Mount Zion College of Engineering and Technology

To Make Man Whole!!

LAB MANUAL

REGULATION 2021

III YEAR &V SEMESTER

CS3591

COMPUTER NETWORKS

ABOUT THE INSTITUTION

Mount Zion College of Engineering and Technology was inaugurated in the year 2001, approved by AICTE, New Delhi and affiliated to anna university, Chennai. This college is an ISO 9001-2015 certified institution and offers The institution has five Under Graduate (UG) programmes (Civil Engineering, Computer Science and Engineering, Electronics and Communication Engineering, Electrical and Electronics Engineering and Mechanical Engineering), two Post Graduate (PG) programmes (Computer Science and Engineering and Communication Systems) and two Doctorate programmes (Computer Science and Engineering, Electronics and Communication Engineering) affiliated to Anna University, Chennai. The UG programmes are permanently affiliated with the university. The institution is approved by AICTE and accredited by the National Assessment and Accreditation Council (NAAC). Founder Chairman Mr.Jayabarathan chelliah, M.A(USA)., B.Ed., has an uncompromising Zeal and vision to impart quality technical education in rural area. Besides promoting disseminating knowledge, the college fosters cooperation between the academic and industrial communities.

ABOUT THE DEPARTMENT

The department of Computer Science & Engineering was incepted in the year 2001 with the objective of high caliber technocrats and eminent software professionals. The department has a team of well qualified, experienced and dedicated faculty members with industrial research background. It has been accredited by A.I.C.T.E., New Delhi. It has well equipped laboratories with computers and laptops. Computer science, study of the theory, experimentation, and engineering Form the basis for the design and use of computers devices that automatically process Information. Computer science traces its roots to work done by English mathematician Charles Babbage, who first proposed a programmable mechanical calculator in 1837. Until the advent of electronic digital computers in the 1940s, computer science was not generally distinguished as being separate from mathematics and engineering. Since then, it has sprouted numerous branches of research that are unique to the discipline. Computer science is a combination of theory, engineering, and experimentation. In some cases, a computer scientist develops a theory, then engineers a combination of computer hardware and software based on that theory, and experimentally tests it. An example of such a theory-driven approach is the development of new software engineering tools that are then evaluated in actual use. In other cases, experimentation may result in new theory, such as the discovery that an artificial neural network exhibits behavior similar to neurons in the brain, leading to a new theory in neurophysiology.

SYLLABUS

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture

   ping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a web page using TCP sockets.
3. Applications using TCP sockets like: a) Echo client and echo server b) Chat
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets
6. Write a code simulating ARP /RARP protocols.
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
8. Study of TCP/UDP performance using Simulation tool.
9. Simulation of Distance Vector/ Link State Routing algorithm.
10. Simulation of an error correction code (like CRC)

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DATE:

1.NETWORKING COMMANDS

AIM:

To study the basic networking commands.

NETWORKING COMMANDS:

C:\>arp –a: ARP is short form of address resolution protocol, It will show the IP address of your computer along with the IP address and MAC address of your router.

C:\>hostname: This is the simplest of all TCP/IP commands. It simply displays the name of your computer.

C:\>ipconfig: The ipconfig command displays information about the host (the computer your sitting at)computer TCP/IP configuration.

C:\>ipconfig /all: This command displays detailed configuration information about your TCP/IP connection including Router, Gateway, DNS, DHCP, and type of Ethernet adapter in your system.

C:\>Ipconfig /renew: Using this command will renew all your IP addresses that you are currently (leasing) borrowing from the DHCP server. This command is a quick problem solver if you are having connection issues, but does not work if you have been configured with a static IP address.

C:\>Ipconifg /release: This command allows you to drop the IP lease from the DHCP server.

C:\>ipconfig /flushdns: This command is only needed if you're having trouble with your networks DNS configuration. The best time to use this command is after network configuration frustration sets in, and you really need the computer to reply with flushed.

C:\>nbtstat –a: This command helps solve problems with NetBIOS name resolution. (Nbt stands for NetBIOS over TCP/IP)

C:\>netdiag: Netdiag is a network testing utility that performs a variety of network diagnostic tests, allowing you to pinpoint problems in your network. Netdiag isn't installed by default, but can be installed from the Windows XP CD after saying no to the install. Navigate to the CD ROM drive letter and open the support\tools folder on the XP CD and click the setup.exe icon in the support\tools folder.

C:\>netstat: Netstat displays a variety of statistics about a computers active TCP/IP connections. This tool is most useful when you're having trouble with TCP/IP applications such as HTTP, and FTP.

C:\>nslookup: Nslookup is used for diagnosing DNS problems. If you can access a resource by specifying an IP address but not it's DNS you have a DNS problem.

C:\>pathping: Pathping is unique to Window's, and is basically a combination of the Ping and Tracert commands. Pathping traces the route to the destination address then launches a 25 second test of each router along the way, gathering statistics on the rate of data loss along each hop.

C:\>ping: Ping is the most basic TCP/IP command, and it's the same as placing a phone call to your best friend. You pick up your telephone and dial a number, expecting your best friend to reply with "Hello" on the other end. Computers make phone calls to each other over a network by using a Ping command. The Ping commands main purpose is to place a phone call to another computer on the network, and request an answer. Ping has 2 options it can use to place a phone call to another computer on the network. It can use the computers name or IP address.

C:\>route: The route command displays the computers routing table. A typical computer, with a single network interface, connected to a LAN, with a router is fairly simple and generally doesn't pose any network problems. But if you're having trouble accessing other computers on your network, you can use the route command to make sure the entries in the routing table are correct.

C:\>tracert: The tracert command displays a list of all the routers that a packet has to go through to get from the computer where tracert is run to any other computer on the internet.

Viva Questions and Answers:

1.What is the use of arp –a?

It will show the IP address of your computer along with the IP address and MAC address of your router.

2. What is the use of netstat?

Netstat displays a variety of statistics about a computers active TCP/IP connections. This tool is most useful when you're having trouble with TCP/IP applications such as HTTP, and FTP.

3.What is the use of ipconfig?

The ipconfig command displays information about the host (the computer your sitting at)computer TCP/IP configuration.

4. What is the use of ping?

The Ping commands main purpose is to place a phone call to another computer on the network, and request an answer. Ping has 2 options it can use to place a phone call to another computer on the network. It can use the computers name or IP address.

5.What is the use of tracert?

The tracert command displays a list of all the routers that a packet has to go through to get from the computer where tracert is run to any other computer on the internet.

RESULT:

Thus the above list of primitive has been studied.

Ex No : 2 **Date:**

HTTP web client program to download a web page using TCP sockets

Aim:

To write a java program to upload and download the HTTP web page using TCP socket.

Algorithm:

1. Create a URL object and pass url as string to download the webpage. ...
2. Create Buffered Reader object and pass openStream(). ...
3. Create a string object to read each line one by one from stream.
4. Write each line in html file where webpage will be downloaded.
5. Close all objects.
6. Catch exceptions if url failed to download.

Program:

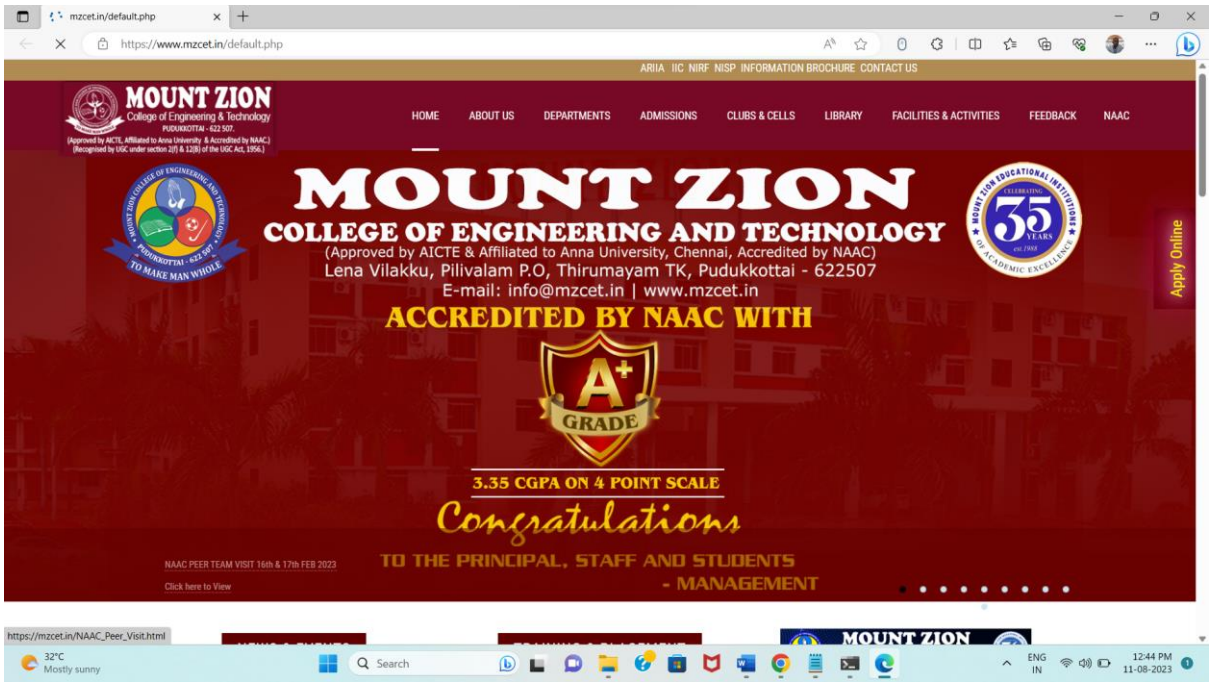
**download.java **

```
import java.io.*;
import java.net.URL;
import java.net.MalformedURLException;
 public class download
{
    public static void DownloadWebPage(String webpage)
   {
      try
          {
                  // Create URL object
                  URL url = new URL(webpage);
                  BufferedReader readr =
                  new BufferedReader(new InputStreamReader(url.openStream()));
                   // Enter filename in which you want to download
                  BufferedWriter writer =
```

```
                new BufferedWriter(new FileWriter("Download.html"));
                // read each line from stream till end

        String line;
                while ((line = readr.readLine()) != null)
                {
                        writer.write(line);
                }

                readr.close();
                writer.close();
                System.out.println("Successfully Downloaded.");
        }
       // Exceptions
      catch (MalformedURLException mue)
     {
      System.out.println("Malformed URL Exception raised");
      }
     catch (IOException ie)
     {
     System.out.println("IOException raised");
      }
   }
   public static void main(String args[])
    throws IOException
   {
      String url = "https://www.mzcet.in//";
      DownloadWebPage(url);
   }
}
```

Output:

```
C:\Users\lenovo\Desktop\cn lab demo>javac download.java

C:\Users\lenovo\Desktop\cn lab demo>java download
Successfully Downloaded.

C:\Users\lenovo\Desktop\cn lab demo>
```



Result:

Thus the java program for uploading and downloading the HTTP webpage using TCP socket is executed and verified successfully.

Ex No : 3 (a) **Date**:

Applications using TCP sockets: Echo client and Echo server

Aim:

To write a java program to implement the Echo client and Echo server using TCP socket.

Algorithm:

Client Side

1. Start the program.

2. Create a socket which binds the Ip address of server and the port address to acquire service.

3. After establishing connection send a data to server.

4. Receive and print the same data from server.

5. Close the socket.

6. End the program.

Server Side

1. Start the program.

2. Create a server socket to activate the port address.

3. Create a socket for the server socket which accepts the connection.

4. After establishing connection receive the data from client.

5. Print and send the same data to client.

6. Close the socket.

7. End the program.

Program:

** TcpEchoClient**

```
import java.io.*;
import java.net.*;
public class TcpEchoClient
{
   private final static String HOSTNAME = "localhost";
   private final static int PORT = 8080;
```

