

PERSONAL ROUTER USING LINUX

AMILIA YANTI BINTI ABDULLAH

**A thesis submitted in partial fulfillment of the
requirement for the award
of the degree of
Bachelor of Computer Science (Computer Systems and Network)**

**Faculty of Computer Systems and Software Engineering
University College of Engineering and Technology Malaysia**

NOVEMBER, 2005

ABSTRACT

The useful of network today are a famous thing in organization. There are many types of network such as local area network and metropolitan area network. All types of networks need a suitable device that allows the communication between the networks. The router is a suitable device for this job. The router is a computer device that allows more than one network to communicate each other. The router also functions to detect the corrupted packet that happened in the connection among the network through the router. For the small organization, the cost to have the own router is a high cost. So this project aim is to help the small organization to build the personal router. The personal router is making using the personal computer that can be function as a router. For this time, this project implement to the Intranet condition where the two computers connected each other with the personal computer as a router. The two computers has been configure with two different LAN. The software are develop base on Linux environment and use QT Designer as a platform. The language for the software coding use a C and C++ language. The detail of this project was included in this report. .

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	Title Page	i
	Declaration	ii
	Dedication	iii
	Acknowledgments	iv
	Abstract	v
	Abstrak	vi
	List of Tables	xii
	List of Figures	xiii
	List of Abbreviation	xv
	List of Appendices	xvi
1	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Problem Statement	2
	1.3 Problem Solution	2
	1.4 Objective Of The Project	2
	1.5 System Scope	3

2	LITERATURE REVIEW	4
2.1	Introduction	4
2.2	Briefly About Router	5
2.2.1	The Function Of Router	6
2.2.2	The Routing Protocol	8
2.2.3	Routing Algorithm	10
2.2.3.1	Static Versus Dynamic	11
2.2.3.2	Single-path Versus Multipath	11
2.2.4	Network Protocol	12
2.2.5	Packet Dropping	12
2.3	Existing Router	13
2.3.4	3Com Router	13
2.3.5	Cisco 12016 Gigabit Switch Router	14
2.3.6	D-Link DI-707 Router	14
2.4	Existing Software	15
2.4.1	IPCop	15
2.4.2	SmoothWall Express	16
2.4.3	Free BSD	17
2.4.4	Coyote Linux	18
2.5	Implementation Devices	18
2.5.1	Client	18
2.5.2	Network Interface Card	19
2.5.3	The Ethernet Cable	20
2.5.3.1	10 Base 5	20
2.5.3.2	10 Base 2	20
2.5.3.3	10 Base T	21

2.5.3.4	10 Base F	21
2.5.3.5	10VG-Any LAN	21
2.5.4	Cross Over Cable	22
2.6	TCP/IP	22
2.6.1	Ping	24
2.7	Network Categories	25
2.8	Implementation Software	26
2.8.1	Fedora Core 3	26
2.8.2	Netfilter	27
2.8.3	QT Designer	27
2.8.4	GTK 1.2.10	28
2.9	Implementation Language	29
2.9.1	C Language	29
2.9.2	C++ Language	30
2.10	Conclusion	31
3	METHODOLOGY	32
3.1	Introduction	32
3.2	Project Identification	33
3.3	Project Initiation And Planning	33
3.4	Analysis	33
3.5	Design	34
3.5.1	A Personal Router	34
3.5.2	Interface Design	35
3.5.2.1	Main Interface	36

3.5.2.2	Interface Two	36
3.5.2.3	Interface Three	37
3.5.2.4	Interface Four	38
3.5.3	Work Flow Of Project	38
3.5.4	Implementation	38
3.5.5	Debug And Testing	39
3.6	Specification Of Tools	39
3.6.1	Personal Computer For Router	40
3.6.2	Personal Computer (Client)	40
3.6.3	Network Interface Card	41
3.6.4	Cross Cable	41
3.7	Conclusion	41
4	RESULT AND DISCUSSION	42
4.1	Introduction	42
4.2	Result And Discussion	42
4.2.1	Interface 1	42
4.2.2	Interface 2	43
4.2.3	Interface 3	44
4.2.4	Interface 4	45
4.2.5	Interface 5	46
4.2.6	Interface 6	47
4.2.7	Interface 7	48
4.3	Testing Result	48
4.3.1	Testing Connection 1	48
4.3.2	Testing Connection 2	49
4.4	Advantages	50

4.5	Weakness	51
4.6	Constraints	51
4.7	Assumption	51
4.8	Future Research	52
5	CONCLUSION	53
	RERERENCES	56
	Appendix A - C	57 - 59

