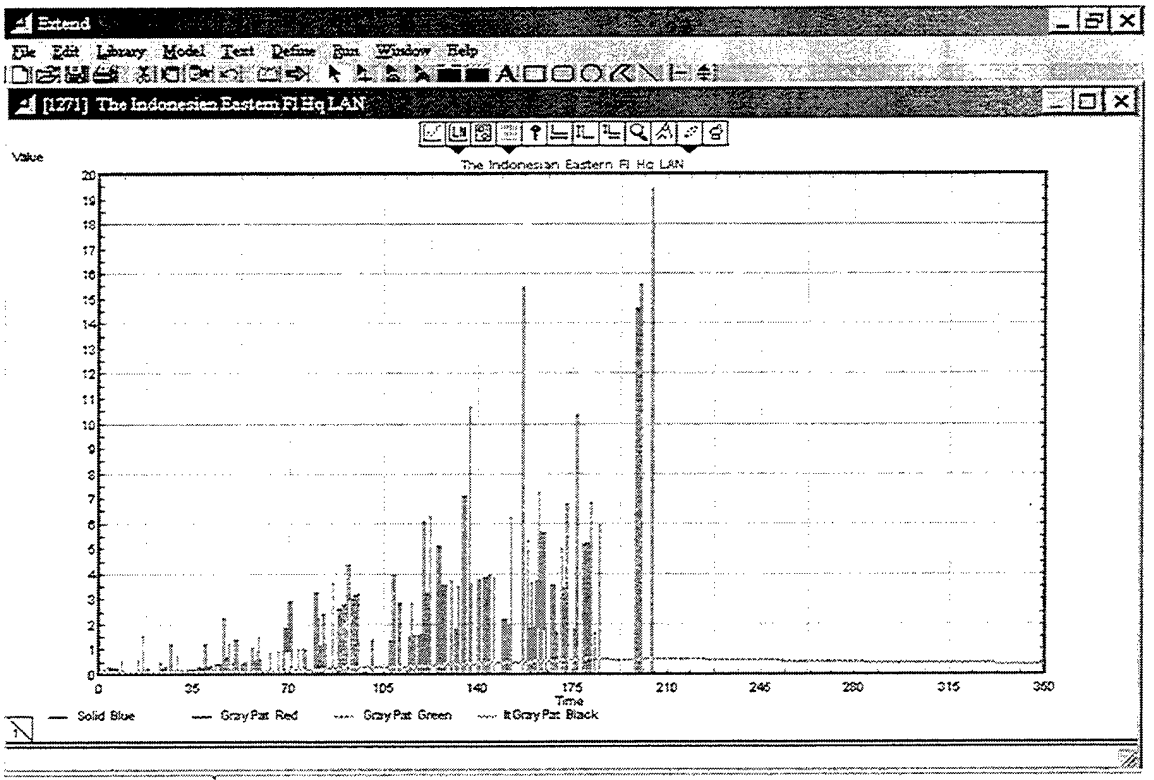
Point Number	1 Time	1 Solid Bl...	2 Time	2 GravPat ...	3 Time	3 GravPat ...	4 Time	4 tGravPa...
245	256.02147393248	0.00401013333333			87.021859264696	0.055804392178		
246	257.25703110076	7.04000000e-005			87.021859264696	0.055054367591		
247	257.8984627204	0.00319986666667			88.003956279029	0.055054924500		
248	258.78283618931	7.04000000e-005			88.003956279029	0.054912085104		
249	259.02773667882	0.00319986666667			88.029139691089	0.054912848304		
250	261.17655568146	7.04000000e-005			88.029139691089	0.054478808635		
251	261.54936592154	0.00617244418703			88.598139784185	0.084412394077		
252	263.09417749417	7.04000000e-005			88.598139784185	0.083747295572		
253	263.13225391257	0.0023896			89.781478263675	0.083779305410		
254	263.47728083662	7.04000000e-005			89.781478263675	0.083124779595		
255	265.50520008629	0.00319986666667			89.207964733327	0.083125329586		
256	267.14264449205	7.04000000e-005			89.207964733327	0.082480947186		
257	271.21589851128	0.00319986666667			91.554893246180	0.082481482923		
258	275.14057509573	7.04000000e-005			91.554893246180	0.081847019900		
259	275.14656517201	0.00319986666667			92.934666912719	0.081865401438		
260	276.19188005583	7.04000000e-005			92.934666912719	0.081240474107		
261	279.77582940362	0.00406043766614			93.593915058635	0.081241012115		
262	280.69161981124	0.0023896			93.593915058635	0.080625548902		
263	281.70056229614	0.00319986666667			94.782227884186	0.080658914998		
264	281.99526800295	7.04000000e-005			94.782227884186	0.080052468991		
265	283.21566027371	0.00319986666667			95.27066661752	0.080116033004		
266	283.50847311225	0.00524263022018			95.27066661752	0.079518152160		
267	283.72503244296	0.00319986666667			95.566810357241	0.079519877539		
268	284.4683461073	7.04000000e-005			95.566810357241	0.078929655229		
269	285.35419887366	0.00401013333333			96.082713998644	0.078955350089		
270	285.99947323498	7.04000000e-005			96.082713998644	0.078372810485		
271	287.973885885	0.00401013333333			96.213297515292	0.078396834207		
272	288.25629848135	7.04000000e-005			96.213297515292	0.077824106053		
273	288.83401575492	0.00615649389804			96.686023989265	0.077824619875		
274	291.02353995449	0.0023896			96.686023989265	0.077260670541		
275	292.07799994892	7.04000000e-005			97.666697261888	0.077261183491		
276	292.44469219651	0.00401013333333			97.666697261888	0.076705347646		
277	294.53339779297	7.04000000e-005			98.822046317522	0.076512815168		
278	294.7020422466	0.00401013333333			98.822046317522	0.076512950605		
279	294.9389638868	0.0023896			99.259150259213	0.076558067959		



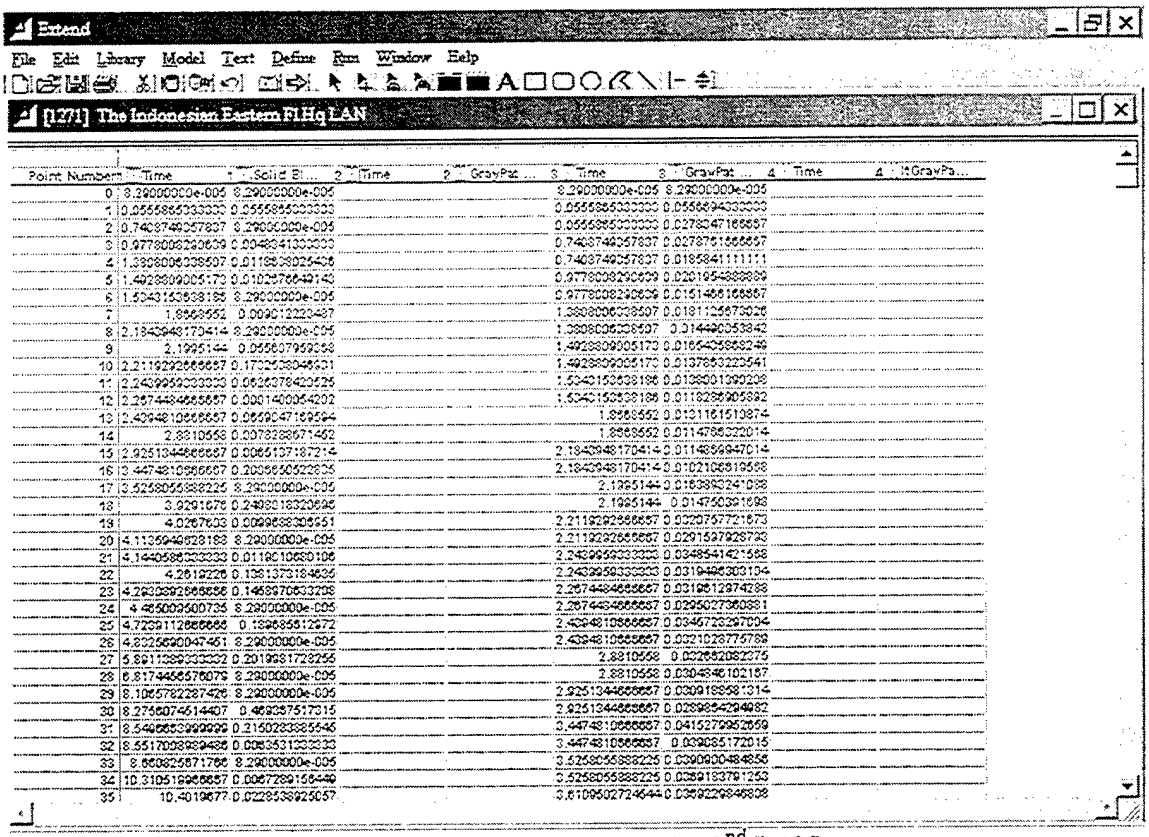
Point Number	1 Time	1 Solid Bl...	2 Time	2 GravPat ...	3 Time	3 GravPat ...	4 Time	4 tGravPa...
279	294.9389638868	0.0023896			99.259150259213	0.076558067959		
280	295.10752124167	7.04000000e-005			99.259150259213	0.076492916992		
281	297.33717395118	0.0023896			100.02431690376	0.076496117386		
282	297.72085916696	0.00319986666667			100.02431690376	0.076457905917		
283	298.20879892534	0.0023896			101.00499020043	0.076458401063		
284	299.59070961467	7.04000000e-005			101.00499020043	0.075795521078		
285	302.05959000188	0.00319986666667			101.03470547501	0.075780929778		
286	302.72019977101	7.04000000e-005			101.03470547501	0.075199157922		
287	303.13246728025	0.00401013333333			104.40909415106	0.075215712867		
288	303.41243767159	0.0023896			104.40909415106	0.075154180977		
289	303.60099265734	0.00319986666667			105.26438051731	0.075156387792		
290	303.94899375462	0.0023896			105.26438051731	0.075097666819		
291	304.11358997053	0.00319986666667			105.65377240567	0.075098615907		
292	304.62759746995	7.04000000e-005			105.65377240567	0.075539781276		
293	305.32085528059	0.00319986666667			107.30601227256	0.075540157059		
294	305.33275954046	7.04000000e-005			107.30601227256	0.076098921003		
295	311.70467582757	0.0023896			108.73182110038	0.076098957078		
296	312.22105147453	7.04000000e-005			108.73182110038	0.076044613077		
297	313.60067852314	0.0023896			109.0625025751	0.076044680324		
298	315.01609504794	7.04000000e-005			109.0625025751	0.079910292565		
299	317.19336036192	0.0023896			110.09256887071	0.079892232317		
300	317.60314437537	0.00319986666667			110.09256887071	0.079359104951		
301	318.05043756818	7.04000000e-005			110.40219878419	0.079868205358		
302	318.48123800067	0.00319986666667			110.40219878419	0.079078750598		
303	319.10826209375	7.04000000e-005			111.57783249038	0.079079213755		
304	320.55398007824	0.00441154324049			111.57783249038	0.078503536202		
305	320.89322866825	0.0023896			112.38733551743	0.078503992751		
306	321.71786102504	7.04000000e-005			112.38733551743	0.078525785005		
307	328.74700000072	0.00401013333333			112.67032641817	0.078696182483		
308	329.54019738696	7.04000000e-005			112.67032641817	0.078540078015		
309	329.59410224625	0.00319986666667			112.93637701055	0.078540123499		
310	329.75154826543	7.04000000e-005			112.93637701055	0.078547309246		
311	331.82409794861	0.0023896			113.16815725086	0.079497729872		
312	332.65527100726	0.00319986666667			113.16815725086	0.079392711503		
313	334.9639900883	7.04000000e-005			113.95516681753	0.103472516031		



Point Number	1 Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 ltGrayPa...
314	335.09402371435	0.0023896			113.95516681753	0.1023177263546		
315	335.226769165	7.04000000e-005			115.35474805379	0.1023181719242		
316	338.27802021741	0.0040101333333			115.35474805379	0.1021715167549		
317	339.12370342336	7.04000000e-005			115.70934844898	0.1021719595222		
318	339.94678173439	0.0064699229627			115.70934844898	0.1015333847752		
319	341.73844857959	7.04000000e-005			115.90182234054	0.1015338247752		
320	341.94584990019	0.0031998666667			115.90182234054	0.1009031799008		
321	342.11811522877	0.0023896			115.96244133966	0.1009036171679		
322	343.22084361418	0.0040101333333			115.96244133966	0.1002807553335		
323	343.68856248206	7.04000000e-005			116.05963211753	0.1183543871847		
324	347.46941286825	0.0061502685679			116.05963211753	0.1176292865499		
325	348.5565422842	0.0031998666667			116.81442965086	0.1176774600027		
326	348.96401328169	7.04000000e-005			116.81442965086	0.1169599046759		
327	350	7.04000000e-005			117.73890073501	0.1169603338442		
328					117.73890073501	0.116251483336		
329					117.96184931351	0.1162519100027		
330					117.96184931351	0.1155515972919		
331					118.06161512344	0.1155708735971		
332					118.06161512344	0.1148788324378		
333					118.77334646709	0.1148792539947		
334					118.77334646709	0.1141954489114		
335					118.77949962366	0.114195867959		
336					118.77949962366	0.113520152764		
337					118.88638546086	0.1226333737092		
338					118.88638546086	0.1219120009227		
339					119.43746835242	0.1219124150404		
340					119.43746835242	0.1211994769407		
341					119.8411734692	0.1212229280128		
342					119.8411734692	0.1205181435476		
343					121.08311495	0.12051855285		
344					121.08311495	0.1198219138162		
345					123.19833272179	0.1198450937776		
346					123.19833272179	0.1191563288708		
347					124.08534400608	0.1191567334686		
348					124.08534400608	0.1184758378487		
349					126.19073966102	0.1184762401244		