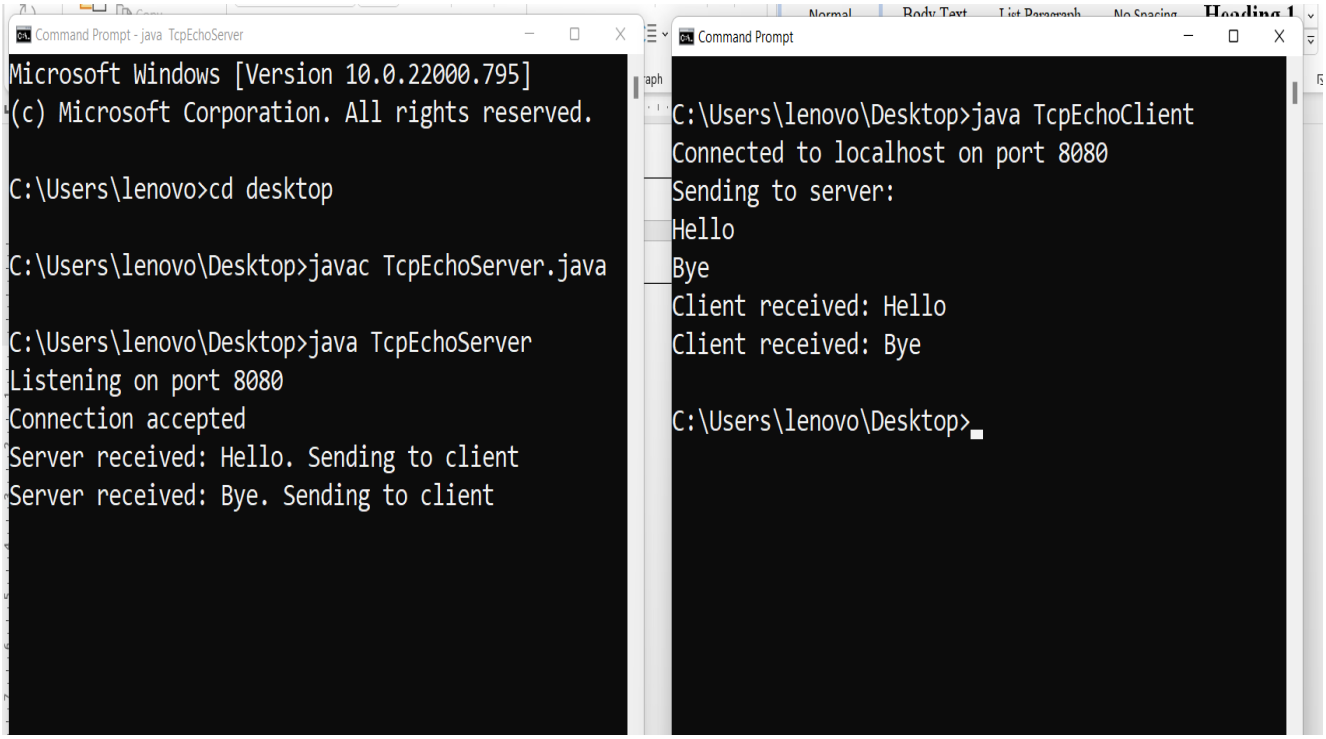
```
   public static void main(String[] args) throws IOException
   {
      try (Socket clientSocket = new Socket(HOSTNAME, PORT);
          InputStreamReader isr = new InputStreamReader(clientSocket.getInputStream());
          BufferedReader in = new BufferedReader(isr);
          PrintWriter out = new PrintWriter(clientSocket.getOutputStream(), true))
          {
                  System.out.println("Connected to " + HOSTNAME + " on port " + PORT);
                  String data = "Hello\nBye";
                  System.out.println("Sending to server:\n" + data);
                  out.println(data);
                  String line;
                  while ((line = in.readLine()) != null)
                  {
                          System.out.println("Client received: " + line);
                  }
           }
      }
}
```

TcpEchoServer

```
import java.io.*;
import java.net.*;

public class TcpEchoServer
{
   private final static int PORT = 8080;
    public static void main(String[] args) throws IOException
```

```
{
    ServerSocket serverSocket = new ServerSocket(PORT);
     System.out.println("Listening on port " + PORT);
     while (true)
       {
              try (Socket socket = serverSocket.accept();
                InputStreamReader isr = new InputStreamReader(socket.getInputStream());
                 BufferedReader in = new BufferedReader(isr);
                 PrintWriter out = new PrintWriter(socket.getOutputStream(), true))
                {
                       System.out.println("Connection accepted");
                       String line;
                      while ((line = in.readLine()) != null)
                       {
                              System.out.println("Server received: " + line + ". Sending to
                              client");
                               out.println(line);
                              if (line.equals("Bye"))
                              {
                                     break;
                              }
          }
       }
    }
}
```

Output:



Result:

Thus the java program for implementing the Echo client and Echo server using TCP socket is executed and verified successfully.

DATE: **3.B. CLIENT- SERVER APPLICATION FOR CHAT**

AIM:

To write a client-server application for chat using TCP

ALGORITHM:

CLIENT

1. Start the program
2. Include necessary package in java
3. To create a socket in client to server.
4. The client establishes a connection to the server.
5. The client accept the connection and to send the data from client to server.
6. The client communicates the server to send the end of the message
7. Stop the program.

SERVER

1. Start the program
2. Include necessary package in java
3. To create a socket in server to client
4. The server establishes a connection to the client.
5. The server accept the connection and to send the data from server to client and
6. vice versa
7. The server communicate the client to send the end of the message.
8. Stop the program.

PROGRAM:

TCPserver1.java

```
import java.net.*;
import java.io.*;

public class TCPserver1
{
 public static void main(String arg[])
{
ServerSocket s=null;
String line;
DataInputStream is=null,is1=null;
PrintStream os=null;
Socket c=null;
try
{
s=new ServerSocket(9999);
}
catch(IOException e)
{
System.out.println(e);
 }
try
{
```

```
c=s.accept();
is=new DataInputStream(c.getInputStream());
is1=new DataInputStream(System.in);
os=new PrintStream(c.getOutputStream());
do
{
line=is.readLine();
System.out.println("Client:"+line);
System.out.println("Server:");
line=is1.readLine();
os.println(line);
}
while(line.equalsIgnoreCase("quit")==false);
is.close();
os.close();
}
catch(IOException e)
{
System.out.println(e);
}
}
}
```

TCPclient1.java

```
import java.net.*;
import java.io.*;

 public class TCPclient1
{
 public static void main(String arg[])
{
Socket c=null;
String line;
DataInputStream is,is1;
PrintStream os;
try
{
c=new Socket("10.0.200.36",9999);
}
catch(IOException e)
{
System.out.println(e);
}
try
{
 os=new PrintStream(c.getOutputStream());
is=new DataInputStream(System.in);
is1=new DataInputStream(c.getInputStream());
do
{
System.out.println("Client:");
line=is.readLine();
os.println(line);
System.out.println("Server:" + is1.readLine());
}
while(line.equalsIgnoreCase("quit")==false);
```

```
is1.close();
os.close();
}
catch(IOException e)
{
System.out.println("Socket Closed!Message Passing is over");
}}
```

OUT PUT :

SERVER

C:\Program Files\Java\jdk1.5.0\bin>javac TCPserver1.java Note:
TCPserver1.java uses or overrides a deprecated API. Note:
Recompile with -deprecation for details. C:\Program
Files\Java\jdk1.5.0\bin>java TCPserver1

Client: Hai Server
Server:Hai Client
Client: How are you
Server:Fine
Client: quit
Server:quit

CLIENT

C:\Program Files\Java\jdk1.5.0\bin>javac TCPclient1.java
Note: TCPclient1.java uses or overrides a deprecated API.
Note: Recompile with -deprecation for details. C:\Program
Files\Java\jdk1.5.0\bin>java TCPclient1

Client:Hai Server
Server: Hai Client
Client:How are you
Server: Fine
Client:quit
Server: quit

Viva Questions and Answers:

1.Define chat.

A real-time communication via keyboard between two or more users on a local network (LAN) or over the Internet

2.Define TCP.

TCP/IP stands for Transmission Control Protocol/Internet Protocol, which is a set of networking protocols that allows two or more computers to communicate. The Defense Data Network, part of the Department of Defense, developed TCP/IP, and it has been widely adopted as a networking standard.

3.what is socket API?

A socket API is an application programming interface (API), usually provided by the operating system, that allows application programs to control and use network sockets. Internet socket APIs are usually based on the Berkeley sockets standard.

RESULT:

Thus the above program a client-server application for chat using TCP / IP was executed and successfully.

Ex No : 4 **Date:**

Simulation of DNS using UDP sockets

Aim:

To write a java program to Simulate the DNS (Domain Name Server) using UDP sockets.

Algorithm:

Client Side

1. Start the program.
2. Create a socket which binds the Ip address of server and the port address to acquire service.
3. After establishing connection, Get a website address and send to the server.
4. Receive the corresponding IP address which is sent from the server.
5. Print the IP Address of the website
6. Close the socket.
7. End the program.

Server Side

1. Start the program.
2. Create a server socket to activate the port address.
3. Create a socket for the server socket which accepts the connection.
4. After establishing connection, Receive the website address which is sent from the client.
5. Get the corresponding IP address for the requested web page from the server Database.
6. Send that IP address to the client.
7. Close the socket.
8. End the program.

Program:

**** UDP DNS CLIENT****

```
import java.io.*;
import java.net.*;
public class udpdnsclient
{
```

```
public static void main(String args[])throws IOException
{
BufferedReader br = new BufferedReader(new InputStreamReader(System.in));
DatagramSocket clientsocket = new DatagramSocket();
InetAddress ipaddress;
if (args.length == 0)
ipaddress = InetAddress.getLocalHost();
else
ipaddress = InetAddress.getByName(args[0]);
byte[] senddata = new byte[1024];
byte[] receivedata = new byte[1024];
int portaddr = 1362;
System.out.print("Enter the hostname : ");
String sentence = br.readLine();
senddata = sentence.getBytes();
DatagramPacket pack = new DatagramPacket(senddata,senddata.length,
ipaddress,portaddr);
clientsocket.send(pack);
DatagramPacket recvpack =new DatagramPacket(receivedata,receivedata.length);
clientsocket.receive(recvpack);
String modified = new String(recvpack.getData());
System.out.println("IP Address: " + modified);
clientsocket.close();
}
}
```

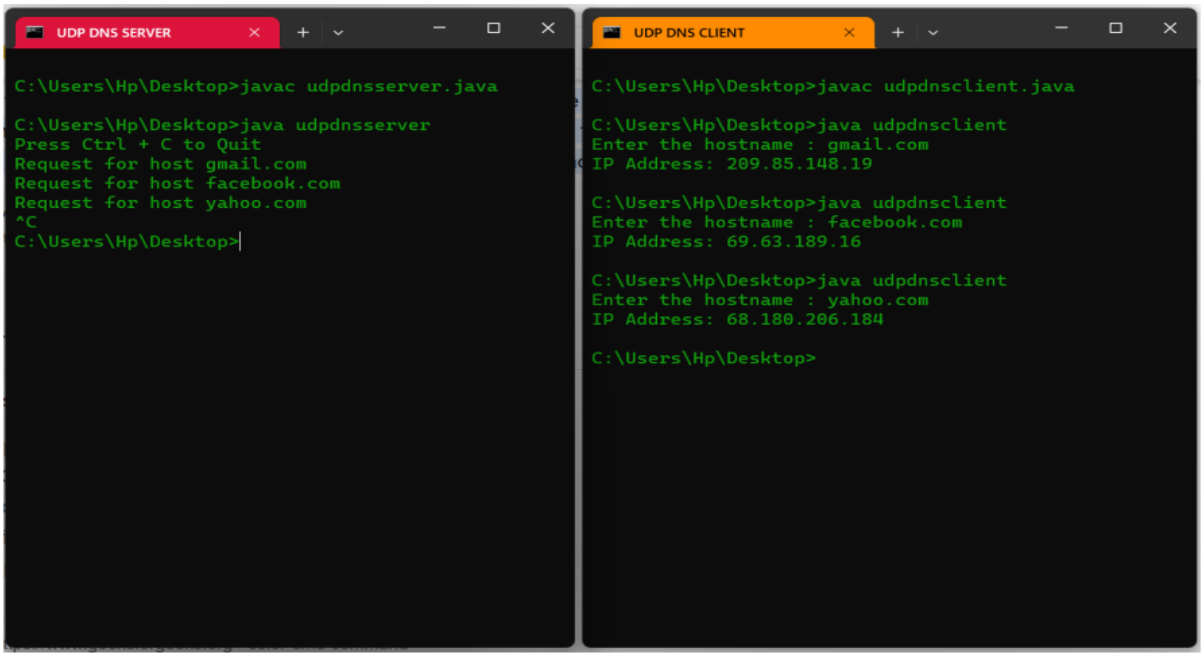
**** UDP DNS SERVER****

```
import java.io.*;
import java.net.*;
public class udpdnsserver
```

```
{
private static int indexOf(String[] array, String str)
{
str = str.trim();
for (int i=0; i < array.length; i++)
{
if (array[i].equals(str))
return i;
}
return -1;
}
public static void main(String arg[])throws IOException
{
String[] hosts = {"yahoo.com", "gmail.com","cricinfo.com", "facebook.com"};
String[] ip = {"68.180.206.184", "209.85.148.19","80.168.92.140",
"69.63.189.16"};
System.out.println("Press Ctrl + C to Quit");
while (true)
{
DatagramSocket serversocket=new DatagramSocket(1362);
byte[] senddata = new byte[1021];
byte[] receivedata = new byte[1021];
DatagramPacket recvpack = new DatagramPacket(receivedata, receivedata.length);
 serversocket.receive(recvpack);
String sen = new String(recvpack.getData());
InetAddress ipaddress = recvpack.getAddress();
int port = recvpack.getPort();
String capsent;
System.out.println("Request for host " + sen);
```

```
if(indexOf (hosts, sen) != -1)
capsent = ip[indexOf(hosts, sen)];
else
capsent = "Host Not Found";
senddata = capsent.getBytes();
DatagramPacket pack = new DatagramPacket (senddata,
senddata.length,ipaddress,port);
serversocket.send(pack);
serversocket.close();
}
}
}
```

Output:



Result:

Thus the java program for simulating the the DNS using UDP sockets is executed and verified successfully.

