SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur-603203.

DEPARTMENT OF INFORMATION TECHNOLOGY

ACADEMIC YEAR: 2025-2026

Lab Manual

AD3466- DATA COMMUNICATION AND NETWORKS LAB

(VI semester)

Regulation 2023

Prepared By

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SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

Department of Information Technology

VISION OF THE DEPARTMENT

To become a model for higher learning through development to prepare self-disciplined, creative culturally competent and dynamic Information Technocrats while remaining sensitive to ethical, societal and environmental issues.

MISSION OF THE DEPARTMENT

M1: To mould the students as innovative and high quality IT professionals to meet the global challenges and Entrepreneurs of international excellence as global leaders capable of contributing towards technological innovations learning process, participation citizenship in their neighborhood and economic growth.

M2: To impart value-based IT education to the students and enrich their knowledge and to achieve effective interaction between industry and institution for mutual benefits.

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PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. To afford the necessary background in the field of Information Technology to deal with engineering problems to excel as engineering professionals in industries.
2. To improve the qualities like creativity, leadership, teamwork and skill thus contributing towards the growth and development of society.
3. To develop ability among students towards innovation and entrepreneurship that caters to the needs of Industry and society.
4. To inculcate and attitude for life-long learning process through the use of information technology sources.
5. To prepare then to be innovative and ethical leaders, both in their chosen profession and in other activities.

PROGRAMME OUTCOMES (POs)

After going through the four years of study, Information Technology Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and

		synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling to complex engineering activities, with an understanding of the limitations.
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES (PSOs)

By the completion of Information Technology program, the student will have following Program specific outcomes

1. Design secured database applications involving planning, development and maintenance using state of the art methodologies based on ethical values.
2. Design and develop solutions for modern business environments coherent with the advanced technologies and tools.
3. Design, plan and setting up the network that is helpful for contemporary business environments using latest hardware components.
4. Planning and defining test activities by preparing test cases that can predict and correct errors ensuring a socially transformed product catering all technological needs.

AD3466 DATA COMMUNICATION AND NETWORKS LABORATORY

AD3466	DATA COMMUNICATION AND NETWORKS LAB	L T P C
		0 0 3 1.5

Objectives:

- To understand examine the network protocol and analyzer.
- To learn to implement TCP sockets.
- To visualize the Simulation of DNS.
- To build simulating ARP /RARP protocols.
- To study Network simulator

LIST OF EXPERIMENTS

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).

TOTAL: 45 PERIODS

LABORATORY REQUIREMENT:

HARDWARE:

Standalone desktops

SOFTWARE:

Java / Equivalent Compiler, NS2 simulator (Open source software)

CO-PO-PSO Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3	PSO3
AD3466.1	3	-	-	3	-	-	-	-	-	-	-	-	3	-	1	-
AD3466.2	-	2	-	2	2	-	-	-	-	-	-	-	3	-	3	-
AD3466.3	2	-	3	-	1	-	-	-	3	-	1	-	-	-	3	-
AD3466.4	-	3	-	3	-	-	-	-	-	-	-	3	-	-	1	-
AD3466.5	3	-	-	1	2	-	-	-	-	-	-	-	2	-	2	-

EVALUATION PROCEDURE FOR EACH EXPERIMENTS

S.No	Description	Mark
1.	Aim & Pre-Lab discussion	20
2.	Observation	30
3.	Conduction and Execution	30
4.	Output & Result	10
5.	Viva	10
Total		**100**

INTERNAL ASSESSMENT FOR LABORATORY

S.No	Description	Mark
1.	Conduction and Evaluation	25
2.	Record	10
3.	Model Test	15
Total		**50**

EX.NO: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

AIM: To Learn to use commands like tcpdump, netstat, ipconfig, nslookup and traceroute ping.

PRE LAB DISCUSSION:

Tcpdump:

The tcpdump utility allows you to capture packets that flow within your network to assist in network troubleshooting. The following are several examples of using tcpdump with different options. Traffic is captured based on a specified filter.

Netstat

Netstat is a common command line TCP/IP networking available in most versions of Windows, Linux, UNIX and other operating systems.

Netstat provides information and statistics about protocols in use and current TCP/IP network connections.

ipconfig

ipconfig is a console application designed to run from the Windows command prompt. This utility allows you to get the IP address information of a Windows computer.