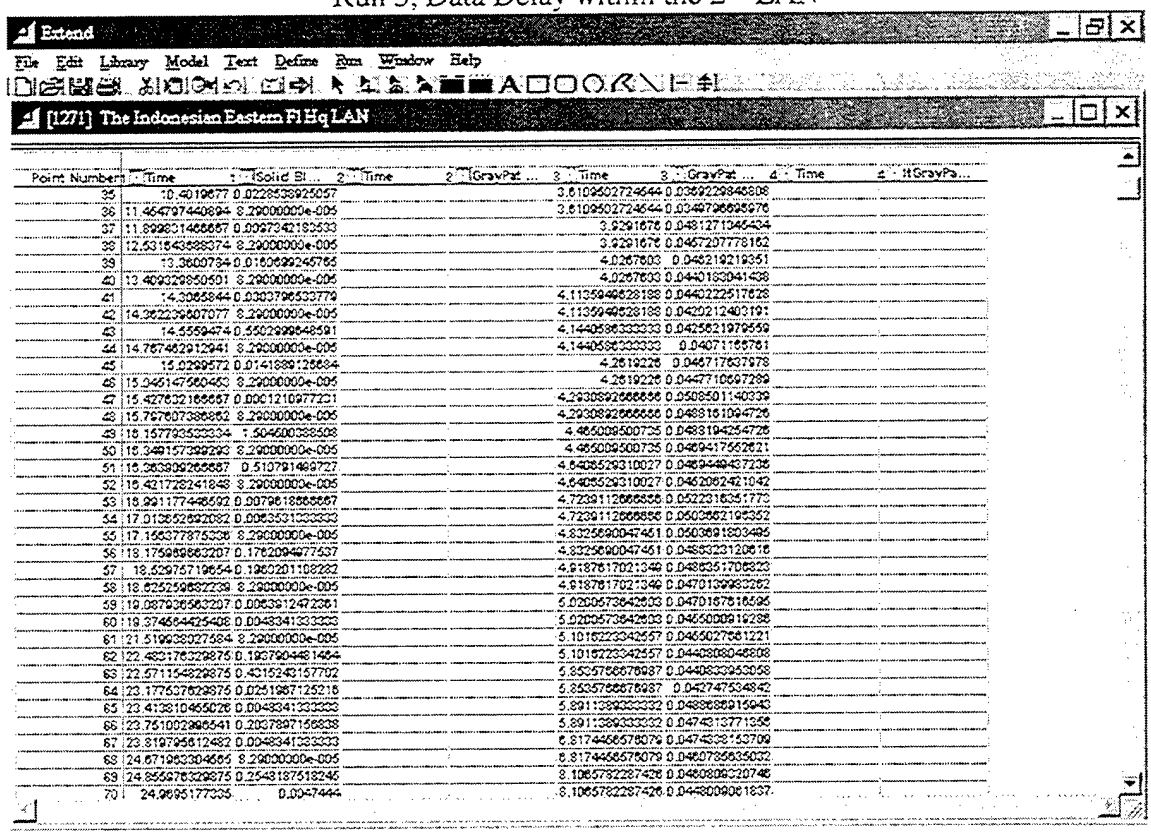


Run 3, The 2nd LAN, Using Simulation Set Up 350, Mean 1 sec, T1 Line 1.544 Mbps

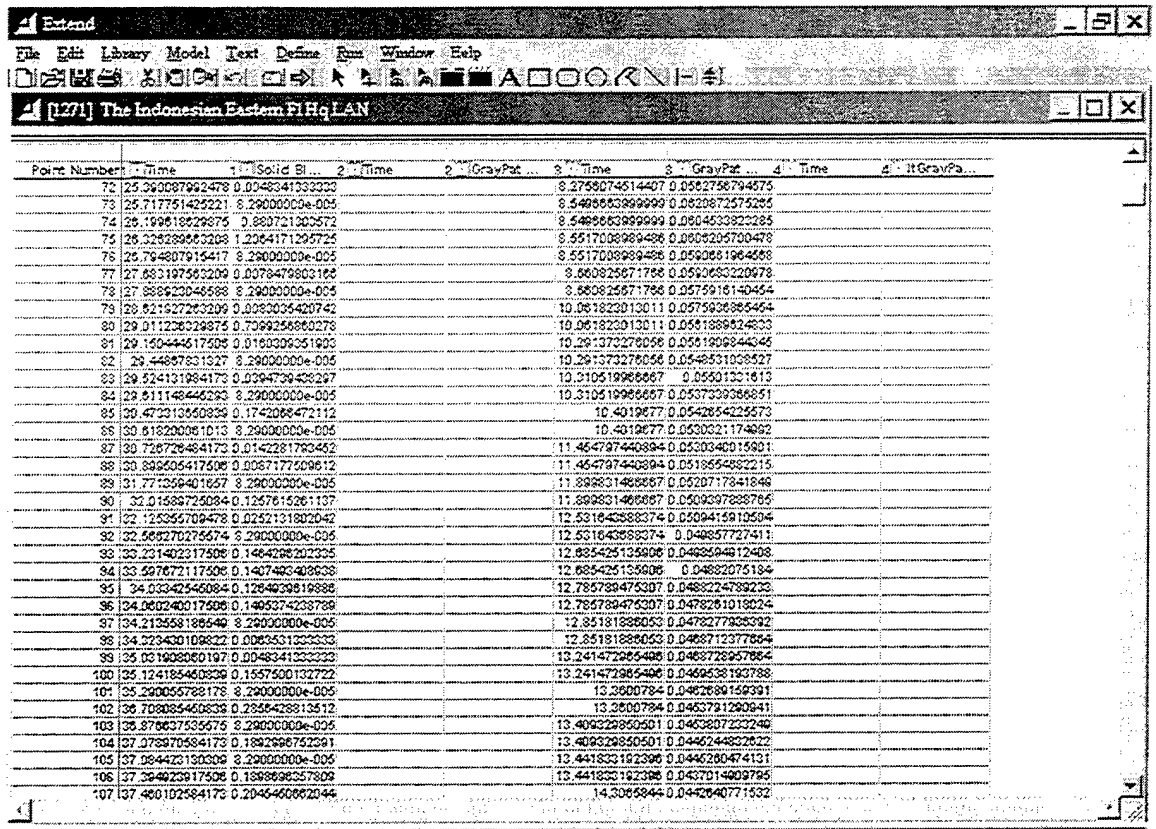


Point Number	Time 1	Solid Bl... 2	Time 2	GrayPat ...	Time 3	GrayPat ... 4	Time 4	#GrayPa...
0	8.29000000e-005	8.29000000e-005			8.29000000e-005	8.29000000e-005		
1	0.05558853333333	0.05558853333333			0.05558853333333	0.05558943333333		
2	0.7403749257837	8.29000000e-005			0.05558853333333	0.02783471666667		
3	0.9778088290609	0.00482413333333			0.7403749257837	0.02787511666667		
4	1.380680963638507	0.01188388325426			0.7403749257837	0.01858411111111		
5	1.492389090051173	0.01027664491433			0.9778088290609	0.02019548888889		
6	1.534215536381186	8.29000000e-005			0.9778088290609	0.01514661666667		
7	1.8668552	0.00901222348?			1.380680963638507	0.01811256753026		
8	2.184094817704143	8.29000000e-005			1.380680963638507	0.01449005384?		
9	2.1995144	0.05560795958?			1.492389090051173	0.01664056662?49		
10	2.211929266666667	0.17225804466?1			1.492389090051173	0.01378532235?1		
11	2.243999593333333	0.06262784?2525			1.534215536381186	0.01380013992?6		
12	2.267444866666667	0.00014000542?2			1.534215536381186	0.01182856?5892		
13	2.429481066666667	0.05590471892?4			1.8668552	0.01211615139?4		
14	2.88110568	0.09782886714?2			1.8668552	0.01147656220?4		
15	2.925134466666667	0.00651378721?4			2.184094817704143	0.01146599470?4		
16	3.447481066666667	0.20056305225?5			2.184094817704143	0.01021068195?8		
17	3.525805588822?5	8.29000000e-005			2.1995144	0.01535902419?8		
18	3.9291676	0.24982183209?6			2.1995144	0.01475039169?2		
19	4.0267603	0.00996883065?51			2.211929266666667	0.02207577215?3		
20	4.113594962818?3	8.29000000e-005			2.211929266666667	0.02915979287?3		
21	4.144058633333?3	0.01190106501?6			2.243999593333333	0.03485414215?8		
22	4.2619226	0.13613781846?5			2.243999593333333	0.03194963001?4		
23	4.293089266666?6	0.14689706332?8			2.267444866666667	0.03196129742?8		
24	4.465009500735	8.29000000e-005			2.267444866666667	0.02950277360?1		
25	4.723911266666?6	0.19986561267?2			2.429481066666667	0.03467239270?4		
26	4.832569000474?1	8.29000000e-005			2.429481066666667	0.02210287757?9		
27	5.891139933333?2	0.20199817282?5			2.88110568	0.02265208227?5		
28	6.817446657607?9	8.29000000e-005			2.88110568	0.03048461021?7		
29	8.106578222874?6	8.29000000e-005			2.925134466666667	0.03091896811?4		
30	8.276507454144?7	9.46903751?7315			2.925134466666667	0.02985429498?2		
31	8.549666339999?9	0.21502838355?6			3.447481066666667	0.04152795?2659		
32	8.551700389894?6	0.00863631333?3			3.447481066666667	0.03908517?2015		
33	8.868025871?66	8.29000000e-005			3.525805588822?5	0.03909004846?6		
34	10.31051996666?7	0.00672891564?9			3.525805588822?5	0.03918379?1?53		
35	10.4019677	0.02285389?5057			3.610950?2724644	0.03692?29846?08		

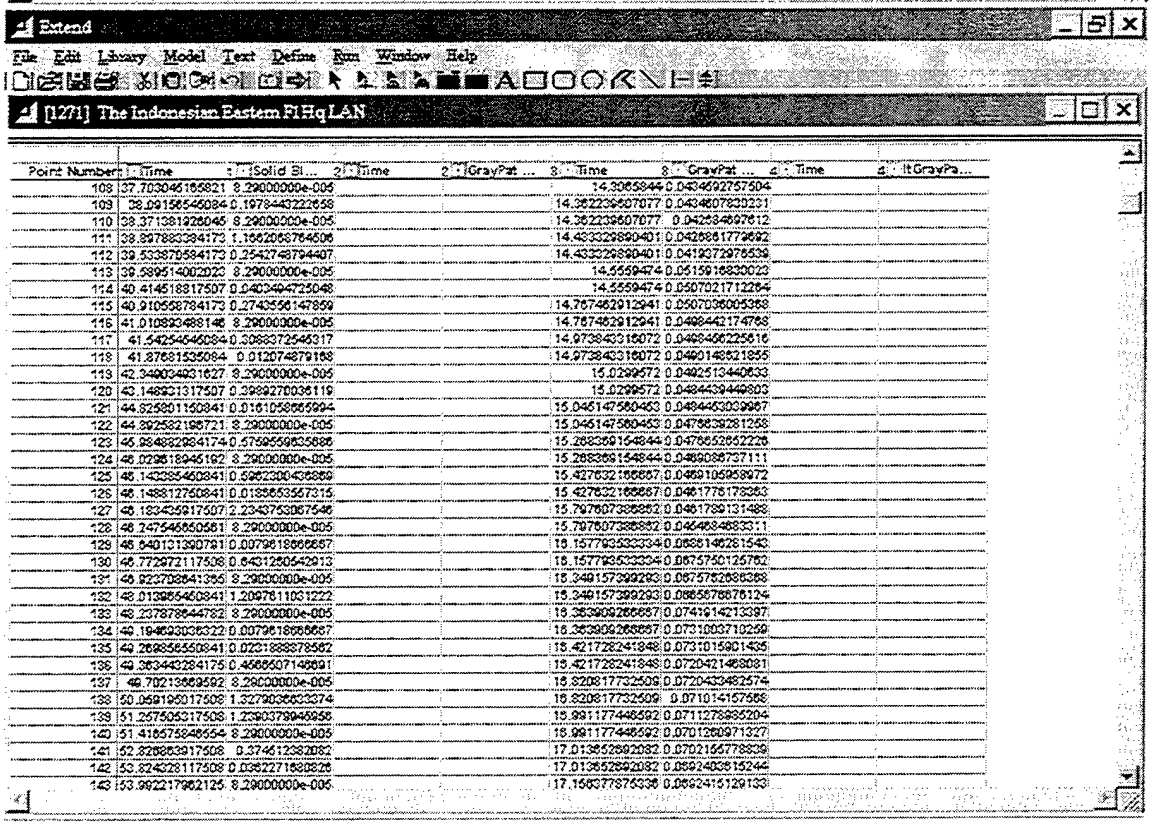
Run 3, Data Delay within the 2nd LAN



Point Number	Time 1	Solid Bl... 2	Time 2	GrayPat ...	Time 3	GrayPat ... 4	Time 4	#GrayPa...
35	10.4019677	0.02285389?5057			3.610950?2724644	0.03692?29846?08		
36	11.464797440894	8.29000000e-005			3.610950?2724644	0.03497?06695?76		
37	11.899801466667	0.00973421?2533			3.9291676	0.04812?10466?24		
38	12.531543588374	8.29000000e-005			3.9291676	0.04572?77?7162		
39	13.3600784	0.18069924?5?65			4.0267603	0.04821921?351		
40	13.409329850501	8.29000000e-005			4.0267603	0.04401820?41?36		
41	14.3065844	0.03037965337?9			4.113594962818?3	0.04402225?17?28		
42	14.362239607077	8.29000000e-005			4.113594962818?3	0.04202124?3?91		
43	14.5559474	0.55022996?48?91			4.144058633333?3	0.04256219?9?559		
44	14.787462912941	8.29000000e-005			4.144058633333?3	0.04071165?781		
45	15.02299572	0.01418891?26?84			4.2619226	0.04671?7637978		
46	15.046147560463	8.29000000e-005			4.2619226	0.04477?0697?89		
47	15.427832166667	0.00012109?7721			4.293089266666?6	0.05085?01?40339		
48	15.797607386862	8.29000000e-005			4.293089266666?6	0.04881?1094?26		
49	16.157793523334	1.50460033?8508			4.465009500735	0.04831?9425472?		
50	16.349157399293	8.29000000e-005			4.465009500735	0.04694?7552621		
51	16.563899265667	0.5107914997?7			4.6405529310027	0.04694?4?37236		
52	16.421728241848	8.29000000e-005			4.6405529310027	0.04520624?21042		
53	16.991177446692	0.00796188666?7			4.723911266666?6	0.05223?63517?3		
54	17.013652692092	0.00635312333?3			4.723911266666?6	0.05036521?6357		
55	17.156377875326	8.29000000e-005			4.832569000474?1	0.05036918?3485		
56	18.175989663207	0.17620947?7537			4.832569000474?1	0.04853231?0616		
57	18.529757179654	0.19022011?8282			4.918761702134?9	0.04853517?6823		
58	18.625259852239	8.29000000e-005			4.918761702134?9	0.04701399?3?67		
59	19.087936563207	0.00639124?2361			5.020057364263?3	0.04701875?6595		
60	19.374564425408	0.00483413333333			5.020057364263?3	0.04650009?19?88		
61	21.519938027584	8.29000000e-005			5.101522304255?7	0.04650275?61?21		
62	22.483176229875	0.19979044?1464			5.101522304255?7	0.04498?0?046?08		
63	22.571154229875	0.42152431?7702			5.8535?566?6987	0.04498?0?53?58		
64	23.177537229875	0.02519871?25?16			5.8535?566?6987	0.04274?534842		
65	23.413810465026	0.00483413333333			5.891139933333?2	0.04886?8?915943		
66	23.751009296541	0.20078971?66?38			5.891139933333?2	0.04743137?1?56		
67	23.819795612482	0.00483413333333			6.817446657607?9	0.04745?3?153?09		
68	24.671993084666	8.29000000e-005			6.817446657607?9	0.04607?35?35?32		
69	24.955878329875	0.25481875?8246			8.106578222874?6	0.04608?9?207?46		
70	24.9695177335	0.0047444			8.106578222874?6	0.04480?9?61637		



Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ItGrayPa...
72	25.990087992478	0.004834133333			8.2758074514407	0.0562756794575		
73	25.717751425221	8.29000000e-005			8.5486653999999	0.0620872575265		
74	25.199518529875	0.89072130357			8.5486653999999	0.0604533822285		
75	26.326289553208	1.2064171295725			8.5517008989486	0.0606205700478		
76	25.794807915417	8.29000000e-005			8.5517008989486	0.0590661964568		
77	27.683197563209	0.007847980316			8.560825671756	0.0592693220978		
78	27.998620045588	8.29000000e-005			8.560825671756	0.0575916140454		
79	28.521927263209	0.008003542074			10.061822013011	0.0575936865464		
80	29.011236029875	0.709925686078			10.061822013011	0.0561889524633		
81	29.150444517505	0.016039963193			10.291372276056	0.0561909844345		
82	29.44857831927	8.29000000e-005			10.291372276056	0.0546531038527		
83	29.524131984179	0.009473946267			10.310519966667	0.05501321613		
84	29.611148446283	8.29000000e-005			10.310519966667	0.0537339366851		
85	29.472313658339	0.174206647211			10.4019677	0.0542654225573		
86	30.618200061013	8.29000000e-005			10.4019677	0.0530021174992		
87	30.726726484173	0.014228178345			11.454797440894	0.0530040015901		
88	30.899205417508	0.008717750961			11.454797440894	0.0518654652215		
89	31.771259401667	8.29000000e-005			11.899831466667	0.0520717841849		
90	32.015897250841	0.125761526113			11.899831466667	0.0509297688765		
91	32.125355709478	0.025213180242			12.531643583374	0.0509415910504		
92	32.566270276574	8.29000000e-005			12.531643583374	0.0498577271411		
93	32.231402317508	0.146429620235			12.685425135906	0.0498594812408		
94	33.597672117506	0.140748408638			12.685425135906	0.0488207518484		
95	34.033425450841	0.126493619888			12.785789475307	0.0488224789235		
96	34.060240017506	0.149537423878			12.785789475307	0.0478261018024		
97	34.213558186549	8.29000000e-005			12.85181886053	0.0478277936392		
98	34.023430109822	0.006353123333			12.85181886053	0.0468712377654		
99	35.031908060197	0.004834133333			13.241472965486	0.0468728957864		
100	35.124185460839	0.155750013272			13.241472965486	0.0459038193788		
101	35.290055768178	8.29000000e-005			13.3600784	0.0462689159391		
102	36.708085460839	0.285642881351			13.3600784	0.0453791290941		
103	36.879607535575	8.29000000e-005			13.409329850501	0.0453807232249		
104	37.078970584173	0.189259675291			13.409329850501	0.0444248826822		
105	37.094423193099	8.29000000e-005			13.441833192396	0.0444260474131		
106	37.294923917506	0.189869635789			13.441833192396	0.0437014909795		
107	37.480102584173	0.204546066204			14.3065844	0.0442640771532		



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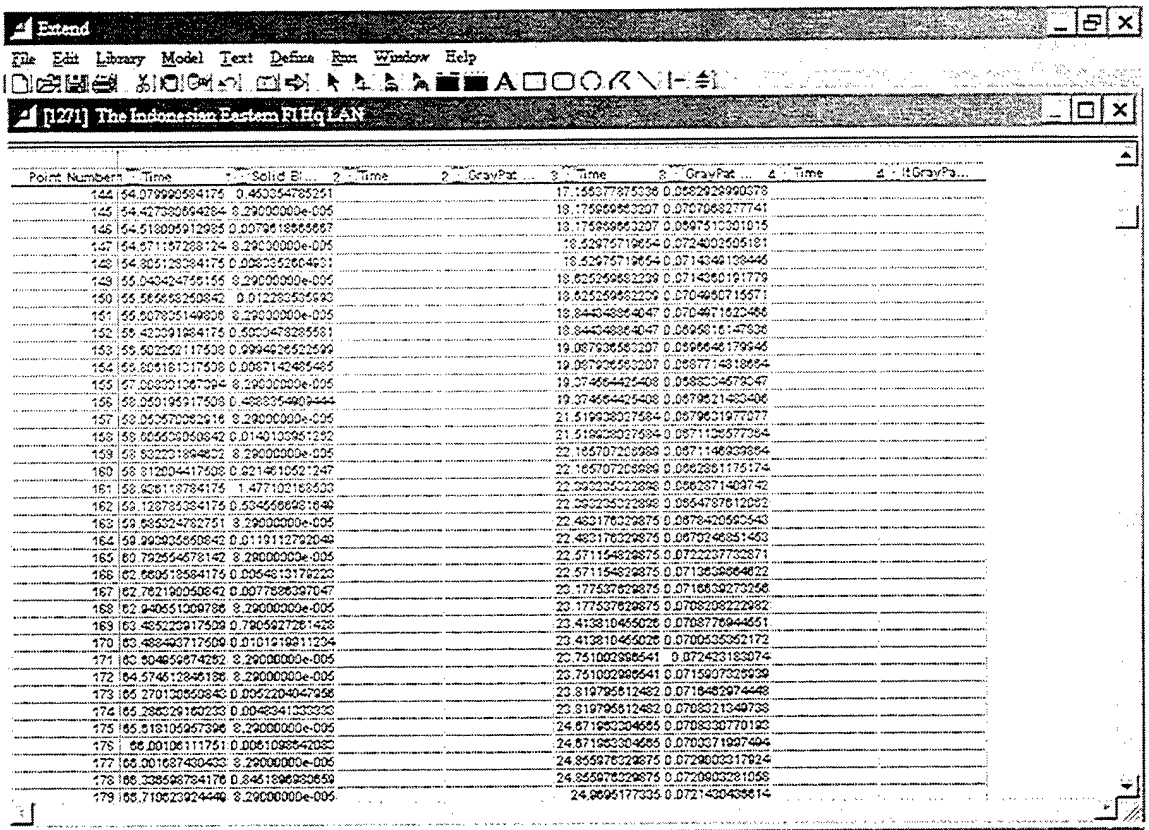
108	37.703046165821	8.29000000e-005			14.3065844	0.0434692757504		
109	38.091565460841	0.197844222658			14.362239507077	0.0434607830231		
110	38.371381926045	8.29000000e-005			14.362239507077	0.042584697612		
111	38.897883294173	1.1662068764506			14.433329890401	0.0425861779692		
112	39.533870584173	0.254274794407			14.433329890401	0.041972795539		
113	39.589514002033	8.29000000e-005			14.5559474	0.0515916830023		
114	40.414618317507	0.040049425048			14.5559474	0.0507021712264		
115	40.910558784173	0.274356147859			14.767462912941	0.0507036005358		
116	41.010893488146	8.29000000e-005			14.767462912941	0.0498442174768		
117	41.542545460841	0.308637246317			14.973840316072	0.0498456225616		
118	41.876815350841	0.012074879168			14.973840316072	0.0490148621855		
119	42.348004831627	8.29000000e-005			15.0299572	0.0492513440633		
120	43.148931317507	0.398927036119			15.0299572	0.0484439449803		
121	44.825801150841	0.016105866994			15.045147560463	0.0484453039967		
122	44.992582196721	8.29000000e-005			15.045147560463	0.0476539281258		
123	45.984882984174	0.575955935686			15.268366154844	0.0476552652226		
124	46.029618946192	8.29000000e-005			15.268366154844	0.0468686737111		
125	46.143285460841	0.596230043686			15.427632166667	0.0469105958972		
126	46.148812750841	0.013565356731			15.427632166667	0.0461776178363		
127	45.193459917507	2.2343753067546			15.797607386882	0.0461799131488		
128	46.247546650561	8.29000000e-005			15.797607386882	0.0454834883311		
129	46.640131390791	0.007961866667			15.157795333334	0.0568146281543		
130	46.772972117508	0.643125542913			15.157795333334	0.0557501257762		
131	46.822708413366	8.29000000e-005			15.349157399293	0.0557562686368		
132	48.013956460841	1.2097611031222			15.349157399293	0.0565676676124		
133	48.237878644782	8.29000000e-005			15.353909266667	0.0741914213397		
134	49.184933063522	0.007961866667			15.353909266667	0.0731003710269		
135	49.269856560841	0.022188888762			15.421728241848	0.0731015901435		
136	49.363440284175	0.468550714691			15.421728241848	0.0720421488081		
137	49.70213569592	8.29000000e-005			15.820817732509	0.0720433482574		
138	50.059196017508	1.3279036633274			15.820817732509	0.071014157668		
139	51.257505217508	1.2390379946958			15.991177446592	0.0711278985204		
140	51.416575946554	8.29000000e-005			15.991177446592	0.0701269971327		
141	52.826853917508	0.374612382082			17.013652692082	0.0702166778839		
142	53.824028117508	0.096227168826			17.013652692082	0.0692403515244		
143	53.992217962125	8.29000000e-005			17.166077876336	0.0692416129133		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[1271] The Indonesian Eastern F1 Hq LAN
Point Number
Time
Solid Bl...
Time
GrayPat
Time
GrayPat ...
Time
GrayPa...
144 64.0799905884175 0.460054765251 17.1553778715036 0.0582929990078
145 64.4273809894284 8.29000000e-005 18.1758569553207 0.0707068277741
146 64.5180959129985 0.00795189566667 18.1758569553207 0.0597510091015
147 64.5711572681124 8.29000000e-005 18.529757719654 0.0724023505181
148 64.9051283984175 0.0883552604931 18.529757719654 0.0714049109446
149 65.0404247456156 8.29000000e-005 18.6252569552209 0.0714060191779
150 65.5656983259842 0.0122805535833 18.6252569552209 0.0704960715571
151 65.5078905149806 8.29000000e-005 18.8443486564047 0.0704971622466
152 65.4203991984175 0.500004782855611 18.8443486564047 0.0695815147636
153 65.5022521117509 0.999492655225699 19.0879356553207 0.0596646179946
154 65.6051810117508 0.0087742485465 19.0879356553207 0.058771431866
155 67.0883011067094 8.29000000e-005 19.3746644254408 0.0588204578047
156 66.0501959175081 0.488805499994444 19.3746644254408 0.0579521493406
157 66.0526752082916 8.29000000e-005 21.5199386027584 0.0579631977077
158 66.6056599050842 0.0140130951292 21.5199386027584 0.0571126577354
159 66.6222318948621 8.29000000e-005 22.1857072259889 0.0571146939864
160 66.8120944417508 0.921461056212471 22.1857072259889 0.0562861175174
161 66.9261187884175 1.477102166503 22.5902356222898 0.0562871409742
162 69.1287853841751 0.534556669181649 22.5902356222898 0.0554787612092
163 69.6853247827511 8.29000000e-005 22.4831762229875 0.0678420952543
164 69.9939356508642 0.011911279204849 22.4831762229875 0.0670246851453
165 60.7925546781421 8.29000000e-005 22.571154829875 0.0722257732871
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167 62.7621900508421 0.00778963970471 20.1775376229875 0.0716639273256
168 62.9405513097986 8.29000000e-005 20.1775376229875 0.0708208222982
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172 64.5746128451186 8.29000000e-005 20.7510029986541 0.0715907329939
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[1271] The Indonesian Eastern F1 Hq LAN
Point Number
Time
Solid Bl...
Time
GrayPat ...
Time
GrayPat ...
Time
GrayPa...
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193 72.0624752543 8.29000000e-005 27.102297958042 0.0885069905804
194 73.8094621175112 0.947109180027 27.102297958042 0.0876038581225
195 73.8095350175112 0.000108513370 27.386446859475 0.0876047040408
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209 79.5492501175151 0.021991154682 29.448678313277 0.0889044656153
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211 79.7188005508481 0.015242125500 29.510750263933 0.0879671767888
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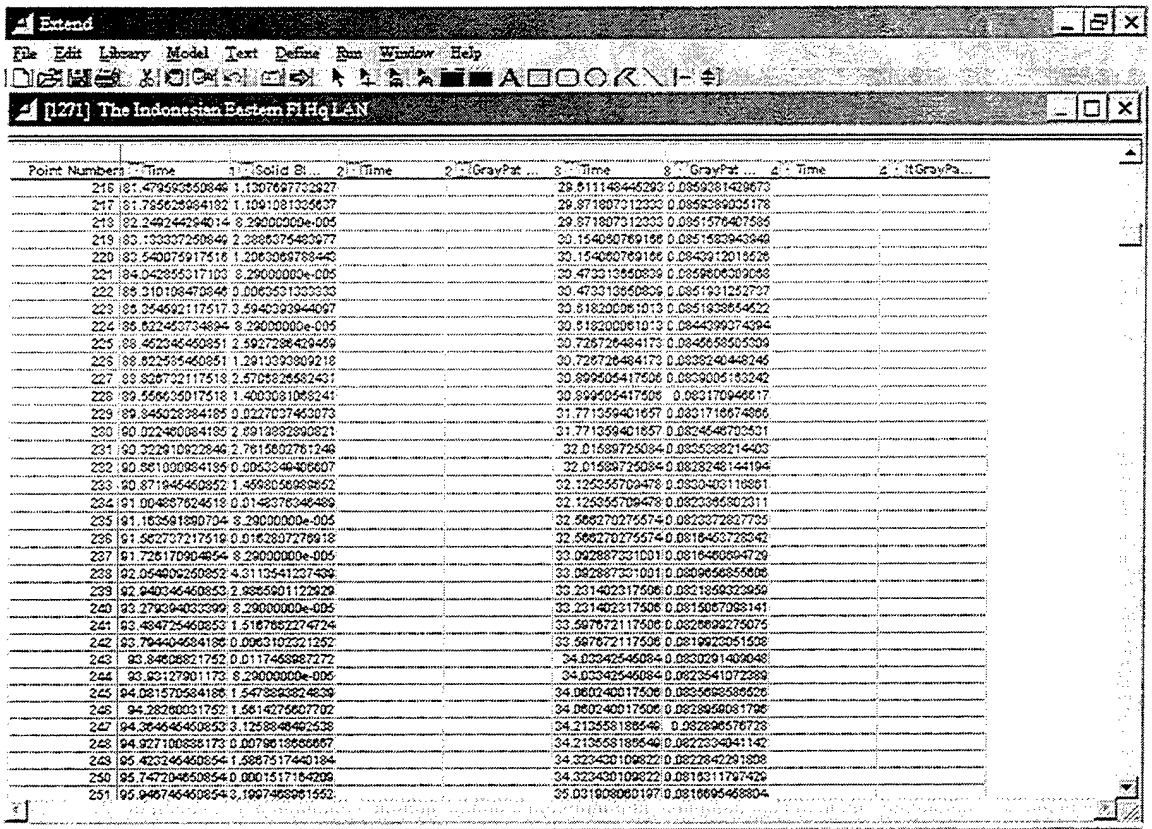

Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ttGrayPa...
216	81.479585508449	1.13076977732927			29.611148445293	0.0859381429673		
217	81.785628994182	1.10910813256637			29.871807312333	0.0859289035178		
218	82.249244294014	8.29000000e-005			29.871807312333	0.0861576407586		
219	83.133307250849	2.38863754803077			30.154060769166	0.0861583940349		
220	83.540075917516	1.20630697884443			30.154060769166	0.0840912018626		
221	84.042555317103	8.29000000e-005			30.473213550839	0.0859606039068		
222	85.310108470946	0.00635313333333			30.473213550839	0.0861931252707		
223	85.946921175717	3.59403939944097			30.518200061013	0.0861938654522		
224	86.622455734894	8.29000000e-005			30.518200061013	0.0844399374394		
225	88.462346450851	2.59272864249459			30.726726484173	0.0846558505309		
226	88.822555450851	1.29103939892218			30.726726484173	0.0839240448245		
227	89.826702117518	2.57068265582431			30.899505417506	0.0839006183242		
228	89.556635017518	1.40030810658241			30.899505417506	0.083170946617		
229	89.945028384185	0.0227037463073			31.771359401657	0.0831716574866		
230	90.022460084185	2.69193892890821			31.771359401657	0.0824546700531		
231	90.322910922846	2.76156027612481			32.015897250844	0.0825388214403		
232	90.561000984185	0.00533494405607			32.015897250844	0.0828248144194		
233	90.871945450852	1.45980356989852			32.125556709478	0.0830403116861		
234	91.004887624618	0.0146376346489			32.125556709478	0.0823366802311		
235	91.183591890704	8.29000000e-005			32.566270275574	0.0823372827735		
236	91.562737217519	0.0162807278918			32.566270275574	0.0818463728342		
237	91.726170904854	8.29000000e-005			33.092887331001	0.0816466894729		
238	92.064809250852	4.31135412374394			33.092887331001	0.0809656855606		
239	92.940046450853	2.98659011229929			33.231402317506	0.0821859322959		
240	93.279394033999	8.29000000e-005			33.231402317506	0.0815057093141		
241	93.484725460853	1.51678622747424			33.597572117506	0.0825699275075		
242	93.794404584186	0.00631022321252			33.597572117506	0.0819923051508		
243	93.84605821752	0.0117468987272			34.03342546084	0.0830291409048		
244	93.93127901173	8.29000000e-005			34.03342546084	0.0823541072389		
245	94.081570584186	1.54738923824839			34.060240017506	0.0835693586526		
246	94.282660031752	1.56142756077702			34.060240017506	0.0828696081796		
247	94.364464460853	3.12588484923538			34.213558186546	0.0828696576728		
248	94.927100886173	0.00796138666667			34.213558186546	0.0822394041142		
249	95.423246460854	1.68675174440184			34.323430109822	0.0822842291808		
250	95.747204650854	0.00015171542099			34.323430109822	0.0816311797429		
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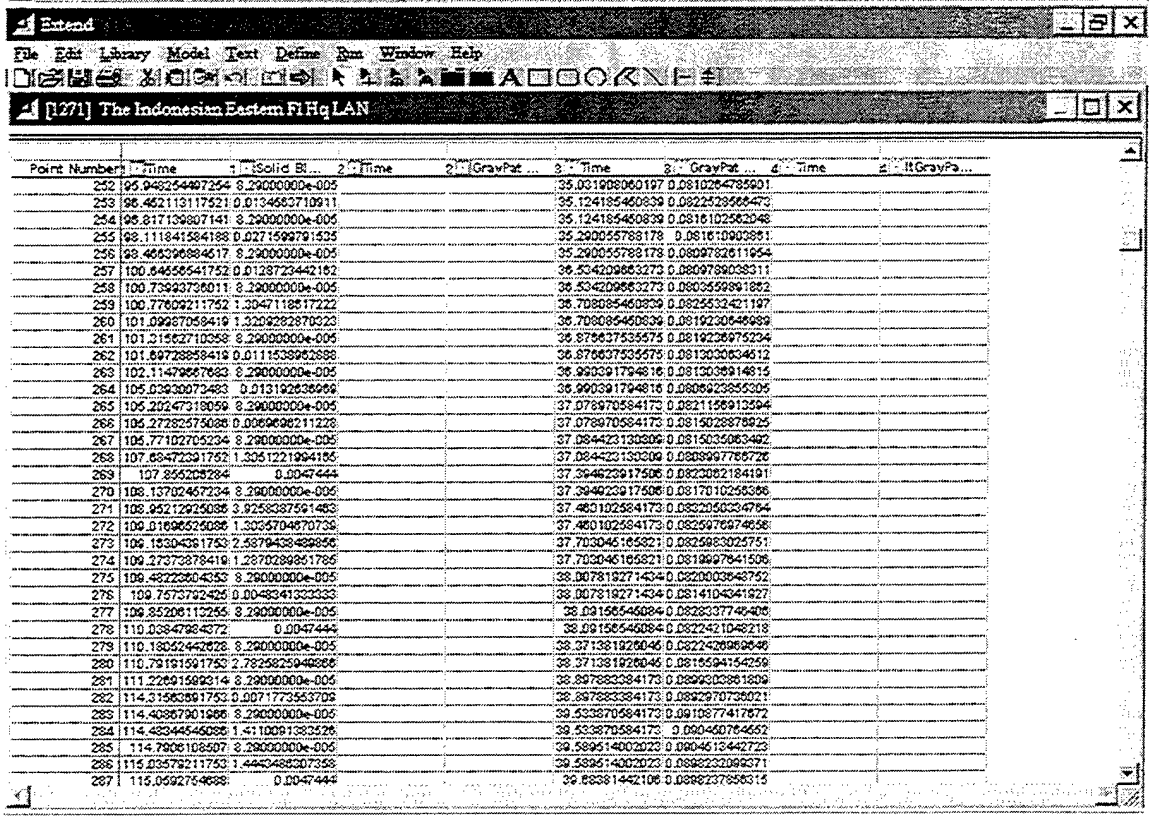

Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ttGrayPa...
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253	96.462113117521	0.0134663710911			35.124185460839	0.0822529566473		
254	96.817139807141	8.29000000e-005			35.124185460839	0.0816102562048		
255	98.111841584188	0.0271599791525			35.290055788178	0.081610900851		
256	98.466296884517	8.29000000e-005			35.290055788178	0.0809782611964		
257	100.64656541752	0.0128723442162			36.534209863273	0.0809789038311		
258	100.73993736011	8.29000000e-005			36.534209863273	0.0803559891852		
259	100.77609211752	1.30471185117222			36.708085460839	0.0825532421197		
260	101.09987054819	1.32092828790323			36.708085460839	0.0819230645989		
261	101.31562710358	8.29000000e-005			36.876637535575	0.0819226975204		
262	101.69728858419	0.0111538962888			36.876637535575	0.0813030634612		
263	102.11479667683	8.29000000e-005			36.990391794816	0.0813036914815		
264	105.02930073483	0.0131926236969			36.990391794816	0.0806923855305		
265	105.20247319059	8.29000000e-005			37.078970584173	0.0821156913594		
266	105.27282575086	0.00696986211228			37.078970584173	0.0815028878925		
267	105.77102705234	8.29000000e-005			37.084423130209	0.0815035063492		
268	107.68472291752	1.3051221994156			37.084423130209	0.0808997765726		
269	107.855205284	0.0047444			37.394823917506	0.0823082184191		
270	108.13702457234	8.29000000e-005			37.394823917506	0.0817010265366		
271	108.95212925086	3.92583875914463			37.460102584173	0.0822050234764		
272	109.01696525086	1.30357046770736			37.460102584173	0.0825976974656		
273	109.15304381753	2.58794384899856			37.703045165821	0.0825983025751		
274	109.27373878419	1.28702899611765			37.703045165821	0.0819997641506		
275	109.49222604353	8.29000000e-005			38.007819271434	0.0820003648752		
276	109.7573792426	0.00483413333333			38.007819271434	0.0814104041927		
277	109.85206112255	8.29000000e-005			38.091565460844	0.0828337746406		
278	110.03847984372	0.0047444			38.091565460844	0.0822421048218		
279	110.18052442628	8.29000000e-005			38.371381926046	0.0822426958646		
280	110.79191591752	2.78258259498866			38.371381926046	0.0815594154259		
281	111.22691599314	8.29000000e-005			38.897883384173	0.0899303861809		
282	114.31563891753	0.00717735537093			38.897883384173	0.0892970736021		
283	114.40867901966	8.29000000e-005			39.533870584173	0.0910877417672		
284	114.48344545085	1.41100913835526			39.533870584173	0.0904507654652		
285	114.7906108507	8.29000000e-005			39.589514002023	0.0904513442723		
286	115.03579211753	1.44404862607358			39.589514002023	0.0898232099371		
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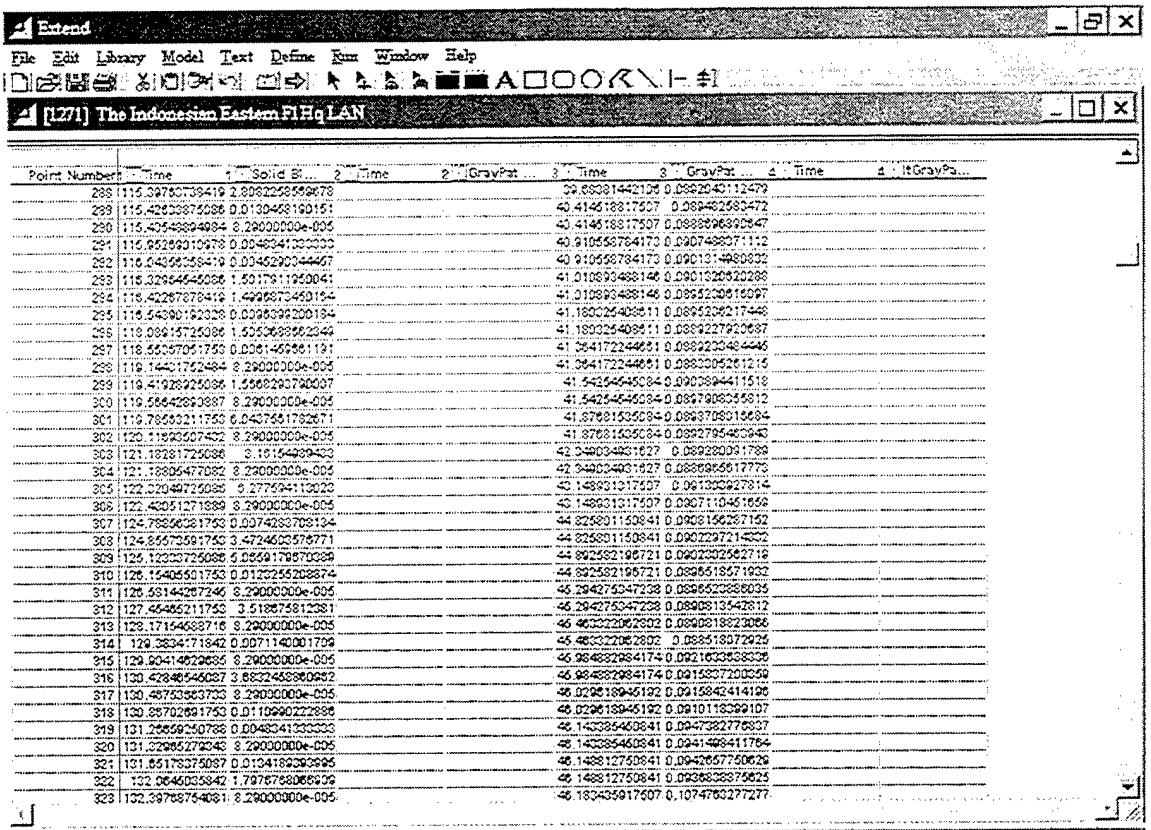