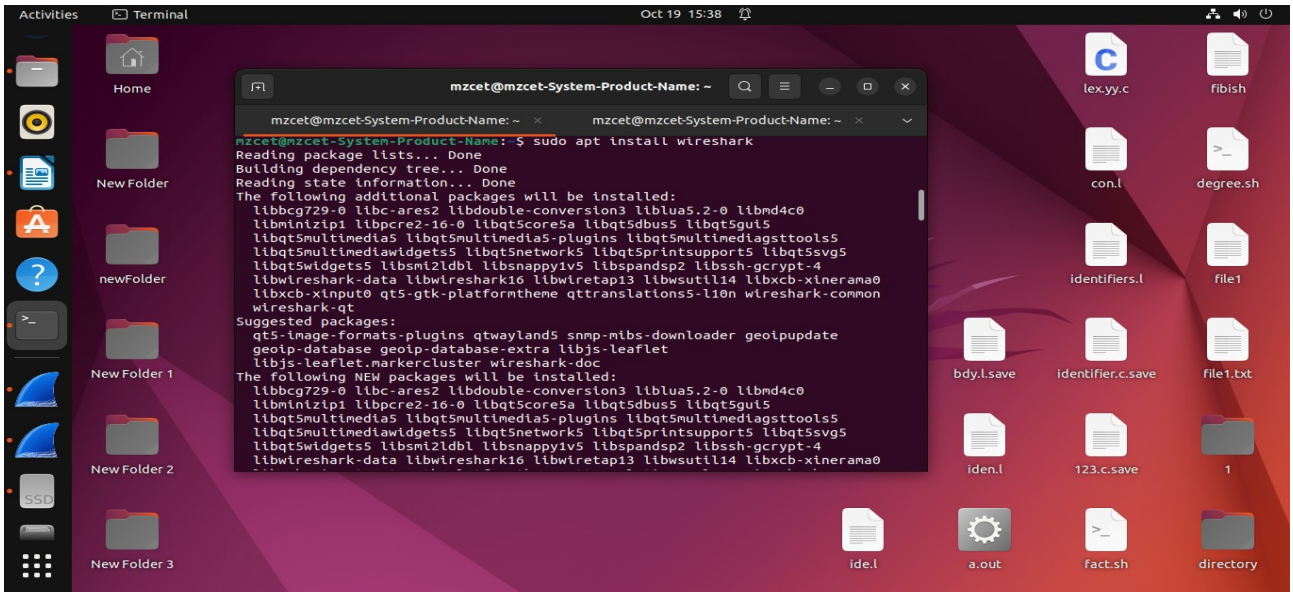
EX:NO:05 **CAPTURE AND FILTER THE PACKETS USING WIRESHARK**

Aim: To use Wireshark tool to capture packets and examine the packets

PROCEDURE:

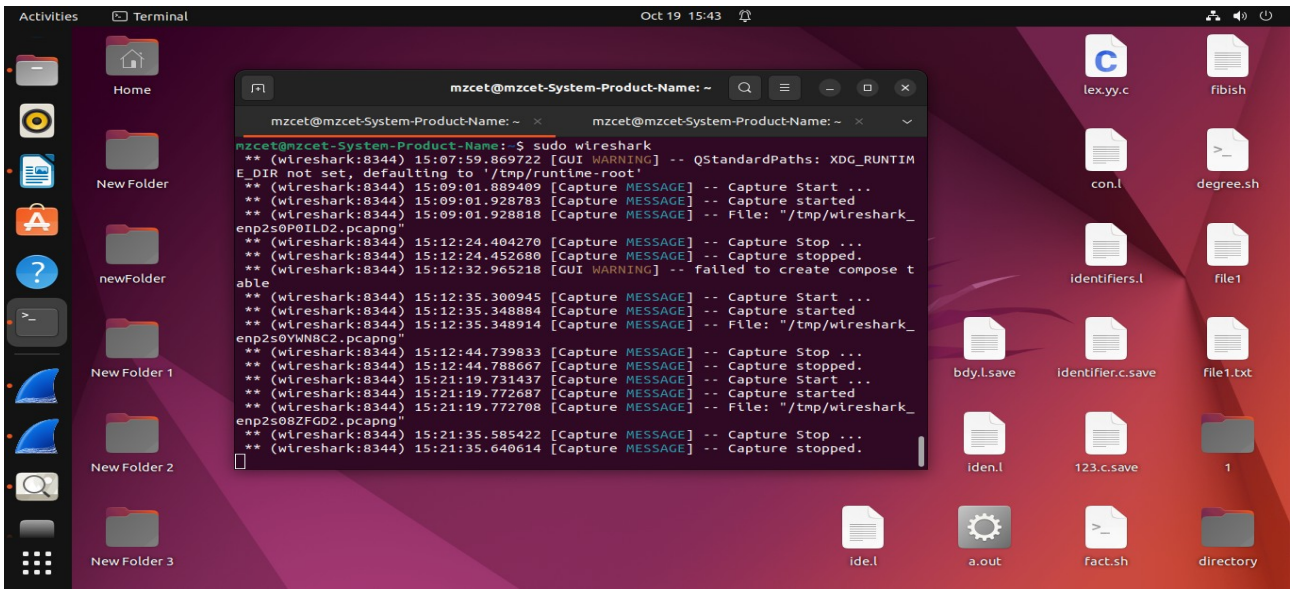
STEP:01

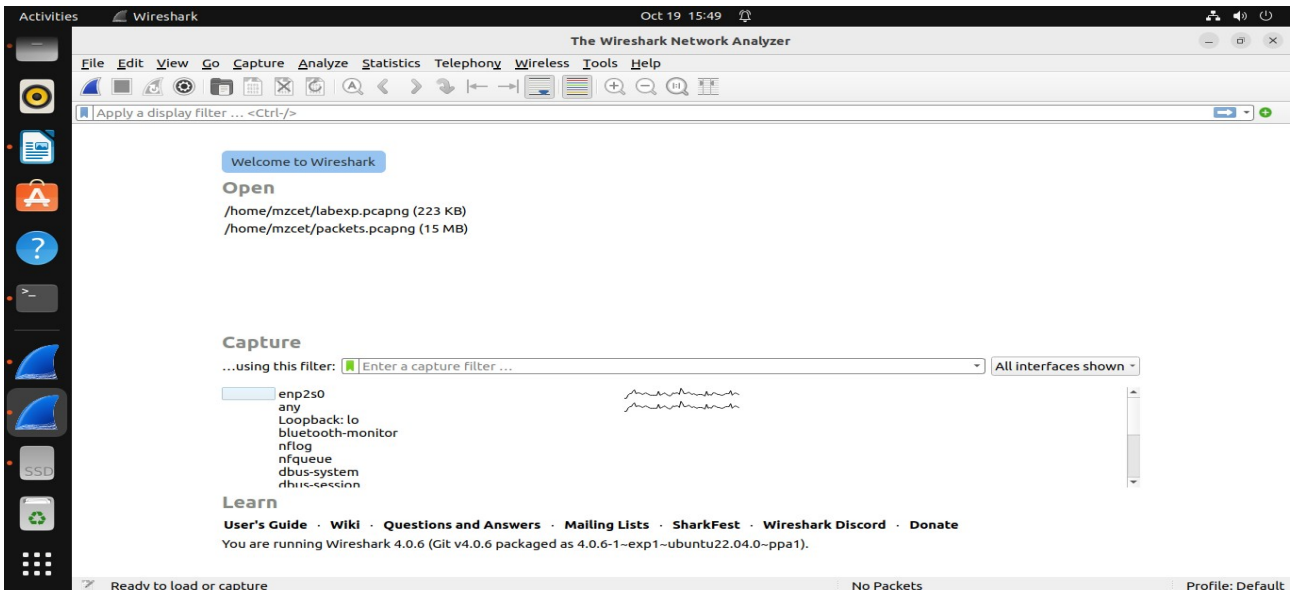
DOWNLOAD THE WIRESHARK IN UBUNTU BY OPENING THE TERMINAL AND ENTER THE COMMAND “sudo apt install wireshark”.



STEP:02

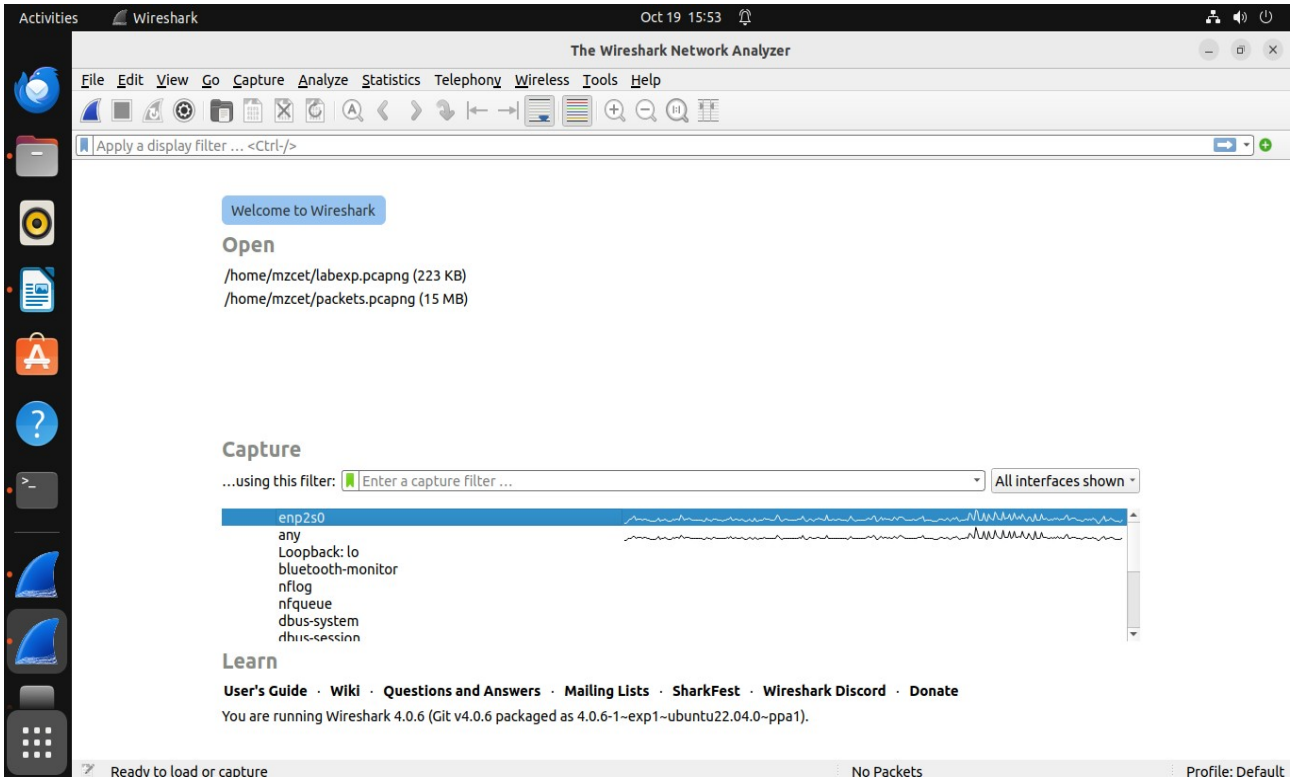
AFTER THE COMPLETION OF INSTALLATION, OPEN THE WIRESHARK WINDOW BY GIVING THE COMMAND “sudo wireshark”.



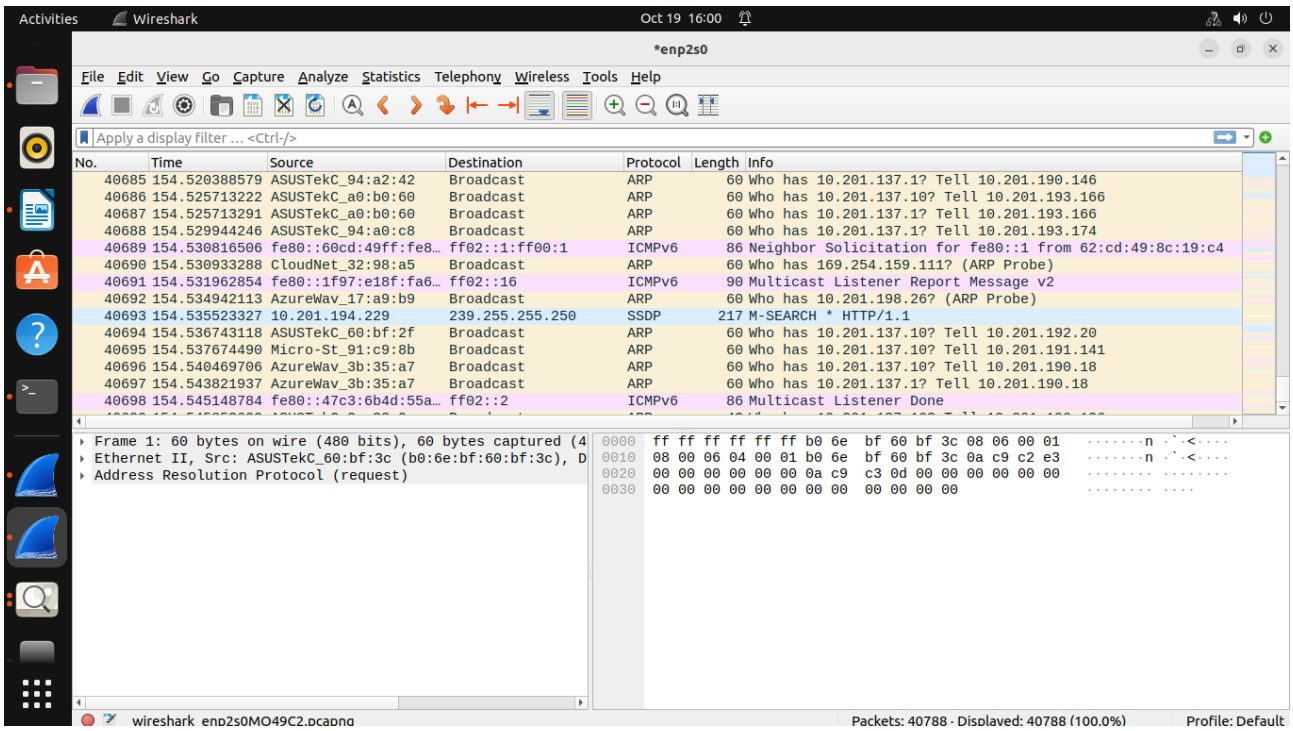


STEP:03

IN THIS STEP, WE HAVE TO CHOOSE THE INTERFACES FOR WHICH WE ARE GOIJNG TO CAPTURE THE PACKETS. FROM THIS WE ARE CHOOSING “enp2s0”.