From the command prompt, type **ipconfig** to run the utility with default options. The output of the default command contains the IP address, network mask, and gateway for all physical and virtual network adapter.

nslookup

The **nslookup** (which stands for *name server lookup*) command is a network utility program used to obtain information about internet servers. It finds name server information for domains by querying the Domain Name System.

Trace route:

Traceroute is a network diagnostic tool used to track the pathway taken by a packet on an IP network from source to destination. Traceroute also records the time taken for each hop the packet makes during its route to the destination

Commands:

Tcpdump:

Display traffic between 2 hosts:

To display all traffic between two hosts (represented by variables host1 and host2): # tcpdump host host1 and host2

Display traffic from a source or destination host only:

To display traffic from only a source (src) or destination (dst) host:

Display traffic for a specific protocol

Provide the protocol as an argument to display only traffic for a specific protocol, for example tcp, udp, icmp, arp

```
# tcpdump protocol# tcpdump src host
# tcpdump dst host
```

For example to display traffic only for the tcp traffic :

```
# tcpdump tcp
```

Filtering based on source or destination port

To filter based on a source or destination port:

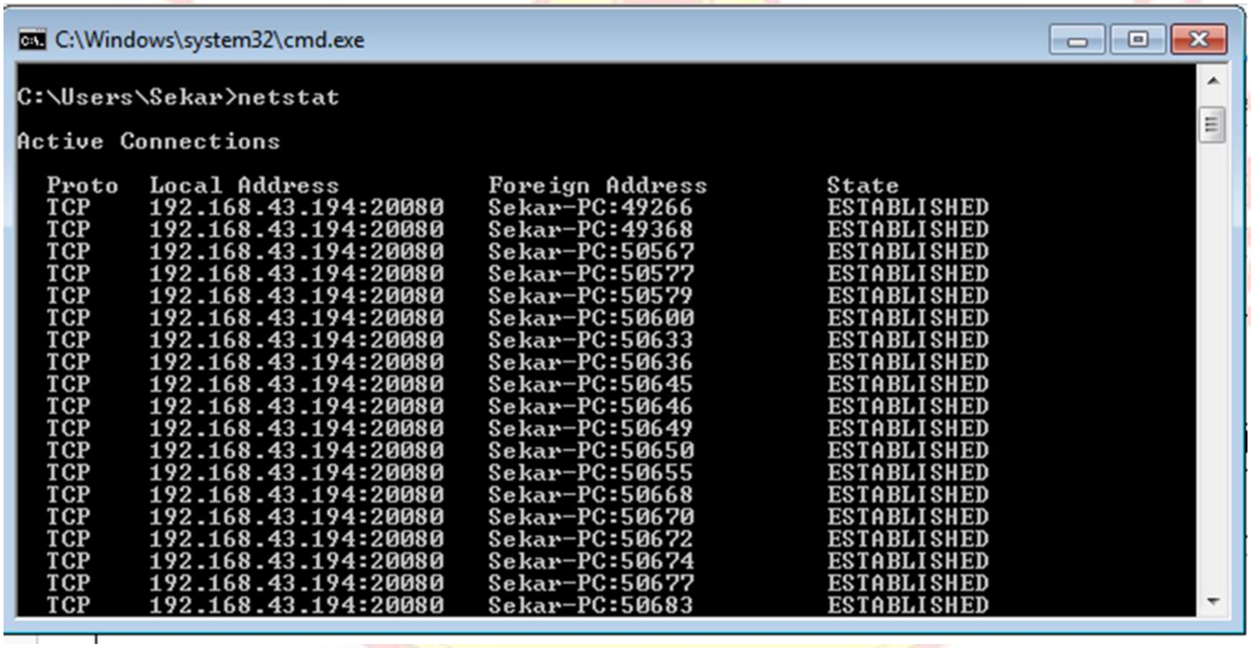
```
# tcpdump src port ftp
# tcpdump dst port http
```

2.Netstat

Netstat is a common command line TCP/IP networking available in most versions of Windows, Linux, UNIX and other operating systems.