Point Number	1 Time	1 Solid Bl...	2 Time	2 GravPat ...	3 Time	3 GravPat ...	4 Time	4 ttGravPa...
288	115.39760739419	2.80822585596878			39.680814421067	0.0882043112479		
289	115.42603875086	0.0130468160151			40.41461881/507	0.0884625830472		
290	115.45548894984	8.29000000e-005			40.41461881/507	0.0886896892847		
291	115.95269010978	0.00469412000333			40.910558784173	0.0907488071112		
292	116.04056584419	0.00452900344457			40.910558784173	0.0901314980832		
293	116.32864545086	1.50179111950041			41.010893488146	0.0901320520288		
294	116.42267878419	1.49966734501644			41.010893488146	0.0895220615097		
295	116.54280182226	0.00963992200184			41.180025408511	0.0895320617446		
296	116.09915725086	1.50536938502349			41.180025408511	0.0889227920687		
297	118.55357051753	0.00614853661191			41.264172244651	0.0882203484445		
298	119.14401752484	8.29000000e-005			41.264172244651	0.0883005251215		
299	119.41928925086	1.55682937900037			41.542546455084	0.0902894411518		
300	119.56642883687	8.29000000e-005			41.542546455084	0.0897986556812		
301	119.78553211753	6.04376617826771			41.876815350584	0.0893709815684		
302	120.11893507402	8.29000000e-005			41.876815350584	0.0892795480843		
303	121.18281725086	3.1815499403			42.049034831627	0.0892800991789		
304	121.78892477082	8.29000000e-005			42.049034831627	0.0886965617775		
305	122.02049725086	9.2775941139033			43.148931017507	0.0913009278145		
306	122.42051271689	8.29000000e-005			43.148931017507	0.0907110451658		
307	124.76856081753	0.00742837081344			44.825801150841	0.0908156287152		
308	124.85575591753	3.47246035767/1			44.825801150841	0.0902297214002		
309	126.12000725086	6.05591795700/99			44.892582196721	0.0902302562718		
310	126.15405501753	0.01222552088474			44.892582196721	0.0896518571932		
311	126.58144267246	8.29000000e-005			45.294275047238	0.0896523886035		
312	127.45465211753	3.5186758123811			45.294275047238	0.0890813542812		
313	128.17164687716	8.29000000e-005			46.462322062802	0.0890818829066		
314	129.3834771842	0.00711400017792			45.462322062802	0.0885188729255		
315	129.80414629686	8.29000000e-005			46.984892984174	0.0921633638308		
316	130.42846546087	3.8832458860952			46.984892984174	0.0915807200059		
317	130.48753863703	8.29000000e-005			46.029618945192	0.0915842414196		
318	130.85702691753	0.01109902228986			46.029618945192	0.0910118099107		
319	131.25659250788	0.00483413333333			46.140385460841	0.0947382776837		
320	131.32985279248	8.29000000e-005			46.140385460841	0.0941498411764		
321	131.65178375087	0.01341892393995			46.148812750841	0.0942657750629		
322	132.06460309842	1.79767768066909			46.148812750841	0.0936838975625		
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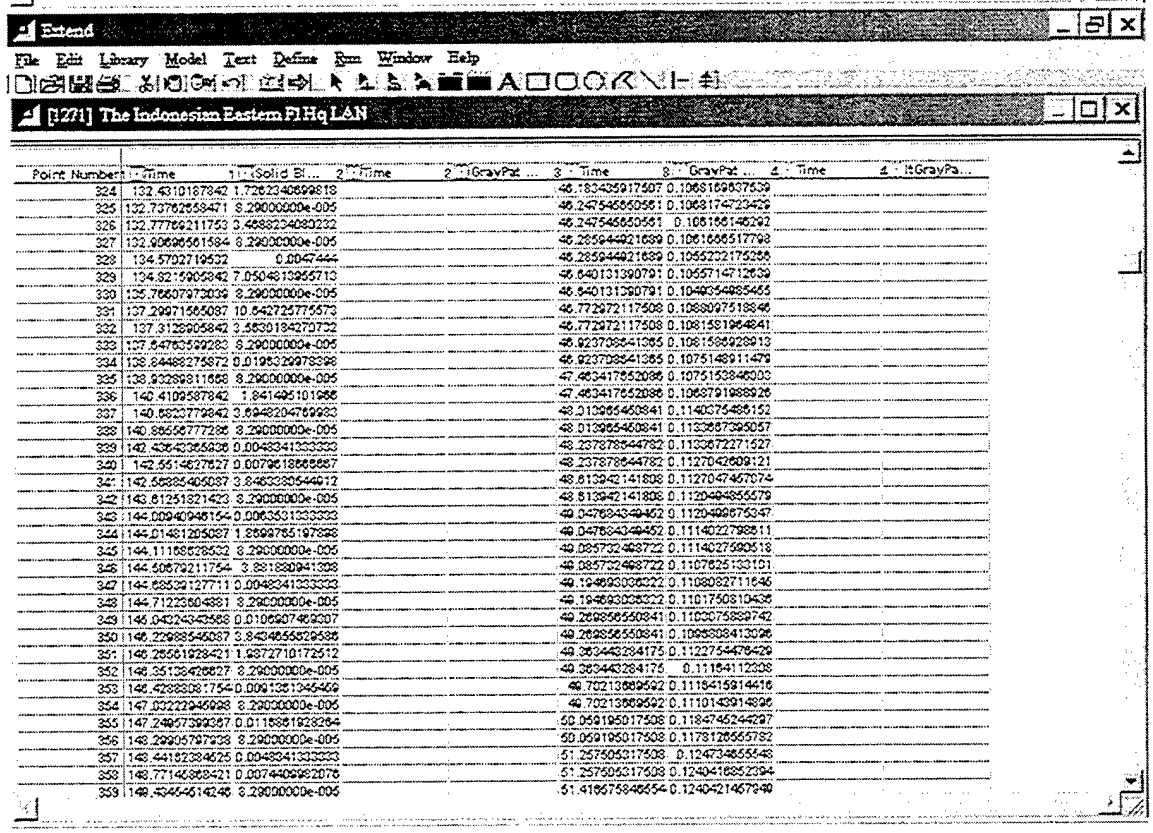

Point Number	1 Time	1 Solid Bl...	2 Time	2 GravPat ...	3 Time	3 GravPat ...	4 Time	4 ttGravPa...
324	132.4310187842	1.72623406998818			46.183435917507	0.1068169837539		
325	132.73762558471	8.29000000e-005			46.247545650561	0.1068174723429		
326	132.77769211753	9.4688204080232			46.247545650561	0.1061661462/2		
327	132.90696561584	8.29000000e-005			46.265944921699	0.1061666517798		
328	134.5702719532	0.0047444			46.265944921699	0.1055202175255		
329	134.9215905842	7.0504613955713			46.640131390791	0.1055714712639		
330	135.76607973039	8.29000000e-005			46.640131390791	0.1049354985465		
331	137.29971565087	10.642725775575			46.772972117508	0.1088097518646		
332	137.3129905842	3.5630194270752			46.772972117508	0.1081581964841		
333	137.54760599283	8.29000000e-005			46.923708641365	0.1081586928913		
334	138.84488275872	0.01963299783398			46.923708641365	0.1075148911479		
335	138.93289811668	8.29000000e-005			47.463417552086	0.1075153846003		
336	140.41095878842	1.8414965101966			47.463417552086	0.1068791988926		
337	140.5822779842	3.6948204769983			48.013965460841	0.1140754861/2		
338	140.86556777286	8.29000000e-005			48.013965460841	0.1133687395057		
339	142.43642365936	0.00483413333333			48.237878544782	0.1133672271527		
340	142.56154627627	0.00796188685687			48.237878544782	0.1127042609121		
341	142.56885405087	3.8463338544612			48.613942141808	0.1127047467074		
342	143.61251821423	8.29000000e-005			48.613942141808	0.1120494855579		
343	144.00940946154	0.00635313333333			49.047684349452	0.1120498675347		
344	144.01481205087	1.8599765197998			49.047684349452	0.1114022798611		
345	144.11168528532	8.29000000e-005			49.085732468722	0.1114027590518		
346	144.50679211754	3.8818809941208			49.085732468722	0.1107625133101		
347	144.68539127711	0.00483413333333			49.194693036222	0.1108827116546		
348	144.71235604881	8.29000000e-005			49.194693036222	0.1101750810436		
349	146.04024345569	0.01066074692207			49.269856550841	0.1102075899742		
350	146.22988546087	3.8424655529588			49.269856550841	0.1095308413096		
351	146.28561928421	1.98727101772512			49.363443284175	0.1122754476429		
352	146.35139426827	8.29000000e-005			49.363443284175	0.1116411/208		
353	146.42988361754	0.00915615945469			49.70213889592	0.1118415914416		
354	147.03222946988	8.29000000e-005			49.70213889592	0.1110143914896		
355	147.24957399367	0.01158619282644			50.059195017508	0.1184746244297		
356	148.29905797938	8.29000000e-005			50.059195017508	0.1178126555782		
357	148.44152384625	0.00483413333333			51.257505317508	0.124734655548		
358	148.77146868421	0.00744059620/6			51.257505317508	0.1240416852094		
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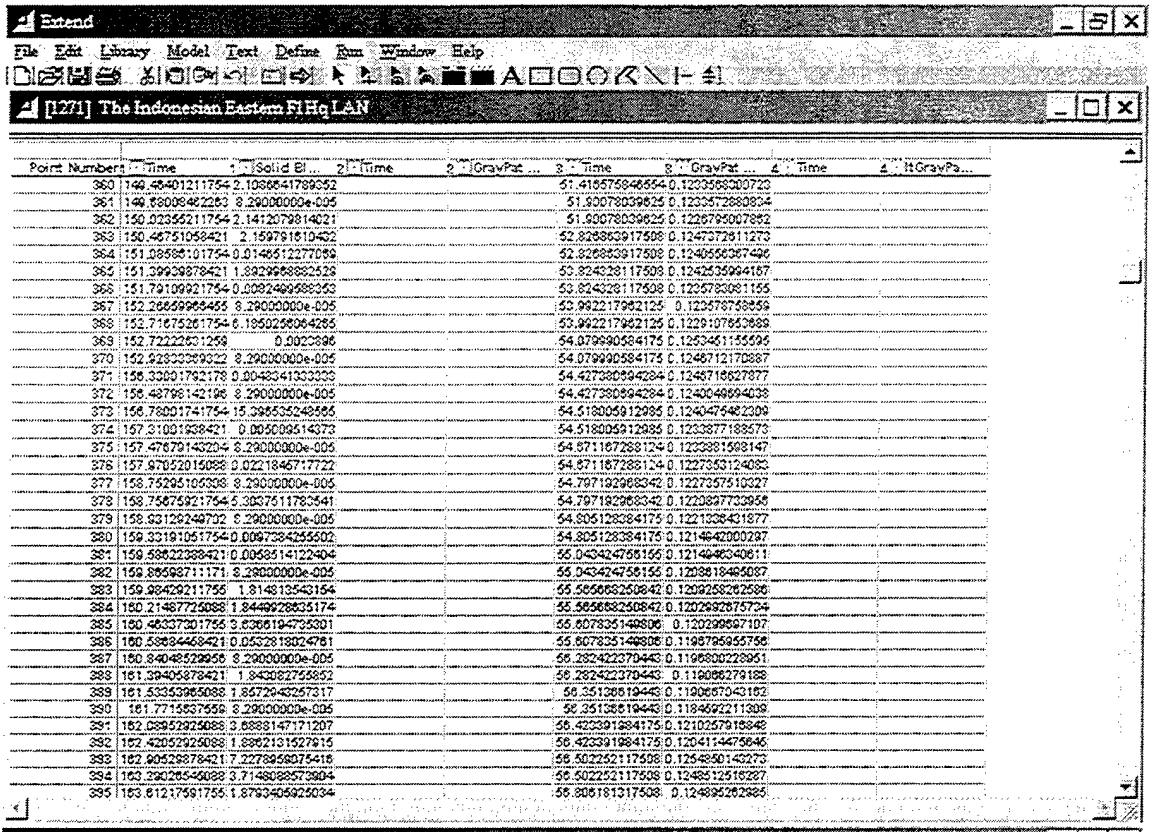

Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : GrayPa...
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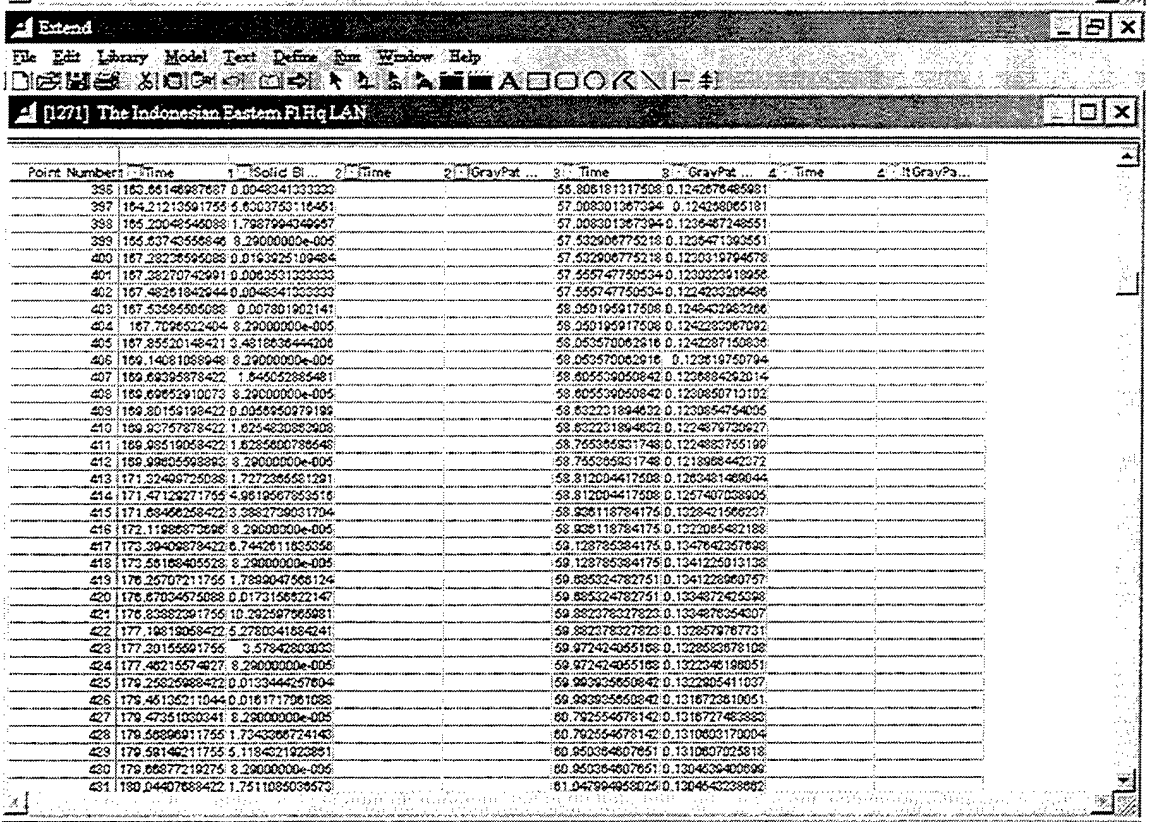
361	149.680084622263	8.290000000e-005			51.90078039625	0.123057288083		
362	150.02355211754	2.141207981402			51.90078039625	0.122679500785		
363	150.46751058421	2.159791810452			52.826863917508	0.124737281127		
364	151.085851017541	0.014651227708			52.826863917508	0.124055636749		
365	151.399298784211	1.892995888252			53.824328117508	0.124235994157		
366	151.791099217541	0.008249958863			53.824328117508	0.123578081155		
367	152.266599654551	8.290000000e-005			53.992217962125	0.123578758659		
368	152.716752617541	6.185025806426			53.992217962125	0.122910780698		
369	152.722226031259	0.0023896			54.079990584175	0.125345115569		
370	152.928303899322	8.290000000e-005			54.079990584175	0.124671217088		
371	156.330017921781	0.004824133333			54.427380594284	0.124571627877		
372	156.487961421981	8.290000000e-005			54.427380594284	0.124004694038		
373	156.780017417554	15.395535248565			54.518005912985	0.124047546230		
374	157.310019338421	0.005509514373			54.518005912985	0.123387188573		
375	157.476791432054	8.290000000e-005			54.671167288124	0.123393515814		
376	157.970520150988	0.022184677722			54.671167288124	0.122753512408		
377	158.752951003388	8.290000000e-005			54.797192968342	0.122735751032		
378	158.756759217541	5.380751178054			54.797192968342	0.122089770395		
379	158.931292497321	8.290000000e-005			54.805128384175	0.122133843187		
380	159.331910517541	0.009738425550			54.805128384175	0.121464200029		
381	159.586223384211	0.005851412240			55.043424756155	0.121496340611		
382	159.859698711171	8.290000000e-005			55.043424756155	0.120861846508		
383	159.984292117551	1.814813543154			55.565668250842	0.120925826258		
384	160.214877250881	1.844992662517			55.565668250842	0.120292767573		
385	160.463379017551	3.636619479530			55.607835149805	0.120299697107		
386	160.598944648421	0.053281802476			55.607835149805	0.119579555756		
387	160.840485299581	8.290000000e-005			55.282422370443	0.119680022895		
388	161.394058784211	1.843082758852			55.282422370443	0.119066279188		
389	161.533539655088	1.857294025731			55.351386819443	0.119066704316		
390	161.771135575591	8.290000000e-005			55.351386819443	0.118469221130		
391	162.089529255088	3.688814717120			55.423391984175	0.121025791684		
392	162.420529255088	1.896213152781			55.423391984175	0.120411447564		
393	162.905298784211	7.227896075415			55.502252117508	0.125485014027		
394	163.290265645088	3.714808857390			55.502252117508	0.124851251628		
395	163.612175917551	1.879340925034			55.806181317508	0.124895262985		



Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : GrayPa...
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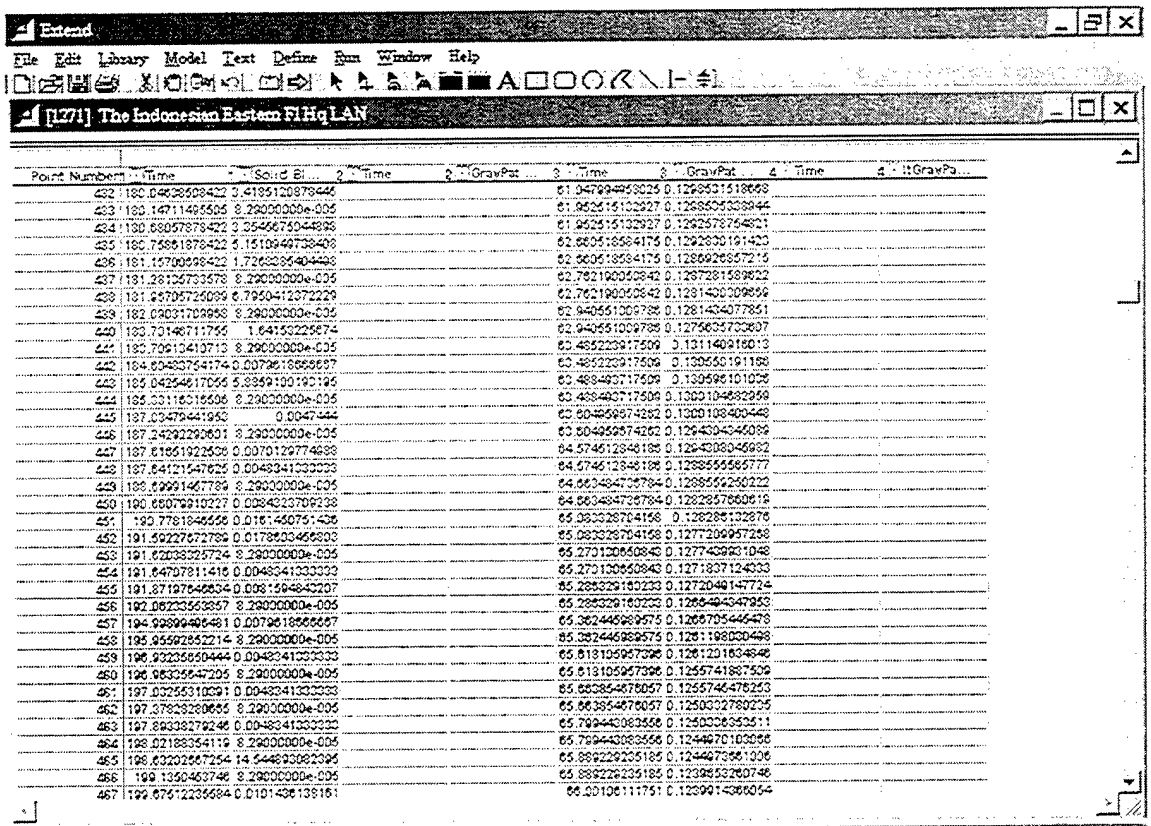
397	164.212135917551	5.600375316451			57.008301367394	0.124258065181		
398	165.200425445088	1.798799434957			57.008301367394	0.123648748551		
399	165.637405568646	8.290000000e-005			57.532906775218	0.123547139355		
400	167.282256950885	0.019325109484			57.532906775218	0.123031979467		
401	167.382707429911	0.006353133333			57.555747750534	0.123032319958		
402	167.482518429444	0.004824133333			57.555747750534	0.122420326486		
403	167.535955050885	0.007801902141			58.050195917508	0.124840962266		
404	167.709522240421	8.290000000e-005			58.050195917508	0.124229367092		
405	167.855201464211	3.481863644206			58.053570062916	0.124228715083		
406	169.140810889048	8.290000000e-005			58.053570062916	0.123619750794		
407	169.693958784221	1.846552885481			58.605539050842	0.123688426214		
408	169.696529100731	8.290000000e-005			58.605539050842	0.123080710102		
409	169.801591984221	0.005595979199			58.632231894632	0.123085475405		
410	169.907578784221	1.626482882908			58.632231894632	0.122467973827		
411	169.985190584221	1.628560786648			58.755355931748	0.122488375519		
412	169.998055938893	8.290000000e-005			58.755355931748	0.121898644207		
413	171.324997250881	1.727238558291			58.812004417508	0.126348146044		
414	171.471229217551	5.961956795516			58.812004417508	0.125740703905		
415	171.694662584221	3.386279031704			58.935118784175	0.132842166207		
416	172.119886730595	8.290000000e-005			58.935118784175	0.132205482188		
417	173.394098784221	6.744261165356			59.128785384175	0.134764236798		
418	173.581884055221	8.290000000e-005			59.128785384175	0.134122501313		
419	176.257072117551	1.789904756124			59.685324782751	0.134122696757		
420	176.670045750881	0.017315652214			59.685324782751	0.133487242509		
421	176.838829917551	10.29259756598			59.882378327823	0.133487654307		
422	177.198198584221	5.278004188424			59.882378327823	0.132857977731		
423	177.301556917551	3.578428033033			59.972424055168	0.132858378108		
424	177.462155748221	8.290000000e-005			59.972424055168	0.132234619805		
425	179.258259884221	0.013344257604			59.993935650842	0.132280541103		
426	179.461362110441	0.016171761088			59.993935650842	0.131672361005		
427	179.473510303411	8.290000000e-005			60.792554676142	0.131672748380		
428	179.568969117551	1.734336572414			60.792554676142	0.131060317004		
429	179.581462117551	5.118452192881			60.950364607651	0.131060702581		
430	179.658772192751	8.290000000e-005			60.950364607651	0.130439400599		
431	180.044076884221	1.751108503657			61.047994958025	0.130464238862		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2 : Time
2 : GravPat ...
3 : Time
3 : GravPat ...
4 : Time
4 : GravPa...
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433 180.14711495505 8.29000000e-005 61.952515102927 0.12685053039845
434 180.68057878422 0.05466750448981 61.952515102927 0.12925787564821
435 180.75551878422 5.15109497738408 62.660518584175 0.12926301917423
436 181.15700598422 1.72683954904498 62.660518584175 0.12869285877215
437 181.28125733578 8.29000000e-005 62.782190050842 0.12872815399022
438 181.95795725099 6.79504123722229 62.782190050842 0.12814020099599
439 182.09031709958 8.29000000e-005 62.940551009786 0.12814340778511
440 182.70146711756 1.64150225674 62.940551009786 0.12756057503607
441 182.79913410713 8.29000000e-005 63.485220917509 0.13114091501313
442 184.60493754174 0.00796185666667 63.485220917509 0.13955019115881
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447 187.61651922536 0.00701297746888 64.574512846186 0.12943080469892
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449 188.59991467789 8.29000000e-005 64.660494726784 0.12885592503222
450 190.65079210227 0.00842237092338 64.660494726784 0.12829576606618
451 190.77619466556 0.01614507514436 65.083028704168 0.12828610326876
452 191.59227672789 0.01786034656803 65.083028704168 0.12772099957258
453 191.62083625724 8.29000000e-005 65.270120650843 0.12774099931048
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455 191.87197646634 0.00815948422207 65.285329160233 0.12720491477241
456 192.06223563857 8.29000000e-005 65.285329160233 0.12664934377953
457 194.93899486481 0.00796185666667 65.382446989575 0.12667054464781
458 195.95592652214 8.29000000e-005 65.382446989575 0.12611980004981
459 196.93235650444 0.00483411333333 65.613105957396 0.12612016049648
460 196.96325647295 8.29000000e-005 65.613105957396 0.12557418875092
461 197.03255310291 0.00483411333333 65.663854676057 0.12557464678253
462 197.07833286655 8.29000000e-005 65.663854676057 0.12503027892235
463 197.89338279246 0.00483411333333 65.799443083556 0.12503063535511
464 198.02188354119 8.29000000e-005 65.799443083556 0.12446970103656
465 198.63202567254 14.5448930822095 65.889229235185 0.12446973661006
466 199.1350463746 8.29000000e-005 65.889229235185 0.12396532607461
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Extend
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[1271] The Indonesian Eastern Fl Hq LAN
Point Number
1 : Time
1 : Solid Bl...
2 : Time
2 : GravPat ...
3 : Time
3 : GravPat ...
4 : Time
4 : GravPa...
468 199.94668836516 0.00891255752201 66.001061111751 0.12346381047091
469 200.02540409861 0.00796185666667 66.001687439403 0.12346416623681
470 200.26497232073 0.00981559803959 66.001687439403 0.12294101299011
471 200.26756912079 15.5101384229631 66.336598784175 0.12652202527
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473 200.39201979959 8.29000000e-005 66.710623924449 0.12598882558531
474 201.34685447654 0.00796185666667 66.710623924449 0.12545946077191
475 201.56820642794 0.00483411333333 66.838684229802 0.12546098909131
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477 203.72878183282 0.00653531333333 66.899144445981 0.12493521951351
478 204.20549096631 0.00884566324771 66.899144445981 0.12441465603681
479 204.27091764751 8.29000000e-005 66.904965524982 0.12441500151551
480 204.28622975529 19.2696480514101 66.904965524982 0.12389387569659
481 204.42554184471 8.29000000e-005 67.215385384177 0.1238999215991
482 204.71702261728 0.01046338544461 67.215385384177 0.12338722357586
483 204.88572998395 17.9005966932788 67.297876643128 0.12338757832216
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485 205.20205965141 8.29000000e-005 68.067725460844 0.12563191100469
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487 205.85784582271 8.29000000e-005 68.212120292537 0.12511326575172
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490 207.46438697478 0.00574081539811 68.542020396503 0.12508529239391
491 207.52146929112 8.29000000e-005 68.814252117511 0.12509705440468
492 208.44253791274 0.00653531333333 68.814252117511 0.12460952301041
493 209.64846142544 8.29000000e-005 69.239535917511 0.12561112920181
494 210.10511382204 0.00653531333333 69.239535917511 0.12526055035871
495 210.49873544653 0.00483411333333 69.980319950844 0.14002509286643
496 210.70496378601 8.29000000e-005 69.980319950844 0.14245095356576
497 211.24458464159 0.00483411333333 70.179595917511 0.15376462234011
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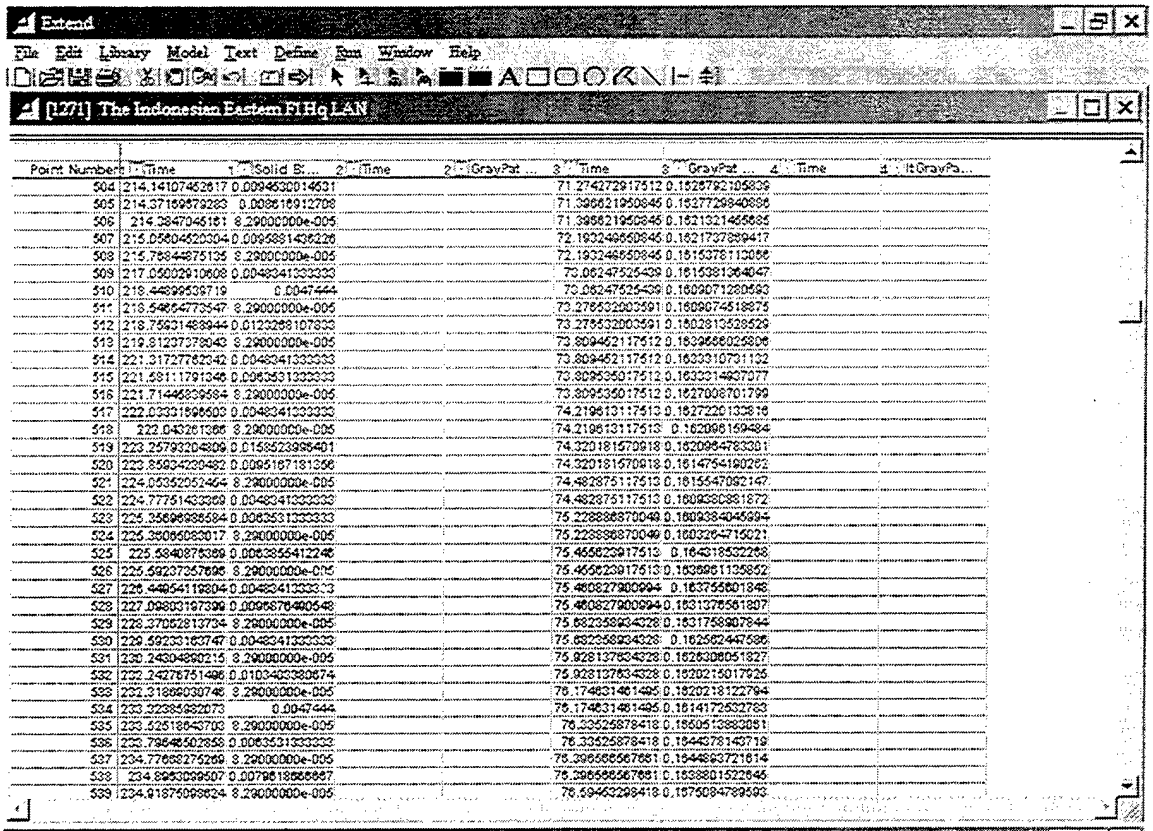

Point Number	1 : Time	1 : Solid Bl...	2 : Time	2 : GrayPat ...	3 : Time	3 : GrayPat ...	4 : Time	4 : ItGrayPa...
504	214.14107452617	0.0094630014631			71.27427917512	0.1526792105809		
505	214.37169579283	0.008618912708			71.39662195845	0.1527729840886		
506	214.3847045151	8.29000000e-005			71.39662195845	0.1521321465585		
507	215.05804620304	0.0095814436226			72.19324665845	0.1521737889417		
508	215.76844875135	8.29000000e-005			72.19324665845	0.1515378112656		
509	217.0500291906	0.0048341333333			73.06247525439	0.1515381364047		
510	218.4489965097	0.0047444			73.06247525439	0.1509071280593		
511	218.54654773547	8.29000000e-005			73.27853203591	0.1509074518675		
512	218.75931489944	0.0123268107833			73.27853203591	0.1502815528529		
513	219.81237278043	8.29000000e-005			73.80946217512	0.1502668025806		
514	221.31727762042	0.0048341333333			73.80946217512	0.1503310791132		
515	221.68111791046	0.0065631333333			73.80953501752	0.1503314927077		
516	221.71446899584	8.29000000e-005			73.80953501752	0.1527008701799		
517	222.03331896503	0.0048341333333			74.21961317513	0.1527220133816		
518	222.0432613366	8.29000000e-005			74.21961317513	0.1520986159484		
519	223.25793204809	0.0156522995401			74.32018157091 8	0.1520964783301		
520	223.56934229482	0.0095167191356			74.32018157091 8	0.1514754190262		
521	224.05352052464	8.29000000e-005			74.48287517513	0.1515547092147		
522	224.77751433369	0.0048341333333			74.48287517513	0.1509386361872		
523	225.25696988584	0.0065631333333			75.22888687004	0.1509384045894		
524	225.35086080017	8.29000000e-005			75.22888687004	0.1503264715021		
525	225.5840875369	0.0065855412246			75.46562291751	0.1503181532268		
526	225.59237257695	8.29000000e-005			75.46562291751	0.1496961135852		
527	226.44954119204	0.0048341333333			75.46082790099	0.1497556013845		
528	227.09803197399	0.0095876490548			75.46082790099	0.1491376561807		
529	228.37052813734	8.29000000e-005			75.68225589343	0.1491758907844		
530	229.59233163747	0.0048341333333			75.68225589343	0.1485624475865		
531	230.24804860215	8.29000000e-005			75.92813765432	0.1485638051827		
532	232.24276751496	0.0103403380674			75.92813765432	0.1479215017625		
533	232.31866030746	8.29000000e-005			76.17463146149	0.1479218122794		
534	233.32386892073	0.0047444			76.17463146149	0.1414172532763		
535	233.42518643709	8.29000000e-005			76.33525878418	0.1414159880851		
536	235.79646502858	0.0065631333333			76.33525878418	0.1344378145719		
537	234.77668275269	8.29000000e-005			76.29666567681	0.1344893721614		
538	234.8953099507	0.007961866667			76.29666567681	0.1338801522645		
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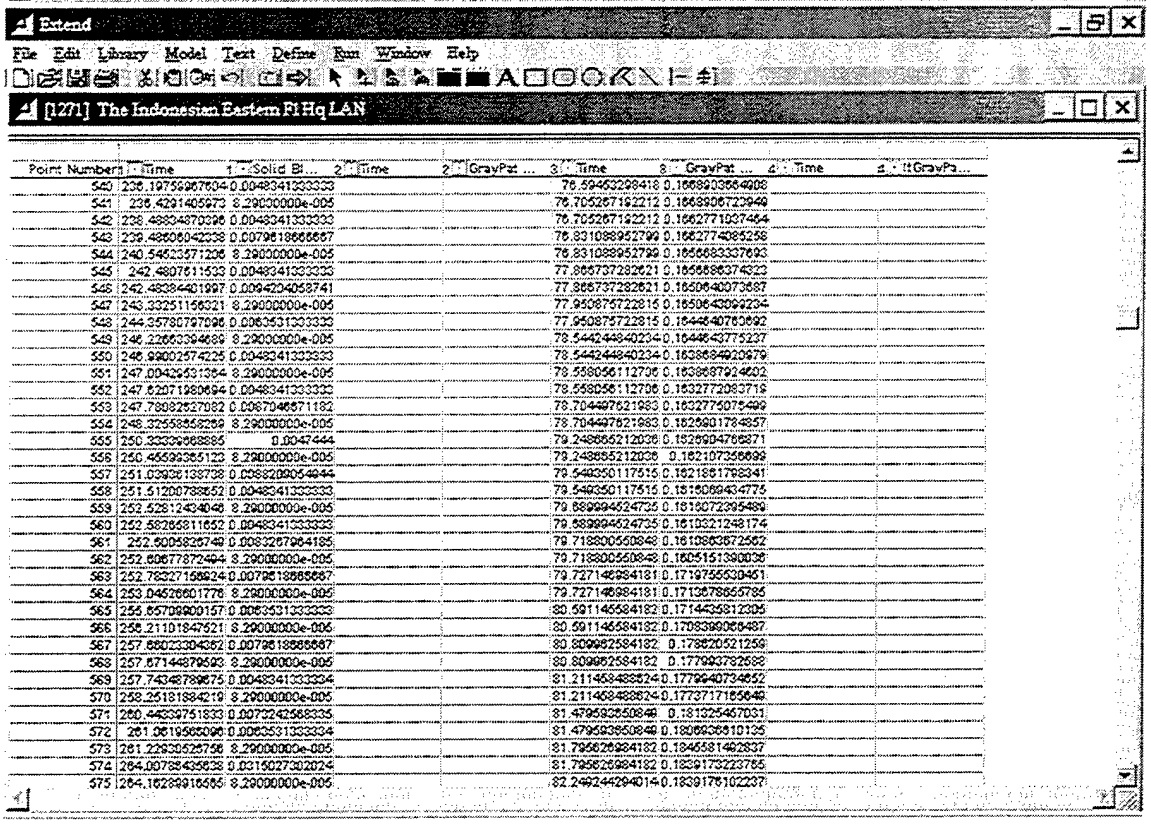