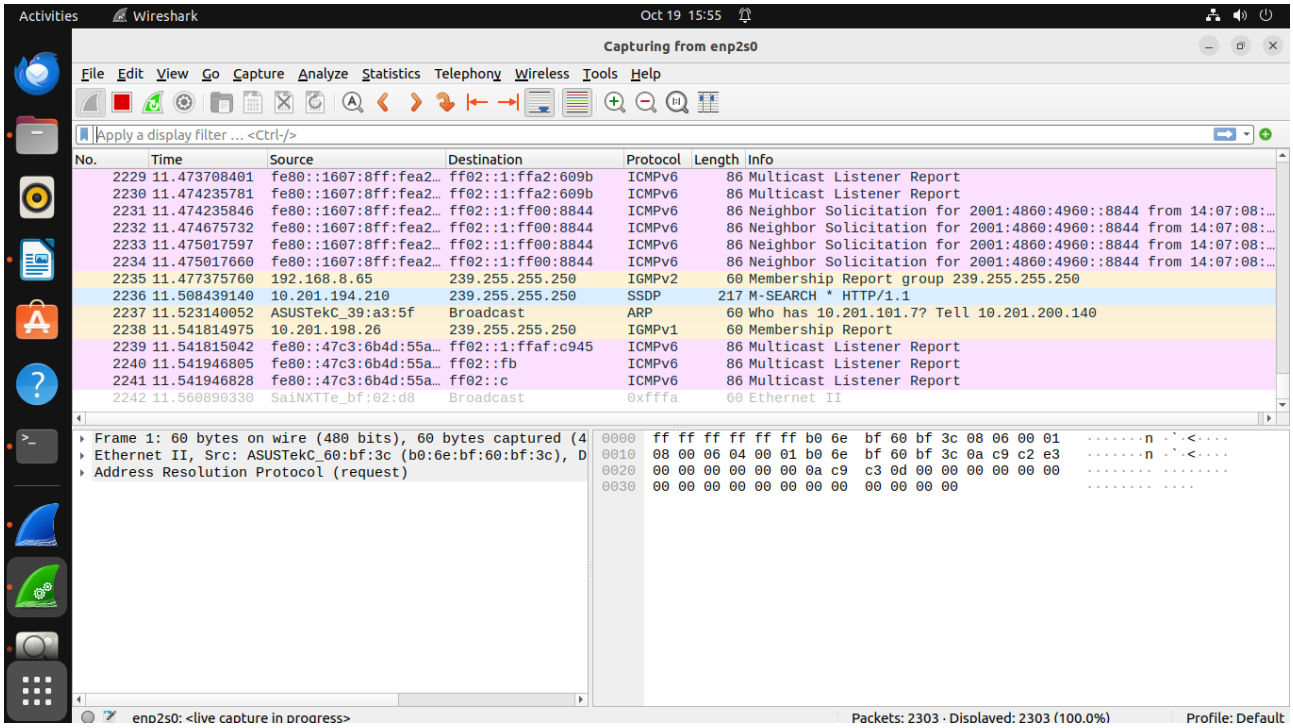


THIS WILL TAKE INTO THE NEXT PAGE, THE PACKETS ARE RINNING INSIDE A NETWORK.



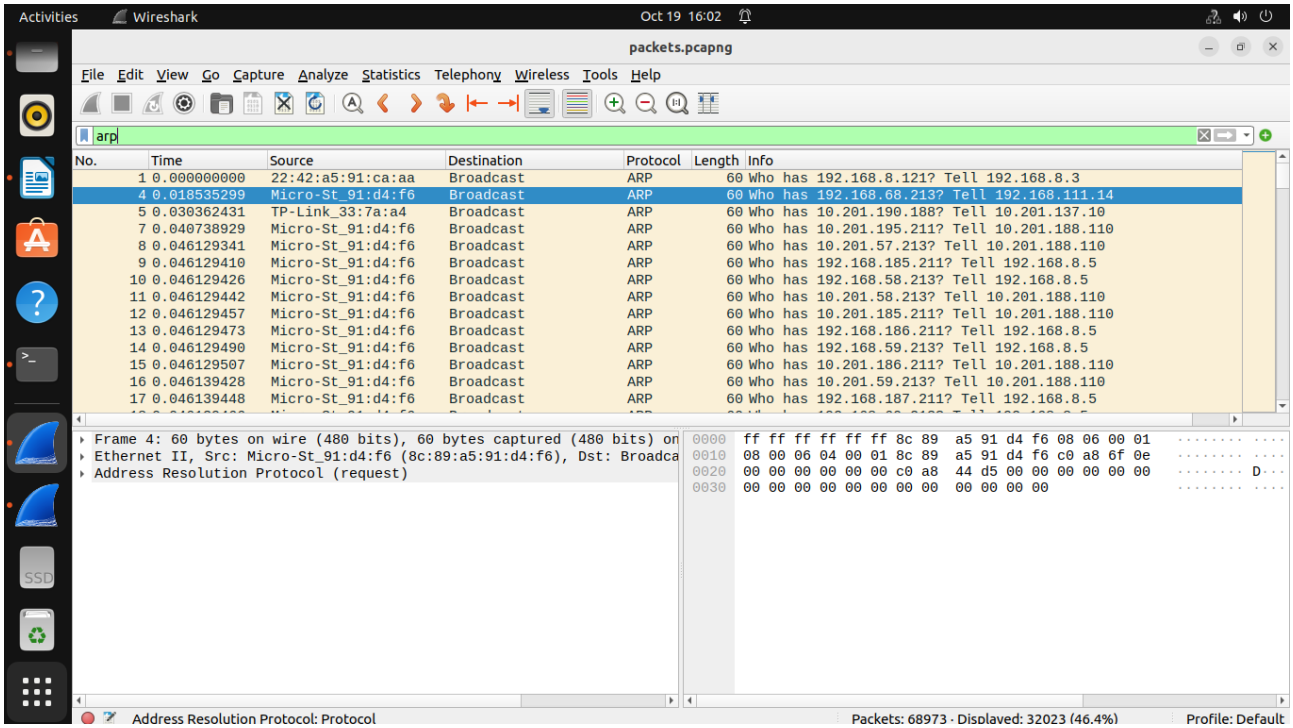
STEP:04

AFTER GOING TO THIS PAGE, BELOW THE FILE OPTION THE ICON TO START THE PACKETS CAPTURING IN BLUE COLOUR BY CLICKING IT.

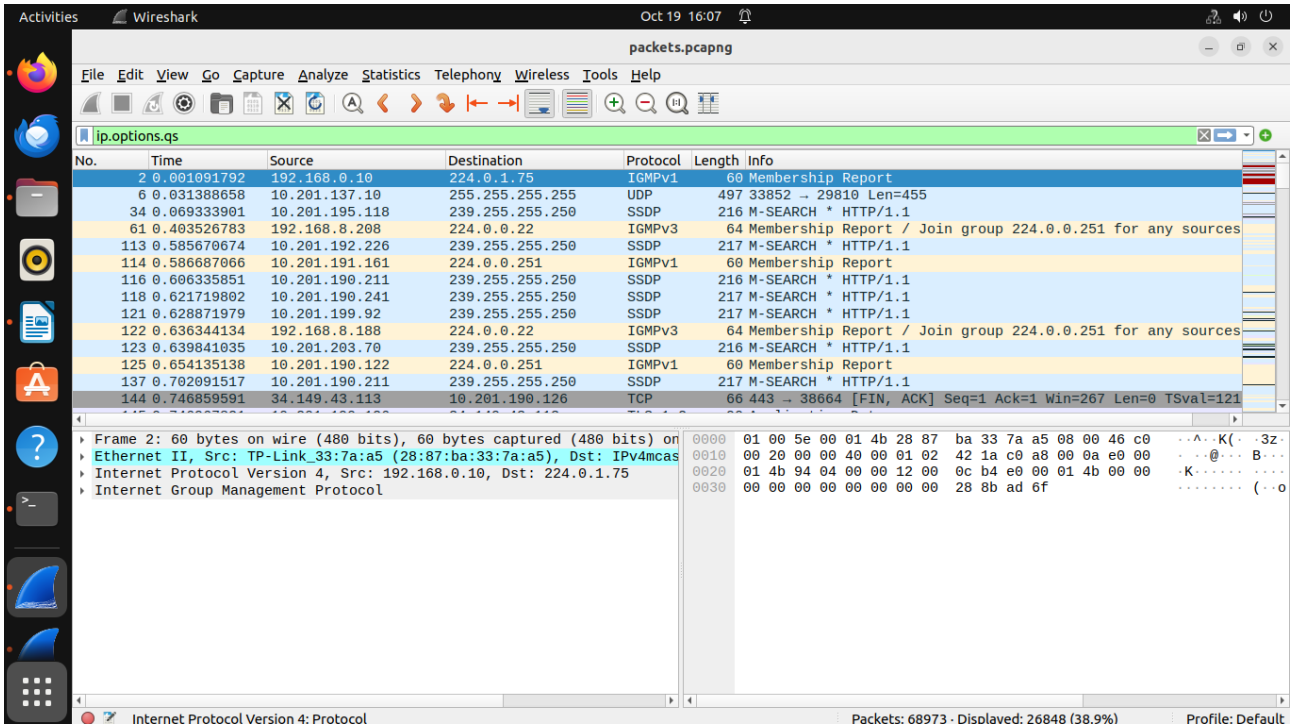


AND SAVE THE CAPTURED PACKETS IN A FILE AND START FILTERING IT BY GIVING SPECIFIC PROTOCOLS NAME.

STEP:05



IN THIS ABOVE IMAGE, I HAVE SEARCHED THE PACKETS BY ARP PROTOCOL.
IT IS AN EXAMPLE FOR THE FILTERING OF THE PACKETS THAT ARE CAPTURED.



RESULT:

Thus the capture and filter the packets using wireshark has been completed successfully and verified.

Ex.No:6.a **Write a code simulating ARP protocols.**
Date:

AIM

To implement Address Resolution Protocol .

ALGORITHM

CLIENT SIDE

1. Establish a connection between the Client and Server. Socket ss=new Socket(InetAddress.getLocalHost(),1100);
2. Create instance output stream writer PrintWriter ps=new PrintWriter(s.getOutputStream(),true);
3. Get the IP Address to resolve its physical address.
4. Send the IPAddress to its output Stream.ps.println(ip);
5. Print the Physical Address received from the server.

SERVER SIDE

1. Accept the connection request by the client. ServerSocket ss=new ServerSocket(2000);Socket s=ss.accept();
2. Get the IPaddress from its inputstream. BufferedReader br1=new BufferedReader(newInputStreamReader(s.getInputStream())); ip=br1.readLine();
3. During runtime execute the processRuntime r=Runtime.getRuntime(); Process p=r.exec("arp -a "+ip);
4. Send the Physical Address to the client.

PROGRAM

ARP CLIENT

```
import java.io.*;
import java.net.*;

class ArpClient
{
public static void main(String args[])throws IOException
{
  try
{
Socket ss=new Socket(InetAddress.getLocalHost(),1100);
PrintStream ps=new PrintStream(ss.getOutputStream());
BufferedReader br=new BufferedReader(newInputStreamReader(System.in));
                String ip;
                System.out.println("Enter the IPADDRESS:");
```

```
                ip=br.readLine();
ps.println(ip);
String str,data;
BufferedReader br2=new
BufferedReader(newInputStreamReader(ss.getInputStream()));
System.out.println("ARP From Server::"); do
{
str=br2.readLine();
System.out.println(str);
}
while(!(str.equalsIgnoreCase("end")));
}
catch(IOException e)
{
System.out.println("Error"+e);

}}}
```

ARP SERVER

```
import java.io.*;
import java.net.*;

class ArpServer
{
public static void main(String args[])throws IOException
{
try
{
ServerSocket ss=new ServerSocket(1100);
Socket s=ss.accept();
PrintStream ps=new PrintStream(s.getOutputStream());
BufferedReader br1=new BufferedReader(newInputStreamReader(s.getInputStream()));
String ip;
 ip=br1.readLine();
Runtime r=Runtime.getRuntime();
Process p=r.exec("arp -a "+ip);
BufferedReader br2=new BufferedReader(newInputStreamReader(p.getInputStream()));
String str;
while((str=br2.readLine())!=null)
{
ps.println(str);
}}
catch(IOException e)
{
System.out.println("Error"+e); }}}
```

OUTPUT

```
C:\Networking Programs>java ArpServer
C:\Networking Programs>java ArpClient
Enter the IPADDRESS:
192.168.11.58
ARP From Server::
Interface: 192.168.11.57 on Interface 0x1000003
Internet Address Physical Address     Type
192.168.11.58    00-14-85-67-11-84   dynamic
```

RESULT

Thus the implementation of ARP is done & executed successfully.