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
2.1	Network Layer Data Extraction	6
2.2	The Process Of Routing Protocol	10
2.3	Interface Of SmoothWall Express	17
2.4	Crossover Ethernet Cable Pinout	22
2.5	OSI Model	24
2.6	QT Designer Platform	28
3.1	The System Development Life Cycle	32
3.2	Simple Topology Of Router	35
3.3	Example Of Main Interface	36
3.4	Example Of Active Network Card	37
3.5	Example Of Routing Tables	37
3.6	Example Of Testing Network	38
4.1	The Main Interface	43
4.2	Active Network Card	44
4.3	Interface : Routing Interface	45
4.4	Interface : Testing Network	45

4.5	Interface : Testing Network 1	46
4.6	Interface : Testing Network 2	47
4.7	Interface : Finish	48
4.8	Testing Output	49
4.9	Testing Output	50

LIST OF ABBREVIATION

PC	-	Personal Computer
SDLC	-	System Development Life Cycle
PSM	-	Undergraduate Project (Projek Sarjana Muda)
IP	-	Internet Protocol Address
KUKTEM	-	Kolej Universiti Kejuruteraan Teknologi Malaysia
LAN	-	Local Area Network
MAN	-	Metropolitan Area Network
NIC	-	Network Interface Card
HTTP	-	Hypertext Transport Protocol
FTP	-	File Transfer Protocol
C/S	-	Client / Server
MAC	-	Medium Access Control
UTP	-	Unshielded Twisted Pair
STP	-	Shielded Twisted Pair
TCP / IP	-	Transmission Control Protocol / Internet Protocol

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Gant Chart	57
B	System Work Flow	58
C	User Manual	59

CHAPTER 1

INTRODUCTION

1.1 Introduction

A router is a computer networking device that forwards data packets toward their destinations through a process known as routing. The function of router is receiving packet from receiver and send it to a correct destination. The router also can drop the packet if the router detects a specified fault for the packet or the packet become corrupted it will be discarded by routers.

In Linux environment, a dedicated Linux router can offer the greatest control over access, security and logging more than windows environment. Linux is an operating system designed from ground up to be secure and robust in a network environment.

This project is created to make Linux router using the personal computer, make that the router more graphical user interface and user can get information about the problem if drop packet happen. The personal router is creating using the personal computer that can be function as a router. For this time, this project is implementation for small office or home network only. The normal user can create their own network using this router. The software for the router also had been created base on Linux environment, using QT Designer as a platform and use Fedora as a kernel. The language for the software coding is using C and C++ language.

1.2 Problem Statement

There are many current problems for this project. The first problem is about some existing software. There are some existing software that can produce user to build the own router but all the software just for expert user only and it is not suitable for normal user. The second problem is about the cost of router. For the small office, it is a high cost to use the router. The third problem is about the configuration of router. It is using the command line program to do a configuration. So, it is difficult to do by a normal user.

1.3 Problem Solution

From the problem statement, there are some solutions for that. Below all the solution that can be make for the problem statement:

- i. Make a software for router that a normal user can create their own router
- ii. Reuse all coding to make a router more to graphical user interface and easy to understand.

1.4 Objective Of The Project

In developing this project, there are certain objectives to fulfill. The objectives to be achieved are:

- i. Develop the personal router base on Linux environment.
- ii. Develop the graphical user interface for personal router.
- iii. Build the personal router that able to detect drop packet.

1.5 System Scope

The scope of this project included:

- i. Develop a personal router that base on Linux environment. This is making a personal computer that can function as a router.
- ii. The kernel use for this development is Fedora Core 3.
- iii. Create a system for user that allow to build a personal router
- iv. Implementation for this project just in Local Area Network only.
- v. Create a message in computer router that can inform if the drop packet happened.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A router is a computer networking device that forwards data packets toward their destinations through a process known as routing. The function of router is receiving packet from receiver and send it to a correct destination. The router also can drop the packet if the router detects a specified fault for the packet. But the router cannot allow user to display the dropped packet, detect with packet is dropped and reordering the packet.

This project is created to build a Linux router using the personal computer, make that the router more graphical user interface and user can get information about the problem if drop packet happen. The personal router is creating using the personal computer that can be function as a router. For this time, this project is implementation to small office or home network. The personal routers use the software that can control the router. The software is base on Linux environment and use Fedora Core 3 as a kernel. The language for the software coding is use a C and C++ language.