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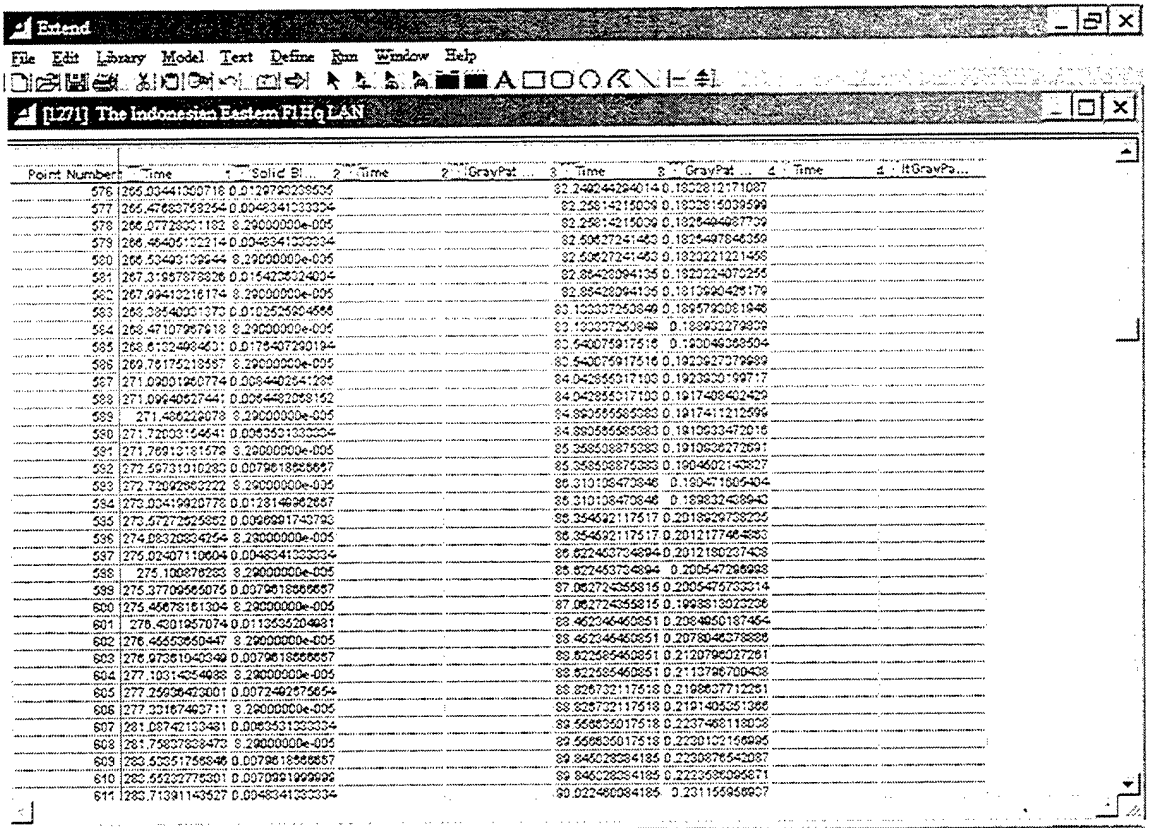
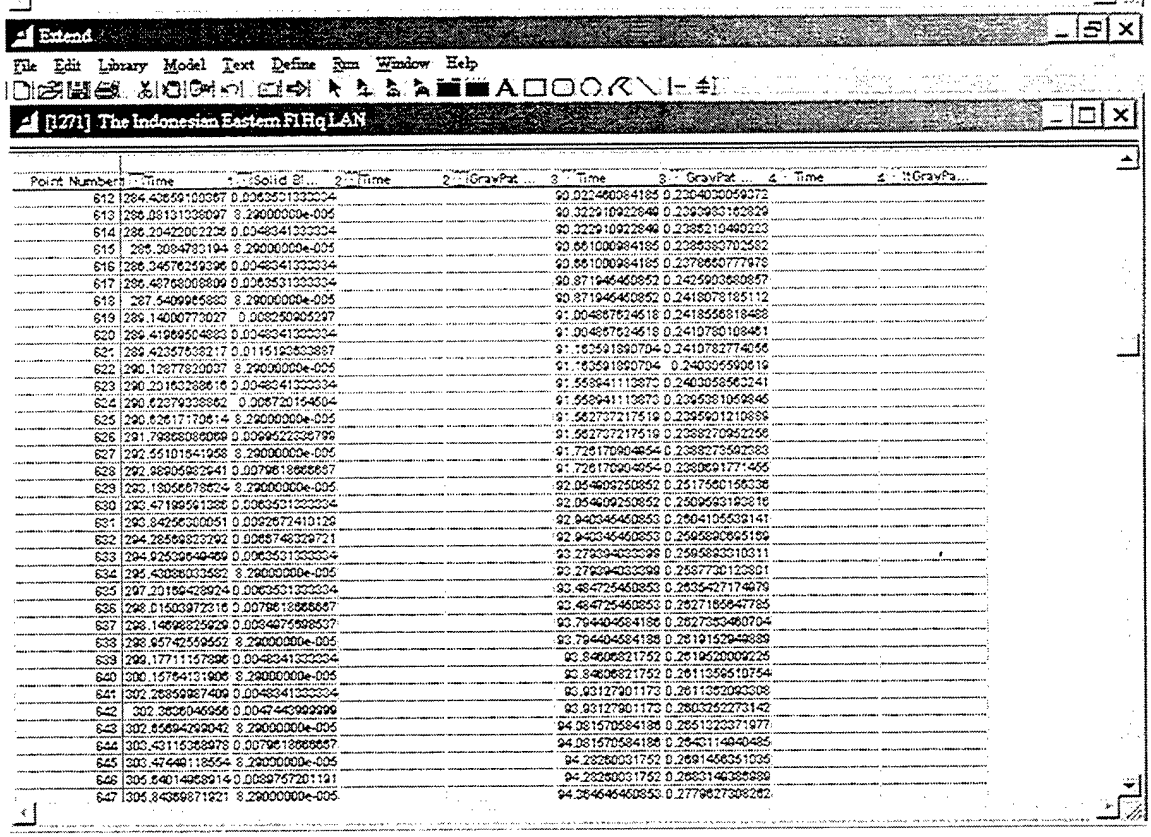
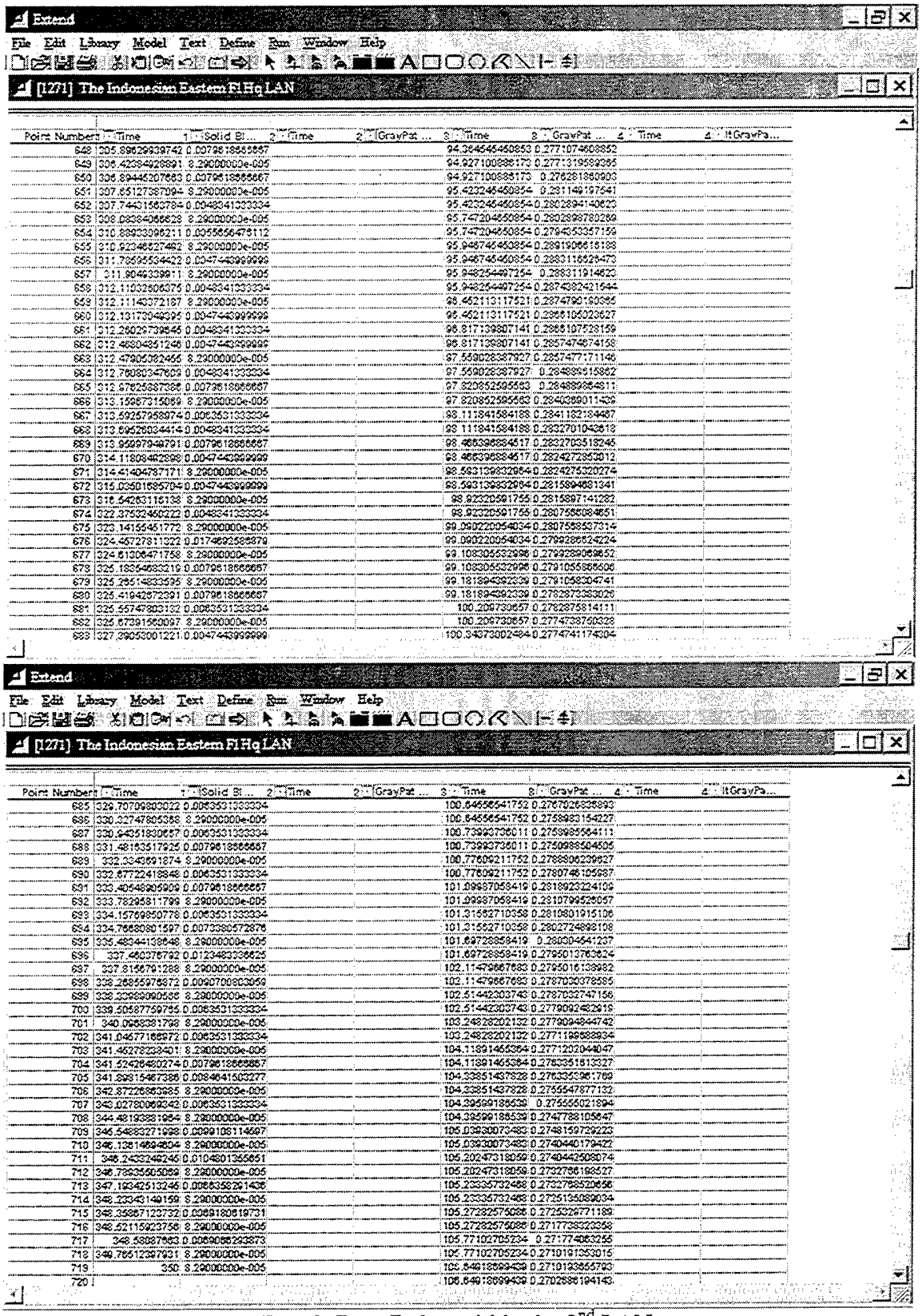
541	236.4291405973	8.29000000e-005			76.70526719212	0.1668906723949		
542	238.48804879096	0.0048341333333			76.70526719212	0.1662771937464		
543	239.48606942238	0.007961866667			76.83108952799	0.1662774085258		
544	240.54623571206	8.29000000e-005			76.83108952799	0.1656683337693		
545	242.4807611533	0.0048341333333			77.36573728621	0.1656686274933		
546	242.48384401997	0.0094204058741			77.36573728621	0.1650640073687		
547	243.33251156321	8.29000000e-005			77.95087572281	0.1650643099234		
548	244.95780797896	0.0065631333333			77.95087572281	0.1644640769692		
549	246.22663094689	8.29000000e-005			78.54424484023	0.1644643775237		
550	246.99002574235	0.0048341333333			78.54424484023	0.1638684920979		
551	247.00426531364	8.29000000e-005			78.55805612706	0.1638687924602		
552	247.62071980694	0.0048341333333			78.55805612706	0.1632772083719		
553	247.78082527082	0.0067046571182			78.70449762193	0.1632775075499		
554	248.32558558259	8.29000000e-005			78.70449762193	0.1626901784357		
555	250.33309968885	0.0047444			79.24886521203	0.1626904766871		
556	250.46599365123	8.29000000e-005			79.24886521203	0.1621107356699		
557	251.03936138738	0.0088209054944			79.54935011751	0.1621891798341		
558	251.51200788652	0.0048341333333			79.54935011751	0.1615069434775		
559	252.52812434048	8.29000000e-005			79.58999462473	0.1615072395499		
560	252.58266811652	0.0048341333333			79.58999462473	0.1609321248174		
561	252.6005826749	0.0083267964185			79.71880055084	0.1609863672562		
562	252.60677872494	8.29000000e-005			79.71880055084	0.1605151390036		
563	252.76927158624	0.007961866667			79.72714694181	0.1719755539451		
564	253.04626601776	8.29000000e-005			79.72714694181	0.1713678655785		
565	255.65709900157	0.0065631333333			80.59114658418	0.1714259812305		
566	258.21101847521	8.29000000e-005			80.59114658418	0.1708399068487		
567	257.66003304562	0.007961866667			80.80996258418	0.178820521259		
568	257.67144879503	8.29000000e-005			80.80996258418	0.1779927826681		
569	257.74348789675	0.0048341333334			81.21146488524	0.1779940734652		
570	258.25181888219	8.29000000e-005			81.21146488524	0.1773717165648		
571	260.44039751833	0.0072242566335			81.47959255084	0.1813254670311		
572	261.0619565096	0.0065631333334			81.47959255084	0.1806966810126		
573	261.22630525796	8.29000000e-005			81.79582584182	0.1846581492837		
574	264.00788435638	0.0031027302024			81.79582584182	0.1839179223765		
575	264.16289916585	8.29000000e-005			82.24924429401 4	0.1839176102237		



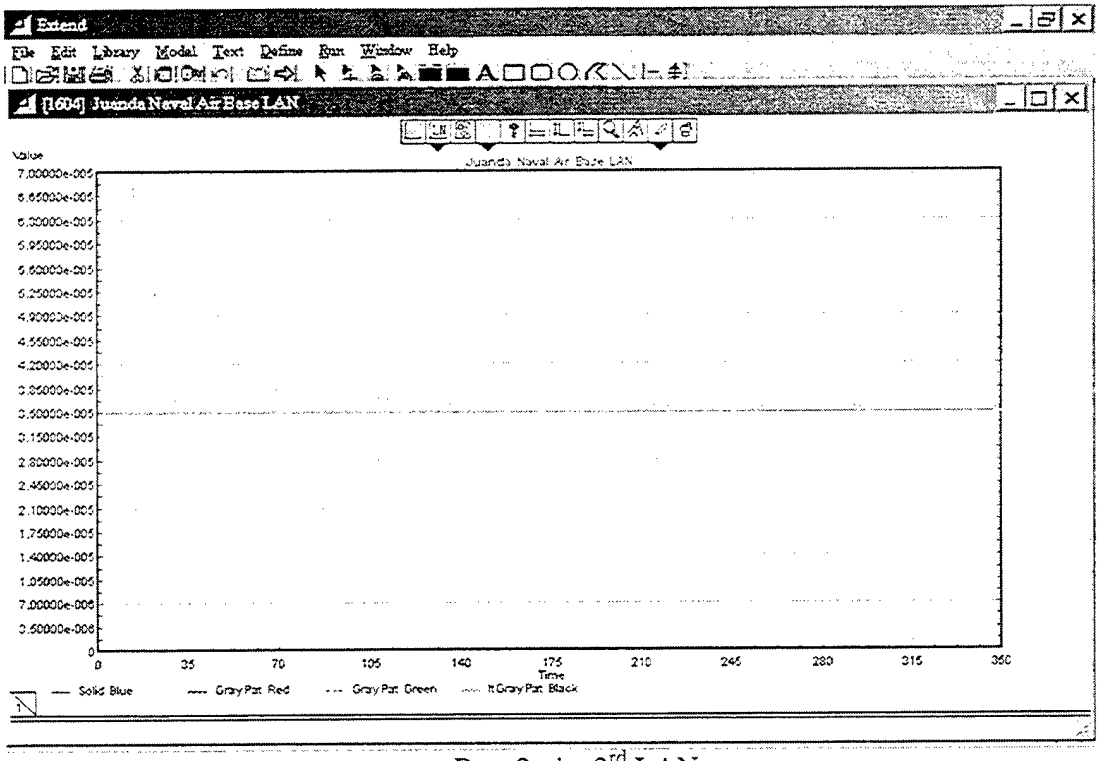
Point Number	1 Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 GrayPa...
576	266.004413507716	0.012979208585			92.2492442940414	0.1802812171087		
577	266.476837593254	0.004834133334			92.25814215039	0.1802815039599		
578	266.07728001182	8.29000000e-005			92.25814215039	0.1825494987709		
579	266.464051022114	0.004834133334			92.50627241463	0.1825497846359		
580	266.534921099444	8.29000000e-005			92.50627241463	0.1820221221468		
581	267.319578769826	0.015423534004			92.86428094135	0.1820224070255		
582	267.99410216174	8.29000000e-005			92.86428094135	0.1819990425179		
583	268.38540031373	0.010252584666			93.1333372503849	0.1895790081946		
584	268.471079679718	8.29000000e-005			93.1333372503849	0.1899022279809		
585	268.61024984401	0.017540729194			93.54007591751	0.1900466368504		
586	269.76175218587	8.29000000e-005			93.54007591751	0.1902927379989		
587	271.09001960774	0.008440264128			94.04285531703	0.1923630199717		
588	271.09940627441	0.006448258152			94.04285531703	0.1917408402429		
589	271.486226078	8.29000000e-005			94.89056585083	0.1917411212599		
590	271.720031564641	0.006353133334			94.89056585083	0.1910633472015		
591	271.769121815779	8.29000000e-005			95.35850875383	0.1910636272691		
592	272.597310102283	0.007961866667			95.35850875383	0.1904602143827		
593	272.720926983222	8.29000000e-005			95.31010647384	0.1904716054404		
594	273.004199207776	0.012814696267			95.31010647384	0.1898324589940		
595	273.477272925852	0.009699174379			95.35464921175	0.2018929758209		
596	274.083208934254	8.29000000e-005			95.35464921175	0.2012177464883		
597	275.024071106044	0.004834133334			95.62240374894	0.2012180237408		
598	275.100876283	8.29000000e-005			95.62245374894	0.2005472969988		
599	275.377095650756	0.007961866667			97.06272455815	0.2005475733214		
600	275.456781513044	8.29000000e-005			97.06272455815	0.1998818029206		
601	276.450919570744	0.011359520483			98.46224640851	0.2048450187464		
602	276.46553650447	8.29000000e-005			98.46224640851	0.2078046578868		
603	276.973619403449	0.007961866667			98.62265640851	0.2120796027261		
604	277.103142540488	8.29000000e-005			98.62265640851	0.2113786700438		
605	277.259364230011	0.007249257654			98.82673211518	0.2198637712261		
606	277.331674907111	8.29000000e-005			98.82673211518	0.2191405351366		
607	281.087421334811	0.006353133334			99.56685017518	0.2237468118008		
608	281.758378638473	8.29000000e-005			99.56685017518	0.2230102156995		
609	283.530517558486	0.007961866667			99.84602884185	0.2230876542087		
610	283.552927775001	0.007099199999			99.84602884185	0.2223536095871		
611	283.713911435271	0.004834133334			99.022460984185	0.231156986907		



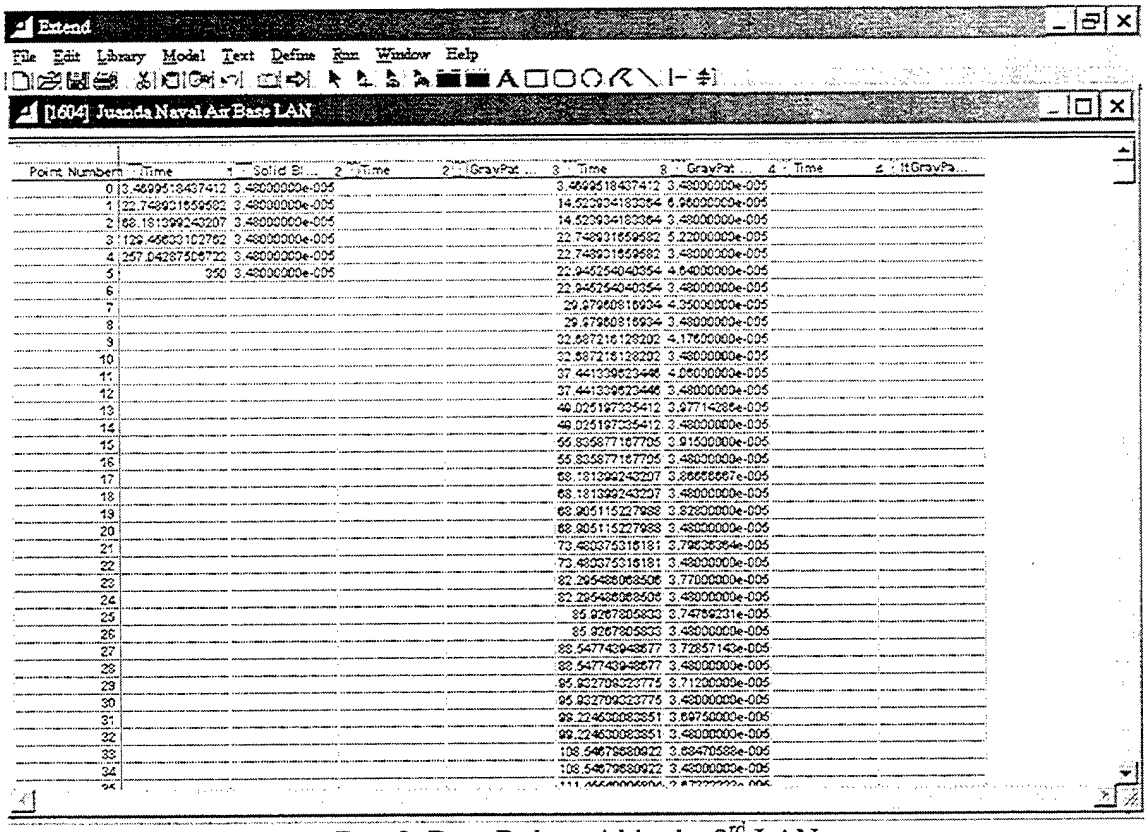
Point Number	1 Time	1 Solid Bl...	2 Time	2 GrayPat ...	3 Time	3 GrayPat ...	4 Time	4 GrayPa...
612	284.426591003567	0.006353133334			99.022460984185	0.2304030059372		
613	286.081313036097	8.29000000e-005			99.322910922649	0.2309983162829		
614	286.204220022225	0.004834133334			99.322910922649	0.2385219490223		
615	286.30847931.94	8.29000000e-005			99.661000984185	0.2356385702582		
616	286.345762593396	0.004834133334			99.661000984185	0.2378650777978		
617	286.487680088699	0.006353133334			99.871946460852	0.2425903680857		
618	287.54099658883	8.29000000e-005			99.871946460852	0.2418078185112		
619	289.140007730027	0.008250905297			99.004867524618	0.2418556818468		
620	289.419695048883	0.004834133334			99.004867524618	0.2410780108451		
621	289.423575082217	0.011519283887			99.163591890794	0.2410782774056		
622	290.12877820037	8.29000000e-005			99.163591890794	0.240395590619		
623	290.201632886116	0.004834133334			99.558941113873	0.2403058562241		
624	290.623793338862	0.006720164504			99.558941113873	0.2395381059846		
625	290.626177706114	8.29000000e-005			99.562737217519	0.2395901210886		
626	291.798688080069	0.009952338799			99.562737217519	0.2388270952256		
627	292.551015419588	8.29000000e-005			99.726170904854	0.2388275592283		
628	292.98905829441	0.007961866667			99.726170904854	0.2380691771466		
629	293.190566786624	8.29000000e-005			99.954699250852	0.2517560156036		
630	293.471995619886	0.006353133334			99.954699250852	0.2509993192816		
631	293.842563000051	0.009267241012			99.940345460853	0.2504105539141		
632	294.265993932292	0.006746392721			99.940345460853	0.2495590695159		
633	294.925399648489	0.006353133334			99.279094033399	0.2595833310311		
634	295.430586033692	8.29000000e-005			99.279094033399	0.2587730120801		
635	297.201594289224	0.006353133334			99.484725460853	0.2655427174979		
636	298.015003972316	0.007961866667			99.484725460853	0.2627185647785		
637	298.146988825929	0.008497598537			99.794404584186	0.2627353460704		
638	298.957425595552	8.29000000e-005			99.794404584186	0.2619152949889		
639	299.177111578896	0.004834133334			99.84606821752	0.2619520009225		
640	300.157641319068	8.29000000e-005			99.84606821752	0.2611356510754		
641	302.268599874099	0.004834133334			99.93127901173	0.2611352093308		
642	302.3636046956	0.004744999999			99.93127901173	0.2603252273142		
643	302.65694299042	8.29000000e-005			94.081570584186	0.2651202371977		
644	303.431153658978	0.007961866667			94.081570584186	0.2643114940485		
645	303.474481185554	8.29000000e-005			94.28260031752	0.2691466351035		
646	305.640149589914	0.008975720191			94.28260031752	0.2683149385889		
647	305.843699711921	8.29000000e-005			94.954654460853	0.2779627308262		