Ex.No:6.b
Date:

Write a code simulating RARP protocols.

AIM:

To write a java program for simulating RARP protocols.

ALGORITHM:

CLIENT

1.Start the program
2. using datagram sockets UDP function is established.
2.Get the MAC address to be converted into IP address.
3.Send this MAC address to server.
4.Server returns the IP address to client.

SERVER

1. Start the program.
2. Server maintains the table in which IP and corresponding MAC addresses are stored.
3. Read the MAC address which is send by the client.
4. Map the IP address with its MAC address and return the IP address to client.

CLIENT:

```
import java.io.*; import
java.net.*; import
java.util.*; class
Clientrarp12
{
        public static void main(String args[])
        {
        try
        {
                DatagramSocket client=new DatagramSocket();
                 InetAddress addr=InetAddress.getByName("127.0.0.1");
                byte[] sendbyte=new byte[1024];
                byte[] receivebyte=new byte[1024];
                BufferedReader in=new BufferedReader(new InputStreamReader(System.in));
                System.out.println("Enter the Physical address (MAC):");
                String str=in.readLine();
                sendbyte=str.getBytes();
          DatagramPacket sender=newDatagramPacket(sendbyte,sendbyte.length,addr,1309);
                client.send(sender);
             DatagramPacket receiver=new DatagramPacket(receivebyte,receivebyte.length);
client.receive(receiver);
                String s=new String(receiver.getData()); System.out.println("The
                Logical Address is(IP): "+s.trim()); client.close();
        }


        catch(Exception e)
        {
```

```
                System.out.println(e);
        }
        }
}
```

SERVER:

```
import java.io.*; import
java.net.*; import
java.util.*; class
Serverrarp12
{
        public static void main(String args[])
        {
        try
        {
                DatagramSocket server=new DatagramSocket(1309);
                while(true)
                {
                byte[] sendbyte=new byte[1024];
                byte[] receivebyte=new byte[1024];
                 DatagramPacket receiver=new DatagramPacket(receivebyte,receivebyte.length);
                        server.receive(receiver);
                        String str=new String(receiver.getData()); String
                        s=str.trim();
                        InetAddress addr=receiver.getAddress();
                        int port=receiver.getPort();
                        String ip[]={"165.165.80.80","165.165.79.1"};
                        String
                        mac[]={"6A:08:AA:C2","8A:BC:E3:FA"};
                        for(int i=0;i<ip.length;i++)
                        {
                                if(s.equals(mac[i]))
                                {
                         sendbyte=ip[i].getBytes();
DatagramPacket  sender=newDatagramPacket(sendbyte,sendbyte.length,addr,port);

                                        server.send(sender);
                                        break;
                                }
                        }
                        break;
                }
        }
        catch(Exception e)
        {
                System.out.println(e);
```

```
        }
        }
}
```

OUTPUT:

I:\ex>java Serverrarp12

I:\ex>java Clientrarp12

Enter the Physical address (MAC):
6A:08:AA:C2

The Logical Address is(IP): 165.165.80.80

RESULT:

Thus the implementation of RARP is done & executed successfully.

DATE: **Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.**

Ex.No:7

OBJECTIVE:

To study of network simulator (ns) and simulation of congestion control algorithms using ns.

SYSTEM REQUIREMENTS:

PC: Pentium or higher

One LAN card onboard or on PCI slot with 10/100Mbps speed.
128MB RAM

500MB free space on Hard
drive CD ROM drive

Serial port, LPT port & USB port installed on system Operating
System: Windows 2000 or higher

THEORY:

LTS-01 Local area network / wireless local area network trainer system:

It is designed to help students understand the basic concepts, modes of operation and protocols involved in networking. The trainer has integrated hardware flow control on panel board for better understanding of different types of LAN topologies involved in networking. The trainer system is provided with windows-based user friendly software with analysis of protocols, different layers, network and measurement of error rate and throughput.

Students can easily do connections in different topologies and can learn actual data transfer either through hardware or through simulated network concept. Facility is provided into system software to introduce errors into packets being sent and analyze the effect of error on different protocols and hence find the effect on through put graph as well.

Trainer and its various types of experimentation using this system. This system works into server-client base. For any topology user has to select one server and select the network type whether it is LAN or WLAN. To understand the topology concept user can connect two or more clients to hardware. Depending on the topology selected user will have option to select protocols for the selected topology. Upon selection of protocol user can then create network of connected computers.

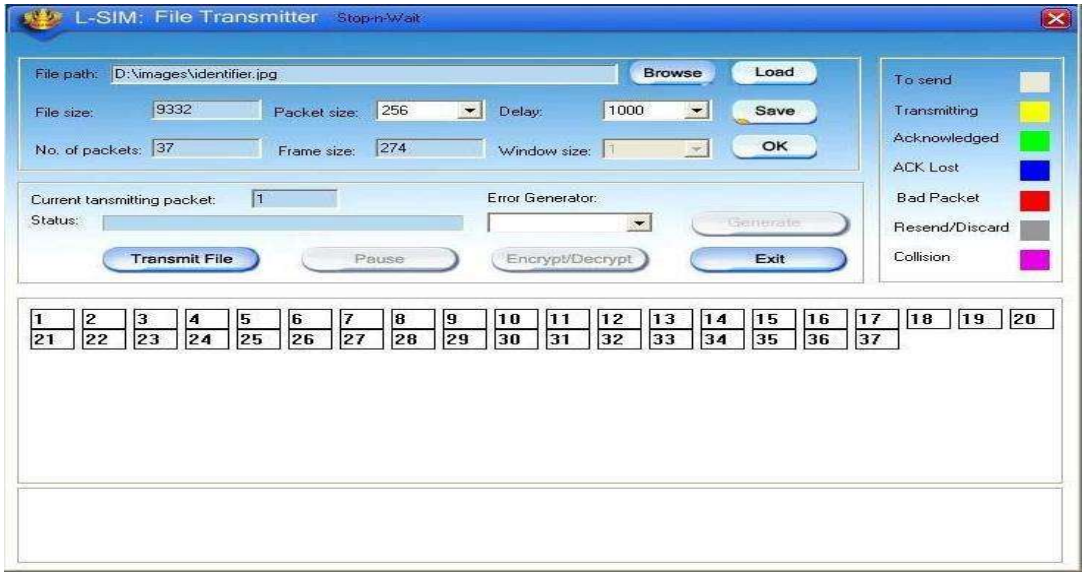
In any network which is created by user server can send or can communicate with any of the clients however clients can communicate only with server, no client to client communication is possible. Transmitter port protocol & network analysis can be done after communication is over between server and clients. Throughput v/s Packet size graph can be plotted for which at least two file transfers should be carried out. This plot can be printed to attach in the lab exercise sheet.

For the LAN network LAN cards must be installed prior to start work on this trainer. For wire less LAN USB ports should be available on the computers which are to be used for experimentation. In WLAN wireless access cards gets connected to computer USB ports and access point gets connected to hardware device.

L-SIM LAN Protocol Simulator & Analyzer Software:

It is designed to teach the basic concepts, topologies & various protocols involved in networking. The software is provided with analysis of protocols, different layers, network and measurement of error rate and throughput. Facility is provided to introduce errors into packets being sent and analyze the effect of error on different protocols and hence find the effect on throughput graph as well. Software is supported with neat operating instruction manual and online help.

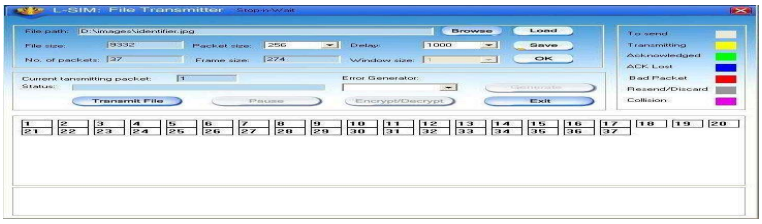
MODEL WINDOW DIAGRAM FOR L-SIM



N-S IM Network simulation software:

It is developed to provide basic understanding and implementation of various advanced concepts in networking. The software provides an opportunity to understand network fundamentals through animations & simulations. The simulation provides for network experimentation with various LAN and WAN protocols, network devices, routers, encryption, decryption, file transfer, error insertion and analysis of error rate and throughput etc. This software covers Ethernet LAN, wireless LAN and router. All networking theory is explained using simulation and animation.

MODEL WINDOW DIAGRAM FOR N-SIM



Rapid advances in computer & communication technologies have resulted in the increasing merger of these two fields. The lines have blurred among computing, switching & digital transmission equipment; and the same digital techniques are being used for data, audio & video transmission. Merging & evolving technologies, coupled with increasing demands for efficient & timely collection, processing & dissemination of information, have led to the development of integrated systems that transmit & process all types of data.

These intgrated systems are broadly divided as follows

- **DATA COMMUNICATION** dealing with transmission, transmission media, signal decoding, interfacing, data link control & multiplexing

- **NETWORKING** deals with the technology & architecture of communication network

- **COMMUNICATION PROTOCOLS** which covers the architecture as well as analysis of individual protocols at various layers depending on the hardware & software Network laboratory is designed & developed considering the curriculum offered by Anna University. Trainers offered under network laboratory are designed for students at all level to study and understand all the concepts of data communication, data transfer using serial and parallel ports, Ethernet and wireless LAN with complete protocol understanding and actual hands on with hardware & software with ease.

Network laboratory consists of DCT-03 Data communication trainer kit, LTS- 01 LAN / Wireless LAN training system, L-SIM LAN / WLAN protocol simulator and analyzer software & N-SIM Network simulation software.

The DCT-03: Data communication trainer is a unique trainer kit for the development of exercises and theoretical-experimental courses to understand the basic concept and working of modes and protocols in serial and parallel communication.

The trainer kit consists of functional blocks for serial and parallel communication system.

The trainer kit is highly innovative from a technological as well as an educational point of view. The trainer kit is used as “basic unit” to examine all the peculiar operating standards of serial and

serial and parallel communication ports and an Oscilloscope. Utmost care has been laid in the design and quality control of all circuits, to ensure the repeatability of the results of the experiments.

Data communication is a term referred when the sender and receiver are digital devices, which communicate with each other by means of binary information. The objective of this trainer kit is to clear the various aspects of the data communications which comprise of

- The information source or sender.
- The medium for carrying information.
- The information receiver.
- The communication protocols, which ensure proper transfer of data.

With an increasing demand in information exchange the field of data communication technique is emerging as the only solution, to satisfy the various needs of today's communication sector and to achieve very high bandwidth along with highest accuracy. The communication media is shifting from analog signal transfer towards digital communication.

With PC becoming the biggest storage devices in digital form, it becomes the main source and destination for information exchange. With rapid growth in both the communication technologies as well as computer hardware and software technologies, these two fields are merged to form a data communication network. Now the digital data is used for data, voice and image transmission.

Depending upon the application the communication link can be of point to point communication between two devices or a multipoint communication between at least 3 devices and data transfer can be serial or in parallel form.

RESULT:

The study of network simulator (ns) and simulation of congestion control algorithms using ns is executed and verified.

DATE: 8. Study of TCP/UDP performance using Simulation tool.

AIM:

To Study TCP/UDP performance using Simulation tool.

TOOLS USED:

Opnet Simulator

INTRODUCTION:

The transport layer protocols provide connection- oriented sessions and reliable data delivery services. This paper seeks to reflect a comparative analysis between the two transport layer protocols, which are TCP/IP and UDP/IP, as well to observe the effect of using these two protocols in a client server network. The similarities and differences between TCP and UDP over the Internet are also presented in our work. We implement a network structure using Opnet Modeler and finally, based on the practical results obtained we present the conclusions-showing the difference between these two protocols and how they work.

The transport layer is not just another layer. It is the heart of the whole protocol hierarchy. Its task is to provide reliable, cost-effective data transport from the source machine to the destination machine, independently of the physical network or networks currently in use.

TCP and UDP are transport layer components that provide the connection point through which applications access network services. TCP and UDP use IP, which is a lower-layer best effort delivery service. IP encapsulates TCP packets and UDP datagrams and delivers this information across router-connected internet works.

The ultimate goal of the transport layer is to provide efficient, reliable, and cost-effective service to its users, normally processes in the application layer. To achieve this goal, the transport layer makes use of the services provided by the network layer. Without the transport layer, the whole concept of layered protocols would make little sense e.g. The Transport Layer prepares applications data for transport over the network and processes network data to be used by applications. It is responsible for the end-to-end transfer of data over the network and is the four of the OSI model. The Transport layer meets a number of functions:

- enabling the applications to communicate over the network at the same time when using a single device;
- ensure that all amount of data is receive by the correct application;
- responsible for fragmentation and reassembly;
- develop mechanism for handling errors.

Comparison Between TCP And UDP

Service	TCP	UDP
Flow controls	The receiver can signal the sender to slow down.	ACKs, which are used in TCP to control packet flow, are not returned.
Connection setup	It takes time, but with TCP reliability is ensured.	No connection is required.
Guaranteed message delivery	Returns acknowledgments.	UDP does not return ACKs, the receiver can't signal that packets have been successfully delivered.
Congestion controls	Network devices can take advantage of TCP ACK to control the behavior of sender.	If ACK, are missing, the network cannot signal congestion to the sender.