2.2 Briefly About Router

The router is the most powerful networking device used today on interconnection LANs. The router is configured to know how to route the data packet entering or existing the LAN (Jeffrey, 2004).

Routing occurs at layer 3 of the OSI seven-layer model. Routing is most commonly associated with the Internet Protocol, although other less-popular routed protocols remain in use.

In the original 1960s-era of routing, general-purpose computers served as routers. Although general-purpose computers can perform routing, modern high-speed routers are highly specialized computers, generally with extra hardware added to accelerate both common routing functions such as packet forwarding and specialized functions such as IP sec encryption (Ed Taylor, 1998).

The first modern (dedicated, standalone) routers were the Fuzzball routers. A router must be connected to at least two networks, or it will have nothing to route (Ed Taylor, 1998). A special variety of router is the one-armed router used to route packets in a virtual LAN environment. In the case of a one-armed router the multiple attachments to different networks are all over the same physical link. A router which connects end-users to the Internet is called Edge router, a router which serves to transmit data between other routers is called Core router.

A router creates and or maintains a table, called a routing table that stores the best routes to certain network destinations and the routing metrics. Routing functions have been added to LAN switches and that create Layer 2/3 Switches where route traffic at near wire speed.

Routers are also now being implemented as Internet gateways, primarily for small networks like those used in homes and small offices (J.F.DiMarzio, 2002).

This application is mainly where the Internet connection is an always on broadband connection like cable modem or DSL.

2.2.1 The Function Of Router

Layer 3 of OSI model is one most important when dealing with router. Layer 3 is the king of all layer. Although each layer serve important purpose, layer 3 is the layer over which most routing take place (J.F.DiMarzio, 2002).

For routing function correctly, the internet layer must pieces together a logical map. It is to do as a guide to route data across the network. The first step in constructing a network map is to converting transport layer segment into a packet. After that, the packet will passed to data link layer when addressing information is added. When device receives packet, sender information is stripped from packet and stored in a table. Figure 2.1 shown the illustrates how routing table information is extracted from network layer data.

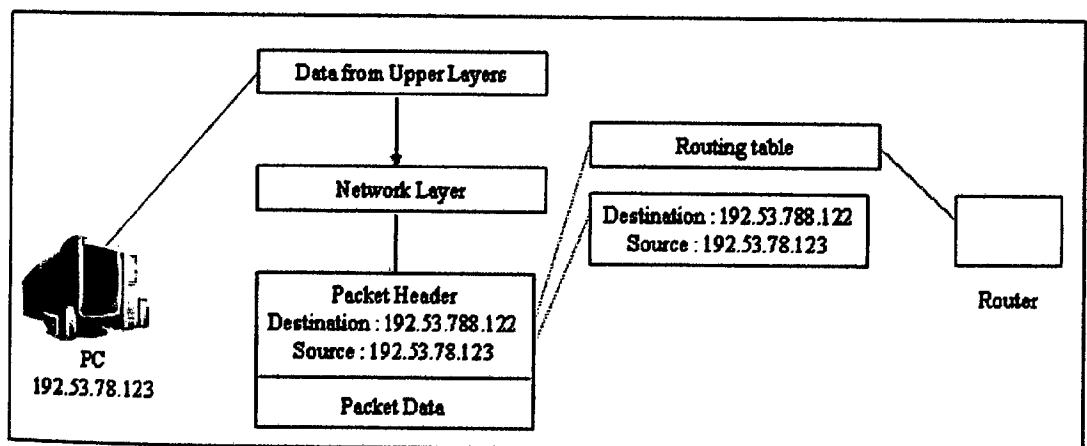


Figure 2.1 : Network Layer Data Extraction (J.F.DiMarzio, 2002).

The all data that used by network layer also stored locally in router routing table. All information are depends on the routing protocol being users only. The table 2.1 are shown the information that router needs to move data between system.

Table 2.1 : Information Of Moving Data.

Information	Why?
Knowledge of network environment	To know the location of every device on the network to successfully move data between them.
A form of device addressing	Knowing where a computer is on the network does no help. So specific target of devices must be collected by address.
A physical connection to the devices being targeted	Need to know for intercommunication
A mechanism to transport the data from source to destination	To makes network transmission reliable

So, each layer of OSI model is responsible for one or more pieces of information and the protocol designed to work on those layer will carry that information together.