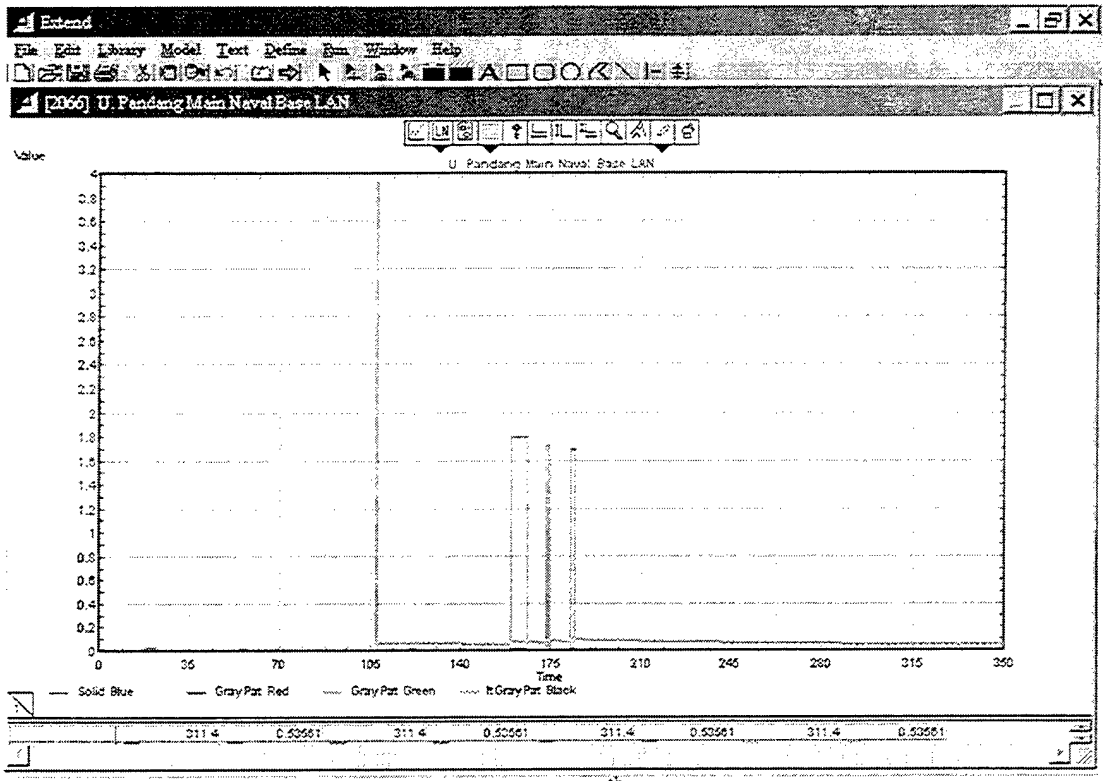
Run 3, Data Delay within the 2nd LAN



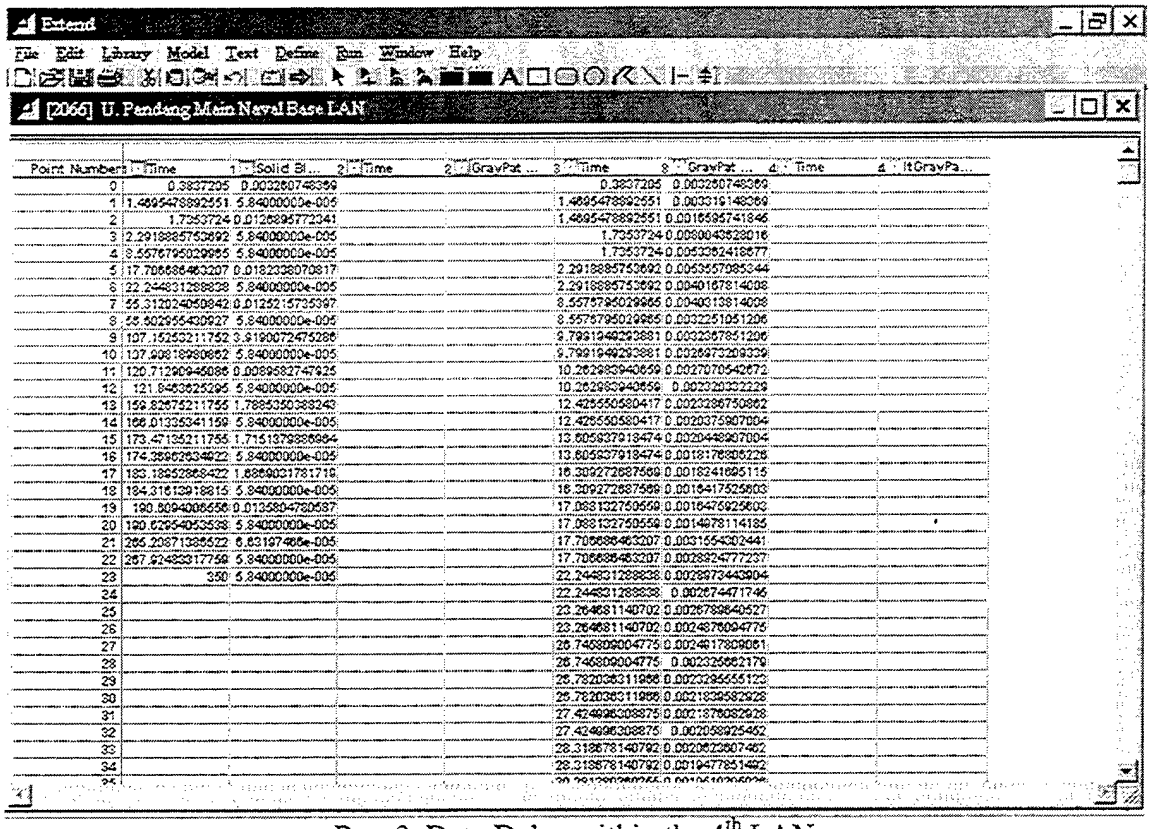
Run 3, the 3rd LAN



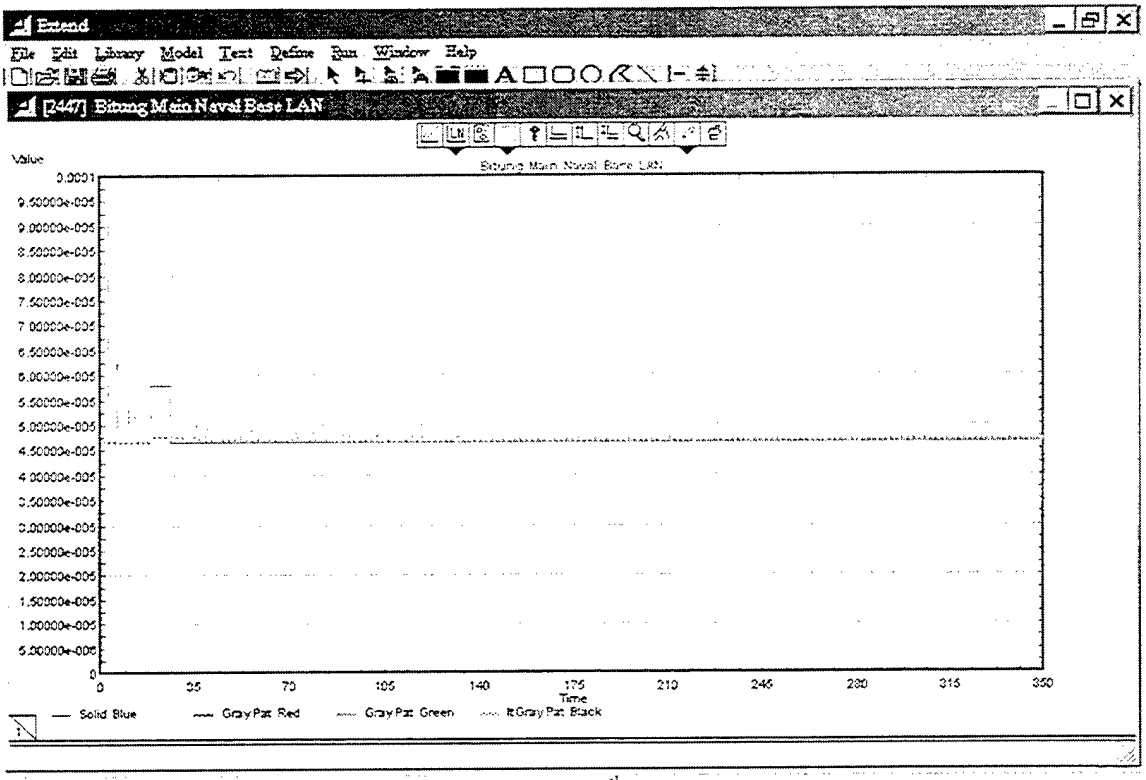
Run 3, Data Delay within the 3rd LAN



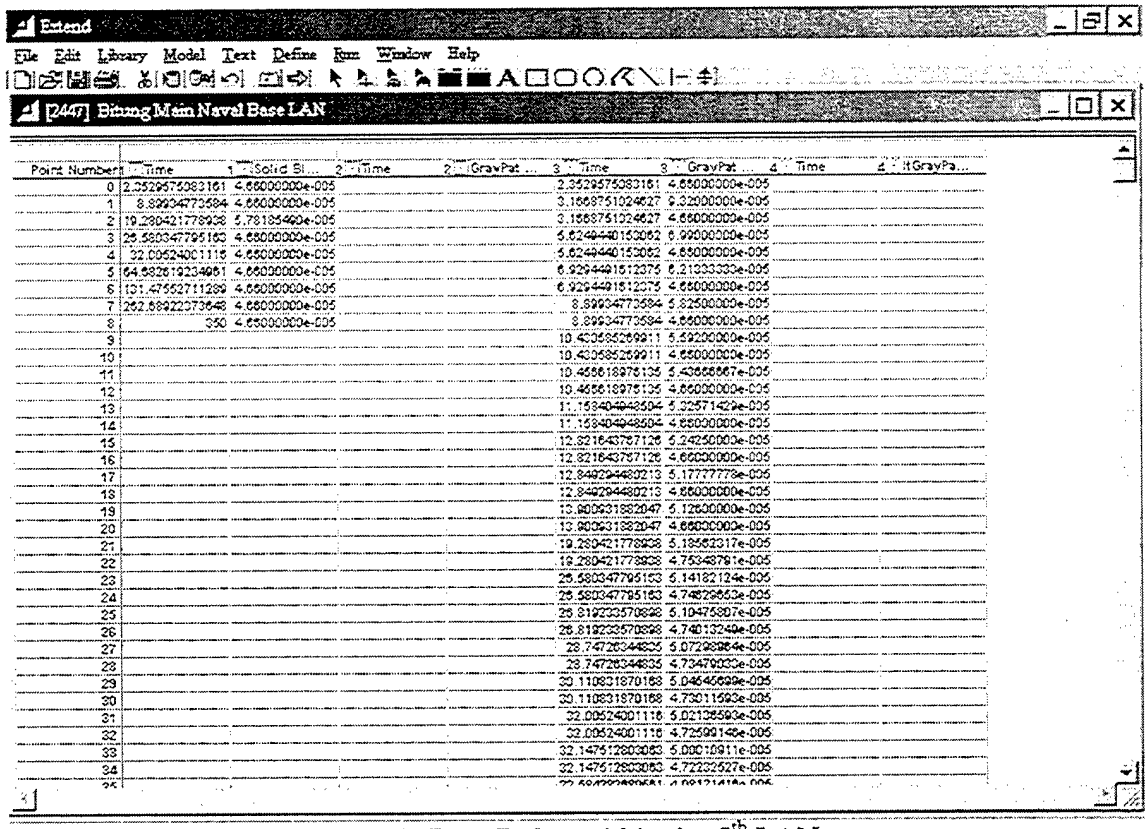
Run 3, the 4th LAN



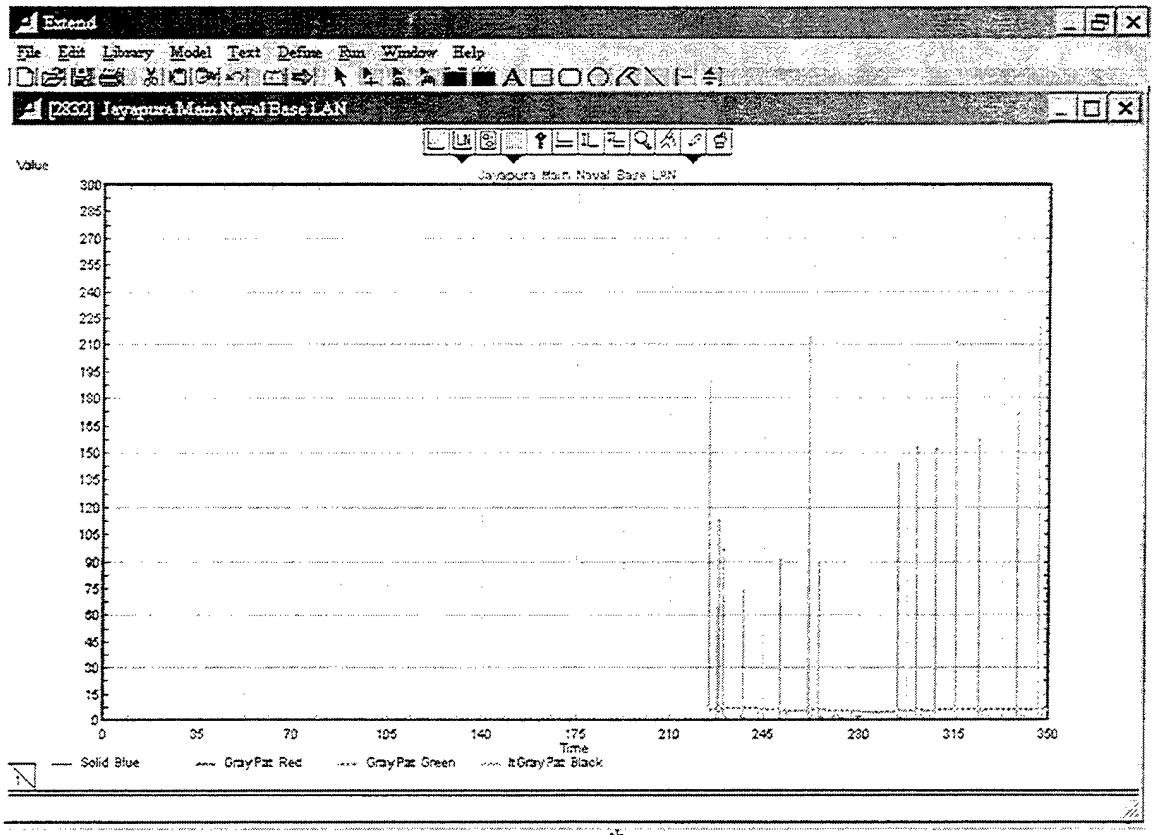
Run 3, Data Delay within the 4th LAN



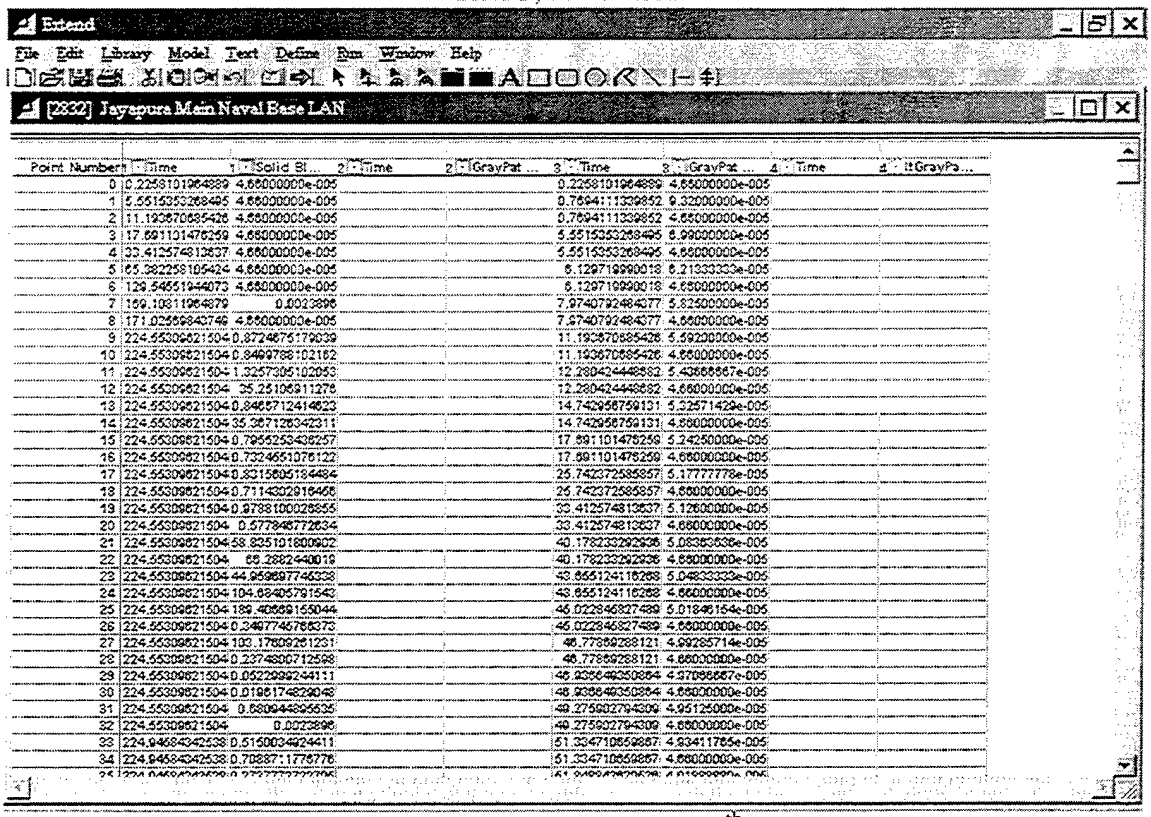
Run 3, the 5th LAN



Run 3, Data Delay within the 5th LAN

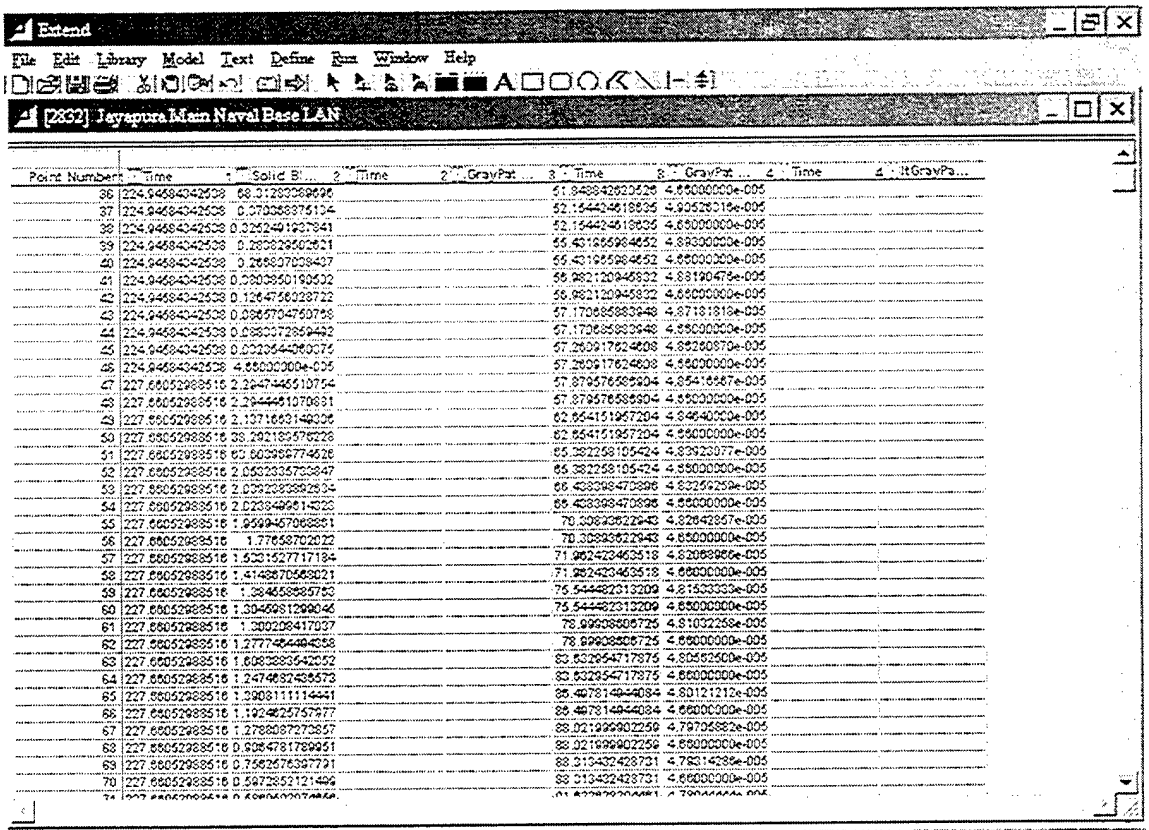


Run 3, the 6th LAN

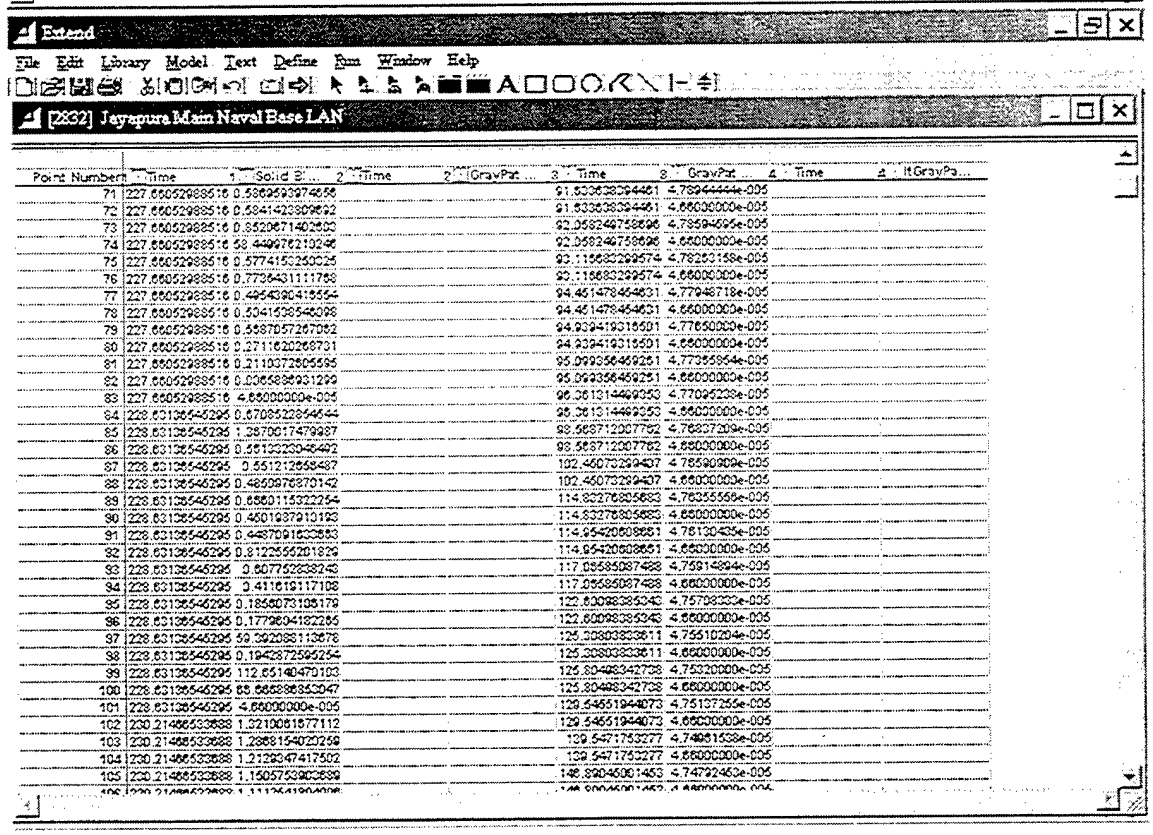


Point Number	Time	Solid Bl...	Time	GrayPat ...	Time	GrayPat ...	Time	ItGrayPa...
0	0.2258101964889	4.66000000e-005			0.2258101964889	4.66000000e-005		
1	5.5515353268495	4.66000000e-005			0.7694111339852	9.32000000e-005		
2	11.193670685426	4.66000000e-005			0.7694111339852	4.66000000e-005		
3	17.691101476259	4.66000000e-005			5.5515353268495	6.99000000e-005		
4	33.412574813637	4.66000000e-005			5.5515353268495	4.66000000e-005		
5	65.382258105424	4.66000000e-005			6.129719990018	6.21333333e-005		
6	129.54551944073	4.66000000e-005			6.129719990018	4.66000000e-005		
7	169.10811964879	0.0023896			7.9740792484377	5.82500000e-005		
8	171.02569843749	4.66000000e-005			7.9740792484377	4.66000000e-005		
9	224.55309621504	0.8724675179039			11.193670685426	5.59200000e-005		
10	224.55309621504	0.8499788102162			11.193670685426	4.66000000e-005		
11	224.55309621504	1.3257305102053			12.280424448682	5.43666667e-005		
12	224.55309621504	35.25106911276			12.280424448682	4.66000000e-005		
13	224.55309621504	0.8466712414623			14.742956759131	5.32571429e-005		
14	224.55309621504	35.367126342311			14.742956759131	4.66000000e-005		
15	224.55309621504	0.7955253436257			17.691101476259	5.24250000e-005		
16	224.55309621504	0.7324651076122			17.691101476259	4.66000000e-005		
17	224.55309621504	0.8315605184484			25.742372585857	5.17777778e-005		
18	224.55309621504	0.7114302916466			25.742372585857	4.66000000e-005		
19	224.55309621504	0.9788100026855			33.412574813637	5.12600000e-005		
20	224.55309621504	0.577846772634			33.412574813637	4.66000000e-005		
21	224.55309621504	58.835101800902			40.178233292936	5.08363636e-005		
22	224.55309621504	66.2882440019			40.178233292936	4.66000000e-005		
23	224.55309621504	44.959697746338			43.655124116268	5.04833333e-005		
24	224.55309621504	104.68405791543			43.655124116268	4.66000000e-005		
25	224.55309621504	189.40669155044			45.022846827489	5.01846154e-005		
26	224.55309621504	0.3497745766373			45.022846827489	4.66000000e-005		
27	224.55309621504	103.17809261231			46.77869288121	4.99285714e-005		
28	224.55309621504	0.2374800712598			46.77869288121	4.66000000e-005		
29	224.55309621504	0.0522999244111			46.936649350864	4.97066667e-005		
30	224.55309621504	0.0196174829048			46.936649350864	4.66000000e-005		
31	224.55309621504	0.680944895535			49.275902794309	4.95125000e-005		
32	224.55309621504	0.0023896			49.275902794309	4.66000000e-005		
33	224.94584342538	0.5150034924411			51.334710659867	4.93411765e-005		
34	224.94584342538	0.7088711776776			51.334710659867	4.66000000e-005		
35	224.94584342538	0.2737777777776			51.94584342538	4.01999999e-005		

Run 3, Data Delay within the 6th LAN



Point Number	0 : Time	1 : Solid Bl...	2 : Time	2 : GravPat ...	3 : Time	3 : GravPat ...	4 : Time	4 : ItGravPa...
36	224.9468042539	68.01283058696			51.94884282052E	4.66000000e-005		
37	224.9468042539	0.07008687511054			52.15444246186E	4.90526316e-005		
38	224.9468042539	0.2252491927841			52.15444246186E	4.66000000e-005		
39	224.9468042539	0.2668029502521			55.40186598465E	4.89300000e-005		
40	224.9468042539	0.2668307038437			55.40186598465E	4.66000000e-005		
41	224.9468042539	0.2803650190502			56.98212094583E	4.88190476e-005		
42	224.9468042539	0.1264756028722			56.98212094583E	4.66000000e-005		
43	224.9468042539	0.0965704760766			57.17068588394E	4.87181818e-005		
44	224.9468042539	0.0960372869492			57.17068588394E	4.66000000e-005		
45	224.9468042539	0.0320644060075			57.26917624608	4.85260870e-005		
46	224.9468042539	4.66000000e-005			57.26917624608	4.66000000e-005		