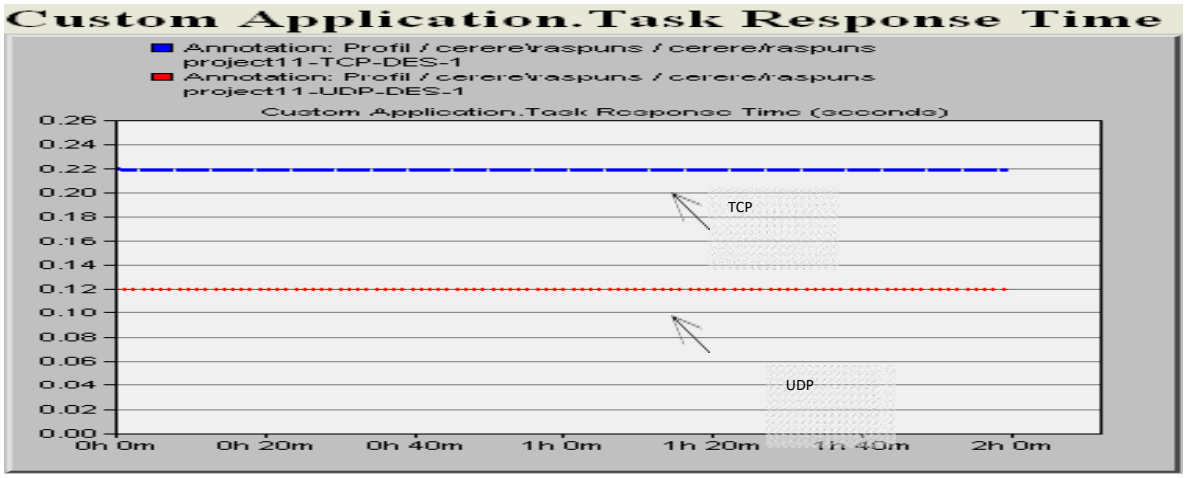
A big difference between TCP and UDP is the congestion control algorithm. For the TCP, congestion algorithm prevents the sender from overrunning the network capacity, while TCP can adapt the sender's rate with the network capacity and attempt to avoid potential congestions problems.

User Datagram Protocol (UDP)**,** another transport protocol in IP networks, is described e.g. The User Datagram Protocol (UDP) provides an unreliable connectionless delivery service using IP to transport messages between machines e.g. [5]. It uses IP to carry messages, but adds the ability to distinguish among multiple destinations within a given host computer. Is a connectionless protocol which doesn't provide flow control, reliability or error recovery and the retransmissions of data in case of errors must be ordered by other protocols. UDP is designed for applications that do not have to recompose the data segment that arrives from the sender. In another way, application-level protocols are directly responsible for the security of data transmitted.

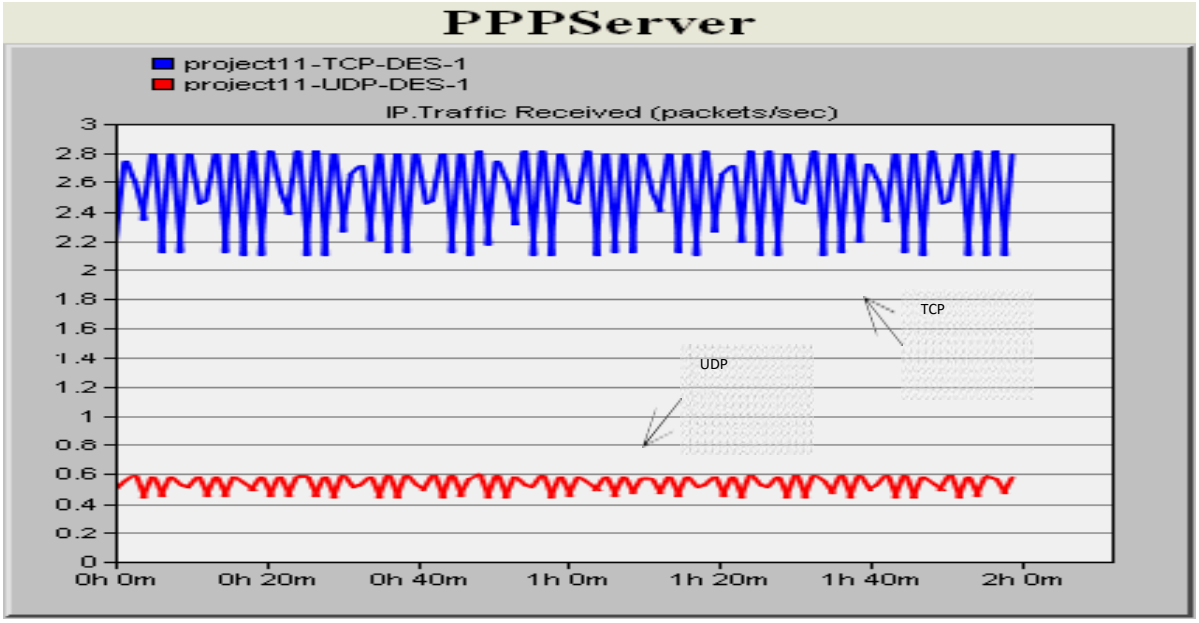
Difference from the TCP is that there is no mechanism for error detections. If applications that use UDP doesn't have their own mechanism for information retrieval can lose those data and be forced to retransmitted again. On the other side this applications are not slow down by the confirmation process and the memory will be available for work much faster.

SIMULATION RESULTS:

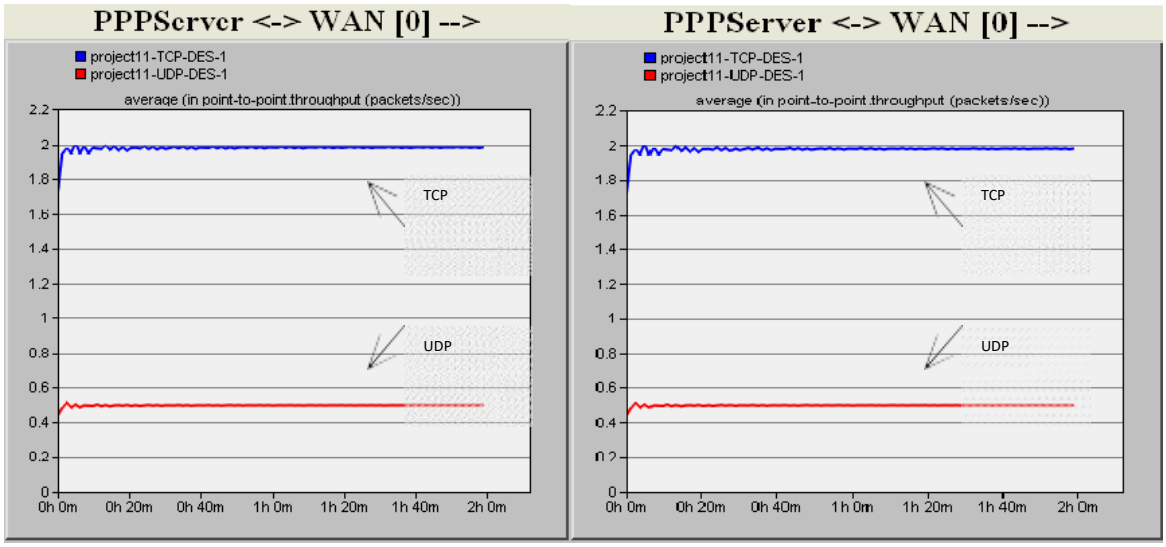
The simulation time is set for two hours data transfer between LAN network and the server with no packet latency and packet discard ratio of 0% while packets traverse thru the WAN. The task response time, in seconds, Fig. 1, shows how long the application need to be completed. The time when using TCP to complete the task is greater that the one using UDP. When using TCP, source and destination need to perform a three-way handshake before starting sending data and all amount of data need to be acknowledge by the destination when it is receive, so is taking more time than UDP, which doesn't perform this tasks.



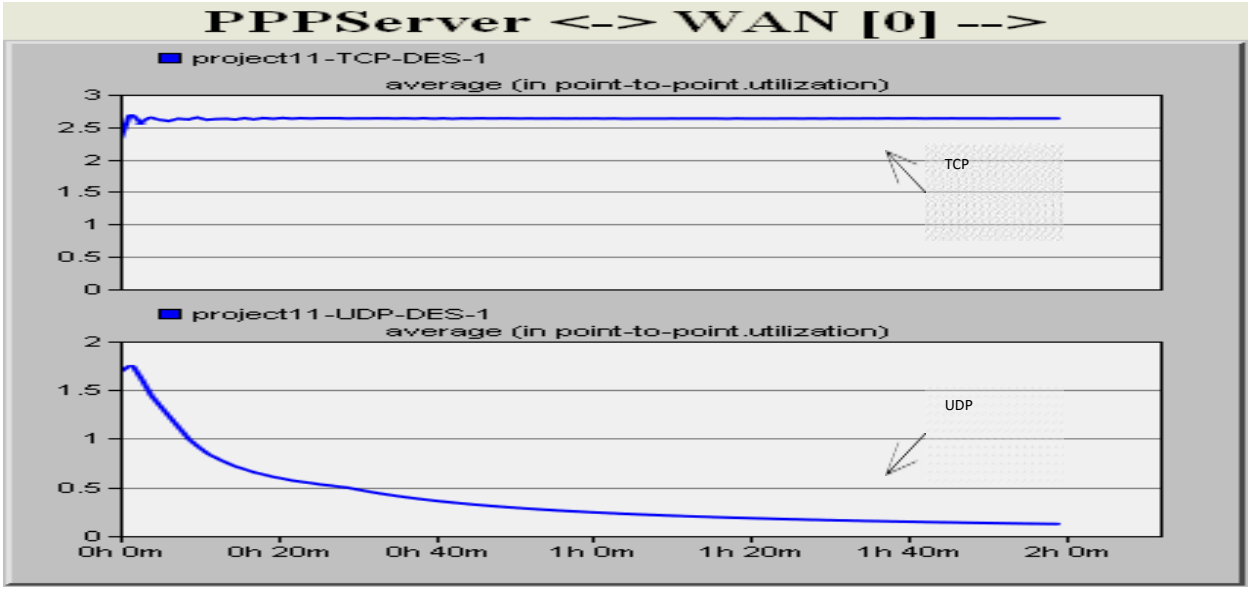
1.Response time for TCP and UDP



2.Traffic received (packets/sec) for the server



3.Traffic/Link utilization from the WAN to the server



Link utilization with a 0.5% packets discard ratio

The main difference between these two protocols is that TCP provides reliability and congestion control services, while UDP is orientated to improve performance.

The most important and common thing that TCP and UDP are using is the ability to set a host-to-host communication channel, so the packets will be delivered between processes running on two different computers. UDP is the right choice for application where reliability is not a must but the speed and performance is. Instead, TCP, even if it takes more time for the processes, has additional functions like same order delivery, reliability and flow control. As future work, we plan to conduct several studies regarding packets routing in computer networks to improve the fairness of data transmissions using different network protocols.

RESULT:

Thus the TCP/UDP performance has been simulated successfully using OPNET.

9.a Simulation of Distance Vector Routing Algorithm

DATE:

AIM:

To implement the Distance – Vector Routing Algorithm

APPARATUS REQUIRED:

1. VI-RTSIM software.
2. Personal computer.

THEORY:

Distance Vector Algorithm:

- A Distance vector routing, each router periodically share its knowledge about the entire network with it's neighbors.
- The three keys to under this algorithm are
    1. Knowledge about the whole network.
    2. Routing only to neighbor.
    3. Information sharing at regular intervals.

Knowledge about the whole work:

- Each router shares its knowledge about entire network. It sends all of its collected knowledge about the network to its neighbors.

Routing only to neighbor:

- Each router periodically sends its knowledge about the network only to those routers to which it has direct links. It sends whatever knowledge it has.

Information sharing at regular intervals:

- The every 30 seconds, each router sends its information about the whole network to its neighbors.

Sharing Information:

- LAN's are connected by router, represented by the assuming A, B, C, D, E and F.
- Distance vector routing simplifies the routing process by assuming a lost of one unit for every link.
- The efficiency of transmission is a function only of the number of links required to reach a destination. In this, the cost on hop count.