Routers are specialized computers that send the messages and those of every other Internet user speeding to their destinations along thousands of pathways (J.F.DiMarzio, 2002). For example, the process when sending e-mail to computer destination on the other side of the country, how does the message know to end up on the true computer destination, rather than on one of the millions of other computers in the world. Much of the work to get a message from one computer to another is done by routers, because they are the crucial devices that let messages flow between networks, rather than within networks.

When one animator sends a file to another, the very large file will use up most of the network's capacity, making the network run very slowly for other users. One of the reasons that a single intensive user can affect the entire network stems from the way that Ethernet works. Each information packet sent from a computer is seen by all the other computers on the local network. Each computer then examines the packet and decides whether it was meant for its address. This keeps the basic plan of the network simple, but has performance consequences as the size of the network or level of network activity increases. To keep the animators' work from interfering with that of the folks in the front office, the company sets up two separate networks, one for the animators and one for the rest of the company. A router links the two networks and connects both networks to the Internet.

2.2.2 The Routing Protocol

The first and most basic job of the router is to know where to send information addressed to a computer. Just as the mail handler on the other side of the country knows enough to keep a birthday card coming toward you without knowing where your house is, most of the routers that forward an e-mail message to you don't know your computer's MAC address, but they know enough to keep the message flowing.

Routers are programmed to understand the most common network protocols (J.F. DiMarzio, 2002). That means they know the format of the addresses, how many bytes are in the basic package of data sent out over the network, and how to make sure all the packages reach their destination and get reassembled. For the routers that are part of the Internet's main backbone, this means looking at and moving on millions of information packages every second. And simply moving the package along to its destination isn't all that a router will do. It is just as important, in today's computerized world, that they keep the message flowing by the best possible route.

There are many things that can do using the networking. One of that included to transfer data between to computer. When application on device such as pc needs to send data to another application on a different pc, the data is given to protocol residing on the pc. This protocol performs on major task enables the transmission of this data anywhere it encapsulates the data and prepared it for delivery.

The process of data encapsulation is one key factor that makes information routing possible with two purposes. It is like the address of data and formatting is according to standard template. The other is to break longer data streams into smaller pieces that can be transmitting quickly.

When pc or other device wants to send to another device in another network, that data must pass through router (J.F.DiMarzio, 2002). However, before the information can reach by router, router protocol were encapsulated the information on the sending device. As the information traverses the OSI model on the sending device, the route protocol being used the data to prepared it for transmission across the network media. The router protocol were accepts the raw data and encapsulates it in packet, adding all pertinent addressing information in the process (J.F.DiMarzio, 2002). The packet is then passed to physical layer of OSI model and sent out onto network.

On this process, the router will reach the packet and pass it to routing protocol. The routing protocol strips off the router protocol header and reads through header information to extract several key pieces of information. Figure 2.2 are shown the process used by routing protocol.

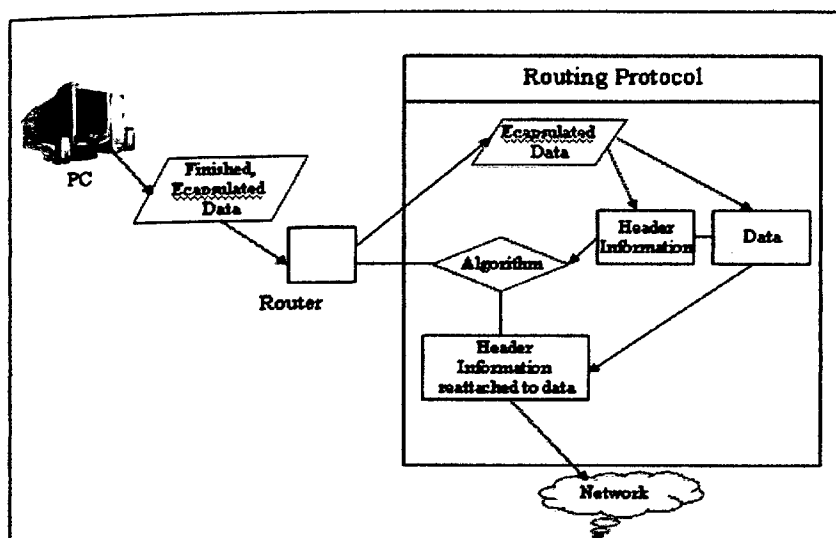


Figure 2.2 : The Process Used By Routing Protocol (J.F.DiMarzio, 2002).

The routing protocol determines the source, destination and any pertinent metric associated with packet. The routing protocol send the information gathered from the packet header to the routing algorithm. The information is then used by algorithm to determine the best way to send packet to its destinations. The protocol header is reattached to the packet and sends onto the network.