47	227.6605298516	2.264744551075E			57.87957656590E	4.85416667e-005		
48	227.6605298516	2.264744551075E			57.87957656590E	4.66000000e-005		
49	227.6605298516	2.137166314930E			62.66451957204	4.84640000e-005		
50	227.6605298516	38.29218957622E			62.66451957204	4.66000000e-005		
51	227.6605298516	60.66098677462E			65.38225810542E	4.83923077e-005		
52	227.6605298516	2.053233575584E			65.38225810542E	4.66000000e-005		
53	227.6605298516	2.029239892634			66.42809847089E	4.83256250e-005		
54	227.6605298516	2.023949961452E			66.42809847089E	4.66000000e-005		
55	227.6605298516	1.959945706865E			70.30893622944	4.82642857e-005		
56	227.6605298516	1.776587020224			70.30893622944	4.66000000e-005		
57	227.6605298516	1.632152771718A			71.95242346351E	4.82058824e-005		
58	227.6605298516	1.414867056802I			71.95242346351E	4.66000000e-005		
59	227.6605298516	1.284658685753			75.54448231320E	4.81503333e-005		
60	227.6605298516	1.304698129904E			75.54448231320E	4.66000000e-005		
61	227.6605298516	1.300209417037			78.99908506725	4.81032258e-005		
62	227.6605298516	1.277745444058			78.99908506725	4.66000000e-005		
63	227.6605298516	1.608988554205E			83.63295471787E	4.80468000e-005		
64	227.6605298516	1.247468246857E			83.63295471787E	4.66000000e-005		
65	227.6605298516	1.290811111444I			86.46781494408E	4.80121212e-005		
66	227.6605298516	1.192462575797I			86.46781494408E	4.66000000e-005		
67	227.6605298516	1.278688727385I			88.92199990225E	4.79705882e-005		
68	227.6605298516	0.9054781789951			88.92199990225E	4.66000000e-005		
69	227.6605298516	0.7662576397791			89.01043242873I	4.78314286e-005		
70	227.6605298516	0.5472852121494			89.01043242873I	4.66000000e-005		



Point Number	0 : Time	1 : Solid Bl...	2 : Time	2 : GravPat ...	3 : Time	3 : GravPat ...	4 : Time	4 : ItGravPa...
71	227.6605298516	0.5869599374656			91.83063894461	4.78944444e-005		
72	227.6605298516	0.5841423099692			91.83063894461	4.66000000e-005		
73	227.6605298516	0.8520671402605			92.06824975696E	4.78594595e-005		
74	227.6605298516	58.44997621024E			92.06824975696E	4.66000000e-005		
75	227.6605298516	0.5774150250025			93.11568329957A	4.78253158e-005		
76	227.6605298516	0.7726431111758			93.11568329957A	4.66000000e-005		
77	227.6605298516	0.4954390415554			94.46147845463I	4.77948718e-005		
78	227.6605298516	0.5041503546095			94.46147845463I	4.66000000e-005		
79	227.6605298516	0.5587057267062			94.93941931659I	4.77650000e-005		
80	227.6605298516	0.2711620268731			94.93941931659I	4.66000000e-005		
81	227.6605298516	0.2110372805595			95.09935645925I	4.77359564e-005		
82	227.6605298516	0.0065686931299			95.09935645925I	4.66000000e-005		
83	227.6605298516	4.66000000e-005			96.36131446935I	4.77095238e-005		
84	228.6313654629E	0.6708522854644			96.36131446935I	4.66000000e-005		
85	228.6313654629E	1.287001747998I			98.56871200776I	4.76837209e-005		
86	228.6313654629E	0.6513920946492			98.56871200776I	4.66000000e-005		
87	228.6313654629E	0.5512126568487			102.4607329940I	4.76590909e-005		
88	228.6313654629E	0.4859976870142			102.4607329940I	4.66000000e-005		
89	228.6313654629E	0.6560115322254			114.8327680568E	4.76355556e-005		
90	228.6313654629E	0.4501937910193			114.8327680568E	4.66000000e-005		
91	228.6313654629E	0.4487091503653			114.9542060866I	4.76130435e-005		
92	228.6313654629E	0.8122555201829			114.9542060866I	4.66000000e-005		
93	228.6313654629E	0.6077528038245			117.0958508748E	4.75914894e-005		
94	228.6313654629E	0.4116191117108			117.0958508748E	4.66000000e-005		
95	228.6313654629E	0.1856073105179			122.6009838504E	4.75708333e-005		
96	228.6313654629E	0.1779804182285			122.6009838504E	4.66000000e-005		
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98	228.6313654629E	0.1942872595254			126.2080383861I	4.66000000e-005		
99	228.6313654629E	112.6514047010E			126.8048834270E	4.75320000e-005		
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104	230.2146653268E	1.212994774175E			139.5471753277	4.66000000e-005		
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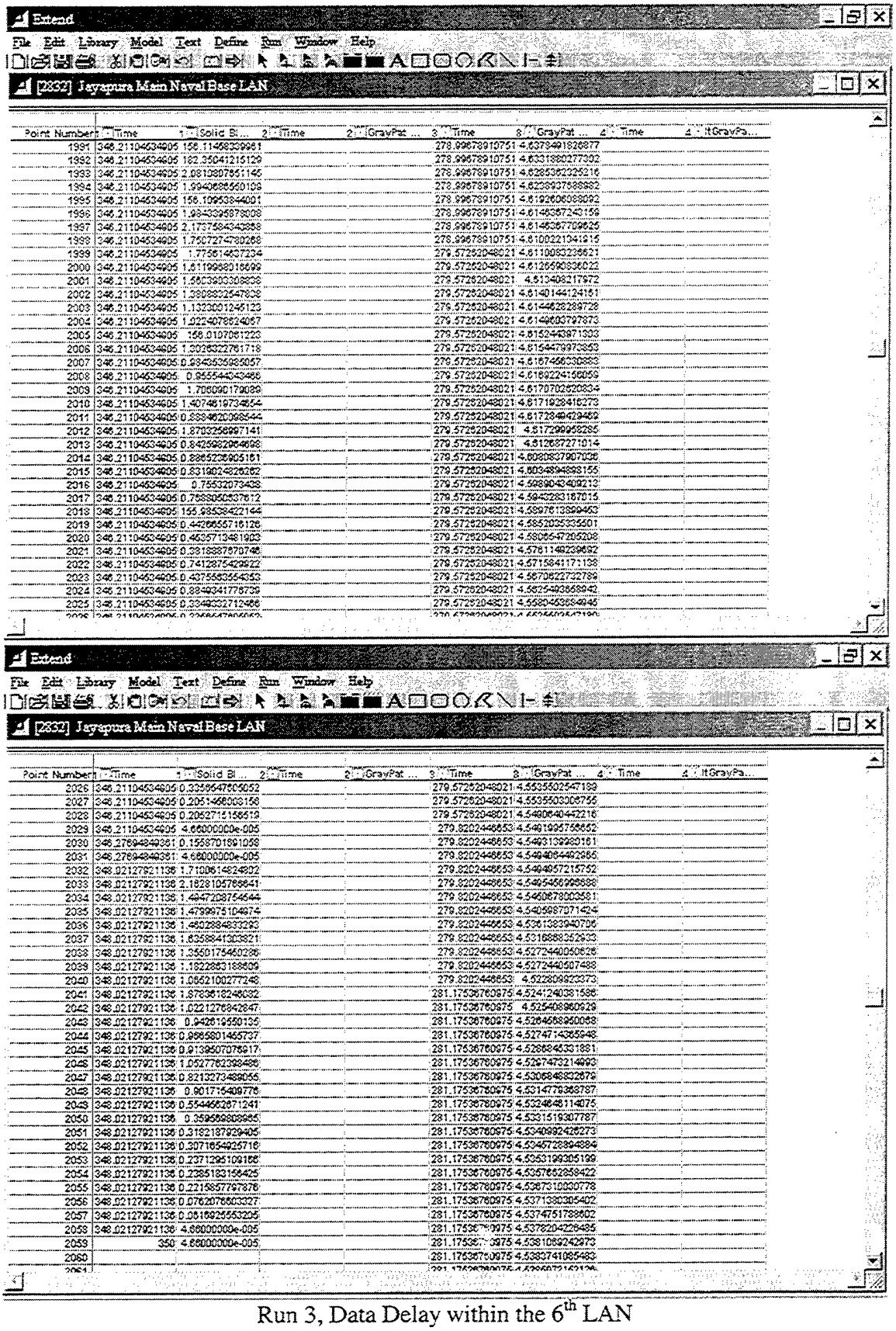

Run 3, Data Delay within the 6th LAN

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