Routing Table:

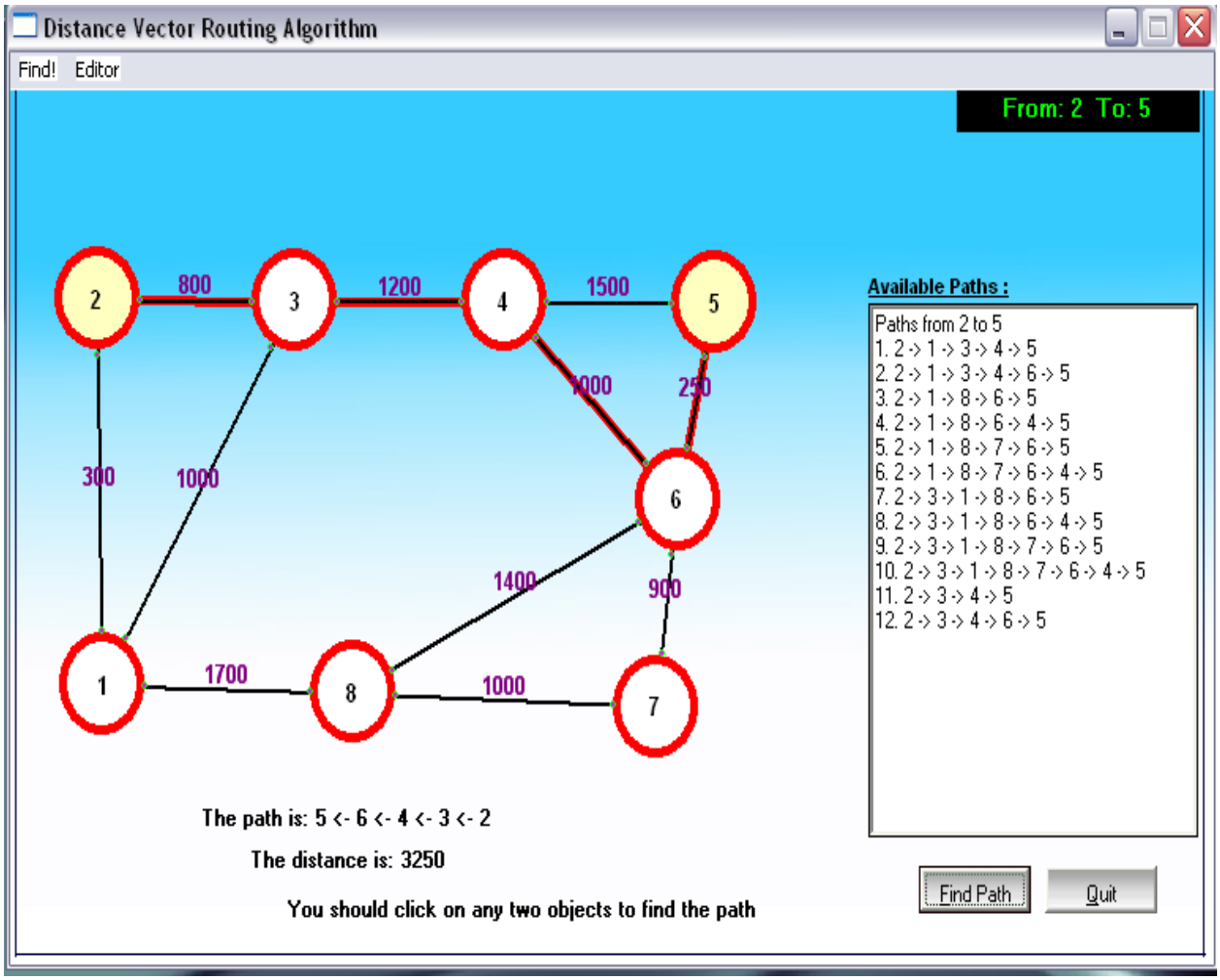
- Each router gets its initial knowledge about the internet work and how it uses shared information to update that knowledge.
- The routing table has e columns network lost router ID.
- The first block is final destination of packet.
- The second block is no of hop count.
- The third block is that to which a packet delivers must.

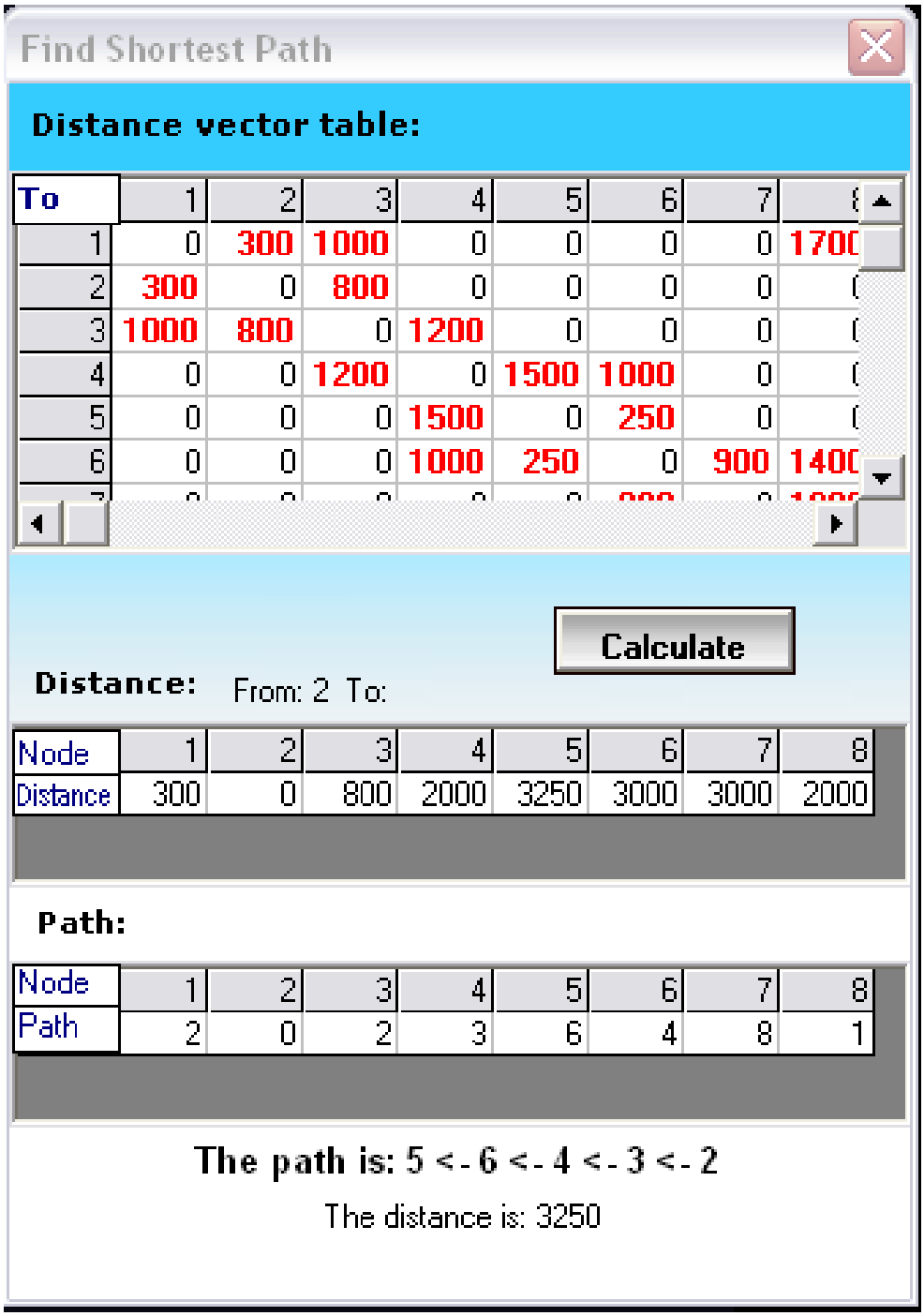
Updating algorithm:

- Updating algorithm requires that the router first has one hop to the hop count field for each advertised router.
- The router should apply the below rules to each router, if the advertised destination is not in routing table
- If next hop field is same, router should replace the entry in the table with advertised one.
- If next hop field is same, router should replace the entry in the table with advertised one.
- . If next hop field is not the same, advertised hop count is smaller than the one in the table, the router should replace the entry in the table with new one.
- IF advertised hop count is not smaller, the router should do no routing.

PROCEDURE

1. Open VI-RTSIM software from desktop
2. Click the Simulation menu bar
3. Select the "Distance – Vector Routing Algorithm" option from Routing algorithm menu bar.
4. Network with routers connected through link is drawn by using option in editor(add router, join link, delete router, delete link, Add caption to link, add caption to router)
5. Select any two nodes to find the shortest distance between them.
6. Click the Find path Button to run the program.
7. Now the shortest paths between the two nodes are calculated.


Distance Vector Routing Algorithm
Find!
Editor
From: 2 To: 5
2
3
4
5
6
1
8
7
800
1200
1500
1000
250
300
1000
1400
900
1700
1000
Available Paths :
Paths from 2 to 5
1. 2 -> 1 -> 3 -> 4 -> 5
2. 2 -> 1 -> 3 -> 4 -> 6 -> 5
3. 2 -> 1 -> 8 -> 6 -> 5
4. 2 -> 1 -> 8 -> 6 -> 4 -> 5
5. 2 -> 1 -> 8 -> 7 -> 6 -> 5
6. 2 -> 1 -> 8 -> 7 -> 6 -> 4 -> 5
7. 2 -> 3 -> 1 -> 8 -> 6 -> 5
8. 2 -> 3 -> 1 -> 8 -> 6 -> 4 -> 5
9. 2 -> 3 -> 1 -> 8 -> 7 -> 6 -> 5
10. 2 -> 3 -> 1 -> 8 -> 7 -> 6 -> 4 -> 5
11. 2 -> 3 -> 4 -> 5
12. 2 -> 3 -> 4 -> 6 -> 5
The path is: 5 <- 6 <- 4 <- 3 <- 2
The distance is: 3250
You should click on any two objects to find the path
Find Path
Quit


Find Shortest Path
Distance vector table:
To 1 2 3 4 5 6 7
1 0 300 1000 0 0 0 0
2 300 0 800 0 0 0 0
3 1000 800 0 1200 0 0 0
4 0 0 1200 0 1500 1000 0
5 0 0 0 1500 0 250 0
6 0 0 0 1000 250 0 900
Calculate
Distance: From: 2 To:
Node 1 2 3 4 5 6 7 8
Distance 300 0 800 2000 3250 3000 3000 2000
Path:
Node 1 2 3 4 5 6 7 8
Path 2 0 2 3 6 4 8 1
The path is: 5 <- 6 <- 4 <- 3 <- 2
The distance is: 3250

Viva questions and answers:

1. **what is distance vector routing protocol?**

In distance vector routing the least cost route between any two nodes is the route with minimum distance. In this each node maintains a vector table of minimum distances to every node. The table at each node also guides the packets to the desired node by showing the next stop in the route.

2. **What is advantage in distance vector routing protocol?**

In this each node shares its routing table with its immediate neighbors periodically and when there is a change.

3. **What are the routing protocols?**

- Intra domain routing protocols
- Interdomain routing protocols

4. **What is intradomain routing protocols?**

Routing inside an autonomous system is referred to as intradomain routing protocols.

5. **What is RIP?**

RIP(routing information protocol) is an intradomain routing protocol used inside an autonomous system. it is very simple protocol based on distance vector routing.

RESULT:

Thus Distance Vector routing algorithm has been implemented and shortest-path has been circulated.

DATE:

9.b Simulation of Link State Routing Algorithm

AIM:

To implement the Link State Routing Algorithm

APPARATUS REQUIRED:

1. VI-RTSIM software.
2. Personal computer.

THEORY:

Link State Vector Algorithm:

- In Link state routing, each router share its information of its neighbors with every other router in the inter-network.

Knowledge about the neighborhood:

- Instead of sending its entire routing table, a router sends information about its neighborhood only.

To all router:

- Each router send this information to every other router on the internetworking, not just to its neighbors.
- If s does so by a process called “flooding” it means that a router sends its information.

Information sharing when there is a Change:

- Each router sends out information about the neighbors when there is a change.

Information sharing:

- Link state routing process use the same internet work as distance vector algorithm.
- Here each other sends its knowledge about is neighbors to every other router in the internet work.
- Cost is applied only by routers and not by any other station on a network, if cost was added by every station, instead of by routers alone, it would accumulate unpredictably.
- Cost is applied as a packet leaves the router rather then as if enters. Most networks are broadcast networks. When a packet is in network every station, including the router, can pick it up, we cannot assign any cost to a packet.

Link state packet:

- When a router floods the network with information about its neighborhood, it is said to be advertising. The basis of this advertising is a short packet called a link state packet (LSP).

Advertiser	Network	Cost	Neighbor

Getting information about neighbors:

- A router gets its information about its neighbors by periodically sending them a short greeting packet.
- If the neighbor responds to the greeting as expected, it is assumed to be alive and functioning.