The routing protocol then summarizes the transaction that just occurred and places the information in the table. The routing table, maintained by the routing protocol and store within the router memory that contains a detailed list of possible destination on the network and their relative path information (J.F.DiMarzio, 2002).

2.2.3 Routing Algorithm

Routing algorithms can be differentiated based on several key characteristics. First, the particular goals of the algorithm designer affect the operation of the resulting routing protocol. Second, various types of routing algorithms exist, and each algorithm has a different impact on network and router resources. Finally,

routing algorithms use a variety of metrics that affect calculation of optimal routes. Routing algorithms can be classified by many types. There is some type of algorithm that used in routing process.

2.2.3.1 Static Versus Dynamic

Static routing algorithms are hardly algorithms at all, but are table mappings established by the network administrator before the beginning of routing (J.F.DiMarzio, 2002). These mappings do not change unless the network administrator alters them. Algorithms that use static routes are simple to design and work well in environments where network traffic is relatively predictable and where network design is relatively simple

Because static routing systems cannot react to network changes, they generally are considered unsuitable for today's large, constantly changing networks. Most of the dominant routing algorithms today are dynamic routing algorithms, which adjust to changing network circumstances by analyzing incoming routing update messages (J.F.DiMarzio, 2002). If the message indicates that a network change has occurred, the routing software recalculates routes and sends out new routing update messages. These messages permeate the network, stimulating routers to rerun their algorithms and change their routing tables accordingly. Dynamic routing algorithms can be supplemented with static routes where appropriate. A router of last resort, for example, can be designated to act as a repository for all unroutable packets, ensuring that all messages are at least handled in some way.

2.2.3.2 Single-Path Versus Multipath

Some sophisticated routing protocols support multiple paths to the same destination. Unlike single-path algorithms, these multipath algorithms permit traffic

multiplexing over multiple lines. The advantages of multipath algorithms are obvious (J.F.DiMarzio, 2002). They can provide substantially better throughput and reliability. This is generally called load sharing.

2.2.4 Network Protocol

Routed protocols are transported by routing protocols across an internetwork. In general, routed protocols also are referred as network protocols. These network protocols perform a variety of functions required for communication between user applications in source and destination devices, and these functions can differ widely among protocol suites. Network protocols occur at the upper five layers of the OSI reference model: the network layer, the transport layer, the session layer, the presentation layer, and the application layer (Doug Lowe, 2004).

Routed protocols are protocols that are routed over an internetwork (Doug Lowe, 2004). For examples such as protocols in the Internet Protocol (IP), DECnet, AppleTalk, Novell NetWare, OSI, Banyan VINES, and Xerox Network System (XNS). Routing protocols, are protocols that implement routing algorithms and used by intermediate systems to build tables used in determining path selection of routed protocols. For the examples of these protocols include Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (Enhanced IGRP), Open Shortest Path First (OSPF), Exterior Gateway Protocol (EGP), Border Gateway Protocol (BGP), Intermediate System-to-Intermediate System (IS-IS), and Routing Information Protocol (RIP).

2.2.5 Packet Dropping

A packet may be dropped for a specified fault, if the packets transport layer protocol and length match that of a fault action being applied and that a randomly

generated value is within the bounds of the probability (Behrouz Forousan, 2003). Packets will be analyzed individually, by each fault in turn until it is dropped. If the packet does not get dropped by any of the specified faults, it gets forwarded, as normal.

The packet drop probability is based on the minimum threshold, maximum threshold, and mark probability denominator. When the average queue depth is above the minimum threshold, RED starts dropping packets. The rate of packet drop increases linearly as the average queue size increases until the average queue size reaches the maximum threshold. For example, if the denominator is 512, one out of every 512 packets is dropped when the average queue is at the maximum threshold (Behrouz Forousan, 2003).

2.3 Existing Router

There are many type of router today but still has the same propose or function. There is 3Com Router, DLink Router, Cicso Router and many more. Below a some of example of router include with the specification for the router.

2.3.1 3Com Router

The 3Com Router 3031 provides all of the components needed to give remote office and tele-workers secure, reliable, cost effective access to the Internet or corporate networks over a broadband ADSL connection with ISDN backup capabilities (Doug Lowe, 2004).

The router includes an integrated ISDN BRI S/T backup port, and a four-port switch for local LAN connections. The 64MB DRAM, 8MB flash memory, and operating software support a full complement of routing, integrated security, and