Initialization:

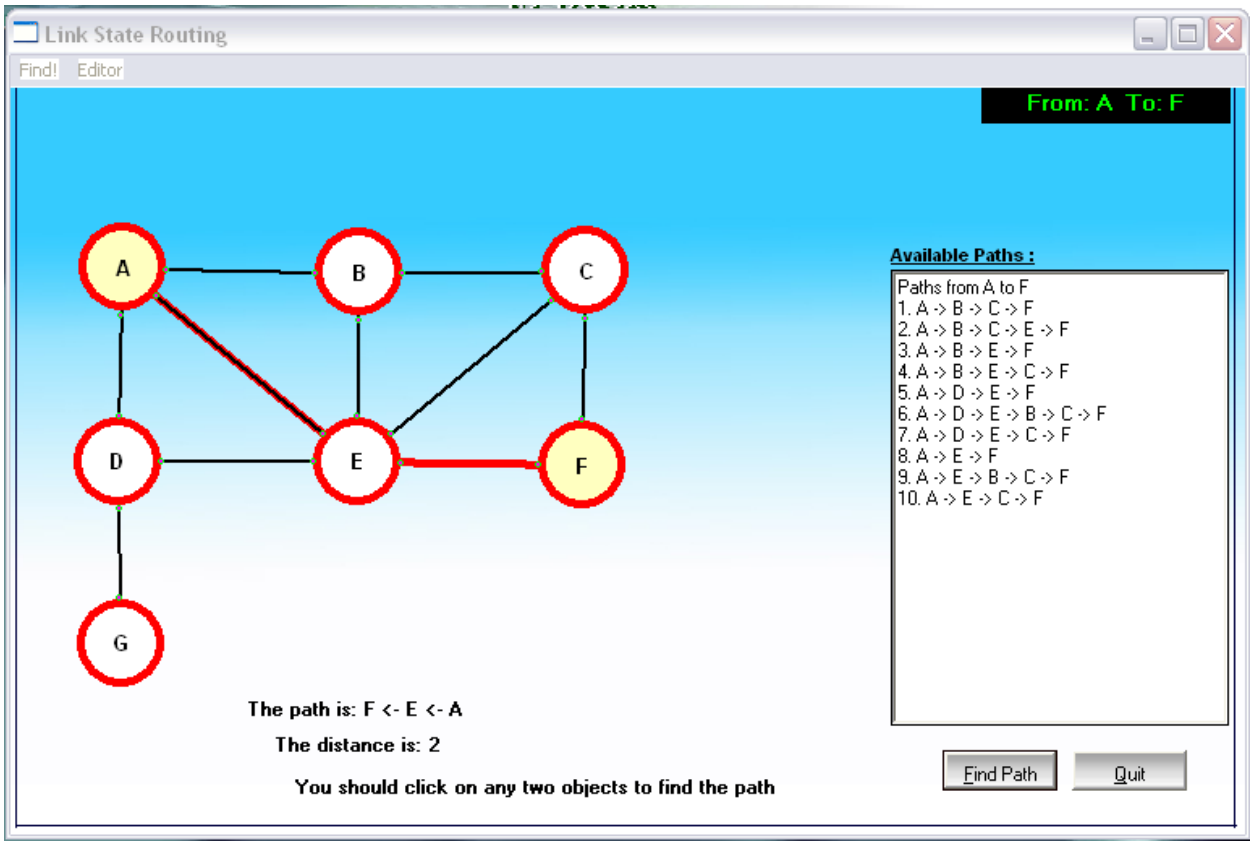
- Imagine that all routers in our sample internet work come up at the same time.
- Each router sends a greeting packet to its neighbors to find out the state of each link.

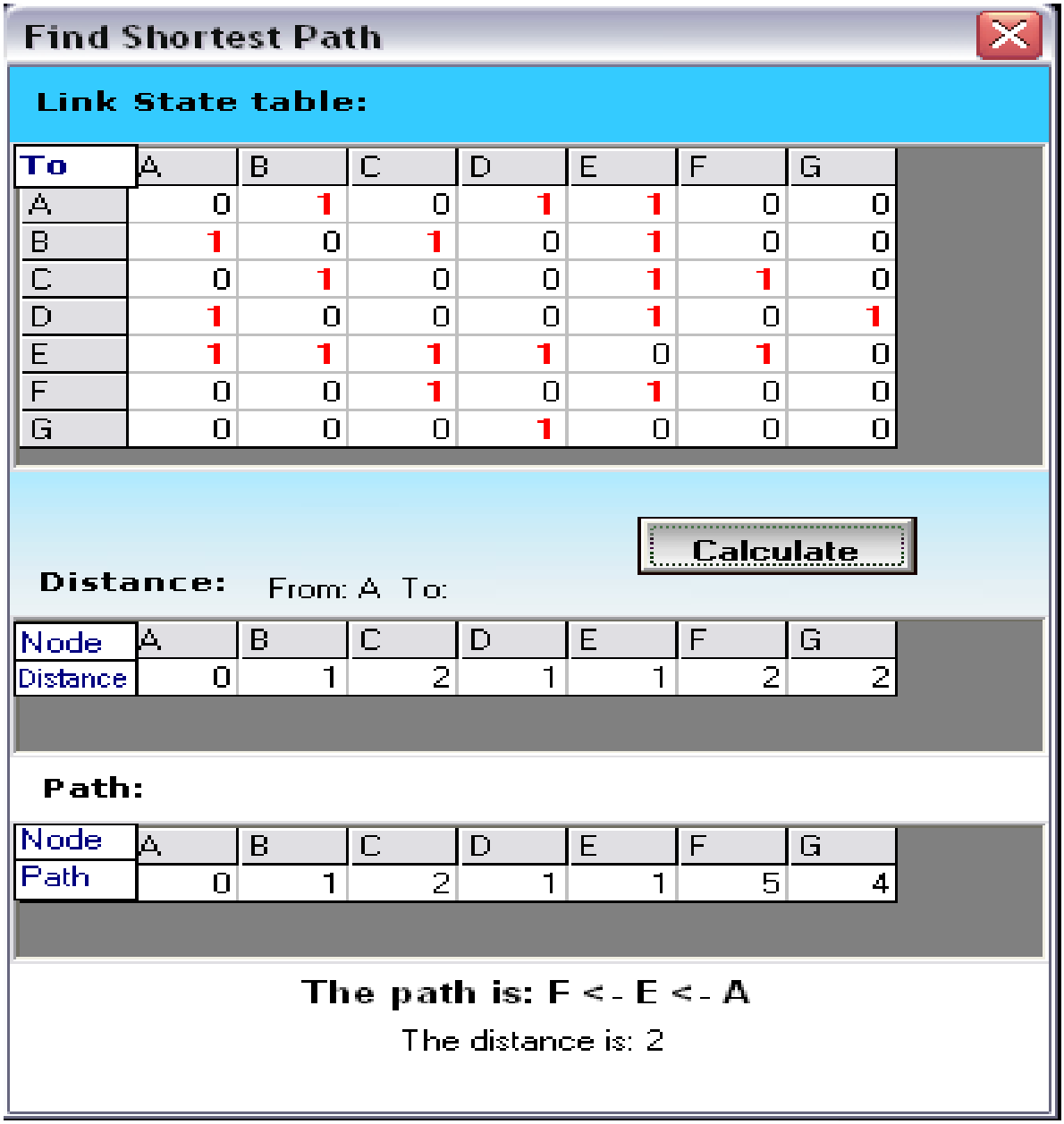
Link – State Database:

- Every router every LSP and puts the information into a link-state database.
- Because every router receives the same LSPs every router builds the same database.
- It stores this database on its disk and uses it to calculate its routing table. If a router is added to be deleted from the system, the whole database must be shared for fast updating.

PROCEDURE

1. Open VI-RTSIM software from desktop
2. Click the Simulation menu bar
3. Select the "Link State Routing Algorithm" option from Routing algorithm menu bar.
4. Network with routers connected through link is drawn by using option in editor(add router, join link, delete router, delete link, Add caption to link, add caption to router)
5. Select any two nodes to find the shortest distance between them.
6. Click the Find path Button to run the program.
7. Now the shortest paths between the two nodes using link state routing algorithm was calculated.


Link State Routing
Find!
Editor
From: A To: F
A
B
C
D
E
F
G
Available Paths :
Paths from A to F
1. A -> B -> C -> F
2. A -> B -> C -> E -> F
3. A -> B -> E -> F
4. A -> B -> E -> C -> F
5. A -> D -> E -> F
6. A -> D -> E -> B -> C -> F
7. A -> D -> E -> C -> F
8. A -> E -> F
9. A -> E -> B -> C -> F
10. A -> E -> C -> F
The path is: F <- E <- A
The distance is: 2
You should click on any two objects to find the path
Find Path
Quit


Find Shortest Path
Link State table:
To A B C D E F G
A 0 1 0 1 1 0 0
B 1 0 1 0 1 0 0
C 0 1 0 0 1 1 0
D 1 0 0 0 1 0 1
E 1 1 1 1 0 1 0
F 0 0 1 0 1 0 0
G 0 0 0 1 0 0 0
Calculate
Distance: From: A To:
Node A B C D E F G
Distance 0 1 2 1 1 2 2
Path:
Node A B C D E F G
Path 0 1 2 1 1 5 4
The path is: F <- E <- A
The distance is: 2

Viva questions and answers:

1. What is link state routing protocol?

It has a different concept from that of distance vector routing. In this each node in the domain has the entire topology of the domain-the list of nodes and links, how they are connected including the type, cost and condition of the links.

2. What is other name of link state routing protocol?

Dijkstra's algorithm.

3. What is advantage of link state routing protocol? The link state

packet can carry a large amount of information. It has topology

4. How the routing table is builded?

By formation of a shortest path tree for each node. Calculation of a

routing table based on the shortest path tree. Creation of the

states of the links by each node.

5. What is periodic update?

A node sends its routing table, normally every 30's in a periodic update. The period depends on the protocol that is using distance vector routing.

RESULT:

Thus Link-State routing algorithm has been implemented and shortest-path has been circulated.

Ex No : 10 **Date**:

Simulation of an error correction code - CRC

Aim:

To write a C program to Simulate the error correction code using CRC algorithm.

Theory:

Transmission Errors

- External electromagnetic signals can cause incorrect delivery of data
- Any of these problems are called transmission errors:
  - Data can be received incorrectly
  - Data can be lost
  - Unwanted data can be generated

Error Detection

- Bit errors occur in frames due to electrical interference or thermal noise.
- Detecting errors is one part of the problem; correcting errors is the other.
- Detecting Transmission Errors: basic idea is to add redundant information to a frame that can determine if errors have been introduced.
- What happens when an error is detected? There are two basic approaches:
  - Notify the sender that message is corrupt so the sender can retransmit it
  - Use an error-correcting code to reconstruct the correct message

Error Correction:

- When error is detected, frame is discarded and resent using bandwidth and causing latency.
- Error correction requires additional bit to be sent with every frame.
- Correction is useful when
  - Errors are probable
  - The cost of retransmission is too high

Algorithm:

1) CRC is a different approach to detect if the received frame contains valid data.The data of length, n, and the generator polynomial of length, L are prepared.
2) The data to be sent is appended with (L-1) number of zeros.
3) At the sender side, Binary division is performed with the data as dividend and the binary equivalent of the generator polynomial as the divisor. The remainder of the binary division is the check value. Actual data bits plus the remainder is called a codeword.
4) The codeword is sent to the receiver side through transmission medium.
5) At the sender side, The data received again proceeds with binary division with the data as dividend and the binary equivalent of the generator polynomial as the divisor.
6) If the remainder of the binary division is zero, then the data transmitted from the sender has no error. If the remainder is not zero, then the data transmitted has been corrupted with an error.

Program:

```
// Include headers
#include<stdio.h>
#include<string.h>
// length of the generator polynomial
#define N strlen(gen_poly)
// data to be transmitted and received
char data[28];
// CRC value
char check_value[28];
// generator polynomial
char gen_poly[10];
// variables
int data_length,i,j;
// function that performs XOR operation
void XOR()
{
   // if both bits are the same, the output is 0
   // if the bits are different the output is 1
   for(j = 1;j < N; j++)
   check_value[j] = (( check_value[j] == gen_poly[j])?'0':'1');
}
// Function to check for errors on the receiver side
void receiver()
{
// get the received data
   printf("Enter the received data: ");
   scanf("%s", data);
   printf("\n-----------------------------\n");
```

```
    printf("Data received: %s", data);
// Cyclic Redundancy Check
    crc();
// Check if the remainder is zero to find the error
    for(i=0;(i<N-1) && (check_value[i]!='1');i++);
        if(i<N-1)
            printf("\nError detected\n\n");
        else
            printf("\nNo error detected\n\n");
}
 void crc()
{
    // initializing check_value
    for(i=0;i<N;i++)
        check_value[i]=data[i];
    do{
    // check if the first bit is 1 and calls XOR function
        if(check_value[0]=='1')
            XOR();
// Move the bits by 1 position for the next computation
        for(j=0;j<N-1;j++)
            check_value[j]=check_value[j+1];
        // appending a bit from data
        check_value[j]=data[i++];
    }while(i<=data_length+N-1);
// loop until the data ends
}
```

```
int main()
{
    // get the data to be transmitted
    printf("\nEnter data to be transmitted: ");
    scanf("%s",data);
    printf("\n Enter the Generating polynomial: ");
    // get the generator polynomial
    scanf("%s",gen_poly);
    // find the length of data
    data_length=strlen(data);
    // appending n-1 zeros to the data
    for(i=data_length;i<data_length+N-1;i++)
        data[i]='0';
    printf("\n----------------------------------------");
// print the data with padded zeros
    printf("\n Data padded with n-1 zeros : %s",data);
    printf("\n----------------------------------------");
// Calling the function for Cyclic Redundancy Check calculation
    crc();
// print the computed check value
    printf("\nCRC or Check value is : %s",check_value);
// Append data with check_value(CRC)
    for(i=data_length;i<data_length+N-1;i++)
        data[i]=check_value[i-data_length];
    printf("\n----------------------------------------");
// printing the final data to be sent
    printf("\n Final data to be sent : %s",data);
    printf("\n----------------------------------------\n");
```

```
// Calling the receiver function to check errors
    receiver();
    return 0;
}
```

Output:

```
/tmp/c0hldHp3ci.o
Enter data to be transmitted: 1011011
Enter the Generating polynomial: 1010
---------------------------------------
 Data padded with n-1 zeros : 1011011000
---------------------------------------
CRC or Check value is : 010
---------------------------------------
 Final data to be sent : 1011011010
---------------------------------------
Enter the received data: 1011011010
-----------------------------
Data received: 1011011010
No error detected
```

```
/tmp/c0hldHp3ci.o
Enter data to be transmitted: 1010101
Enter the Generating polynomial: 101
---------------------------------------
 Data padded with n-1 zeros : 101010100
---------------------------------------
CRC or Check value is : 00
---------------------------------------
 Final data to be sent : 101010100
---------------------------------------
Enter the received data: 101010110
-----------------------------
Data received: 101010110
Error detected
```

Result:

Thus the C program for simulating the error correction code using CRC algorithm is executed and verified successfully.