Netstat provides information and statistics about protocols in use and current TCP/IP network connections. The Windows help screen (analogous to a Linux or UNIX for netstat reads as follows: displays protocol statistics and current TCP/IP network connections.

```
#netstat
```



```
C:\Users\Sekar>netstat

Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    192.168.43.194:20080   Sekar-PC:49266         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:49368         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50567         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50577         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50579         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50600         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50633         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50636         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50645         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50646         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50649         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50650         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50655         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50668         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50670         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50672         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50674         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50677         ESTABLISHED
  TCP    192.168.43.194:20080   Sekar-PC:50683         ESTABLISHED
```

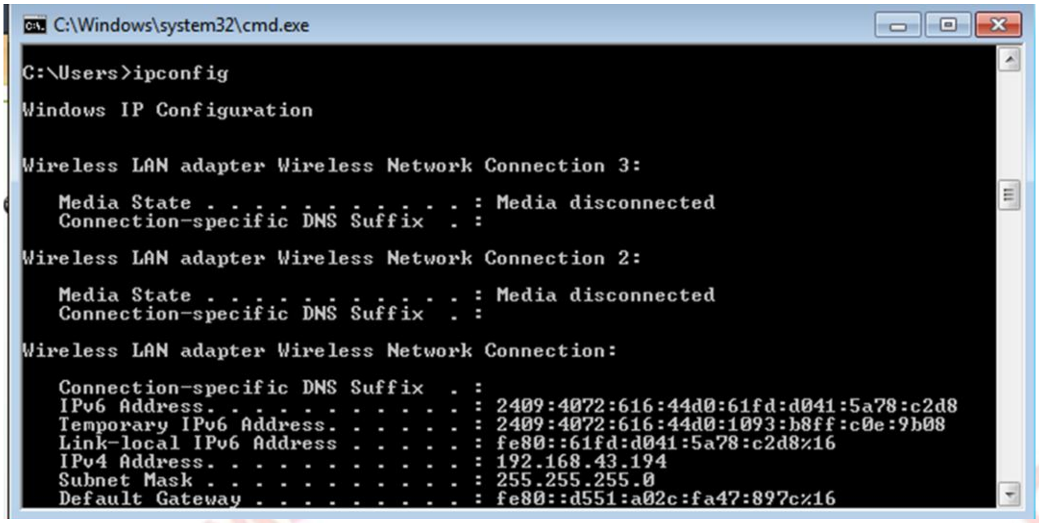
3. **ipconfig**

In Windows, **ipconfig** is a console application designed to run from the Windows command prompt. This utility allows you to get the IP address information of a Windows computer.

Using ipconfig

From the command prompt, type **ipconfig** to run the utility with default options. The output of the default command contains the IP address, network mask, and gateway for all physical and virtual
network adapter.

```
#ipconfig
```



```
C:\Users>ipconfig

Windows IP Configuration


Wireless LAN adapter Wireless Network Connection 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Wireless Network Connection 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Wireless Network Connection:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2409:4072:616:44d0:61fd:d041:5a78:c2d8
   Temporary IPv6 Address. . . . . . : 2409:4072:616:44d0:1093:b8ff:c0e:9b08
   Link-local IPv6 Address . . . . . : fe80::61fd:d041:5a78:c2d8%16
   IPv4 Address. . . . . . . . . . . : 192.168.43.194
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : fe80::d551:a02c:fa47:897c%16
```

4.nslookup

The **nslookup** (which stands for *name server lookup*) command is a network utility program used to obtain information about internet servers. It finds name server information for domains by querying the Domain Name System.

The nslookup command is a powerful tool for diagnosing DNS problems. You know you're experiencing a DNS problem when you can access a resource by specifying its IP address but not its DNS name.

```
#nslookup
```

5.Trace route:

Traceroute uses Internet Control Message Protocol (ICMP) echo packets with variable time to live (TTL) values. The response time of each hop is calculated. To guarantee accuracy, each hop is queried multiple times (usually three times) to better measure the response of that particular hop.
Traceroute is a network diagnostic tool used to track the pathway taken by a packet on an IP network from source to destination. Traceroute also records the time taken for each hop the packet makes during its route to the destination. Traceroute uses Internet Control Message Protocol (ICMP) echo packets with variable time to live (TTL) values.

The response time of each hop is calculated. To guarantee accuracy, each hop is queried multiple times (usually three times) to better measure the response of that particular hop. Traceroute sends packets with TTL values that gradually increase from packet to packet, starting with TTL value of one. Routers decrement TTL values of packets by one when routing and discard packets whose TTL value has reached zero, returning the ICMP error message ICMP Time Exceeded.

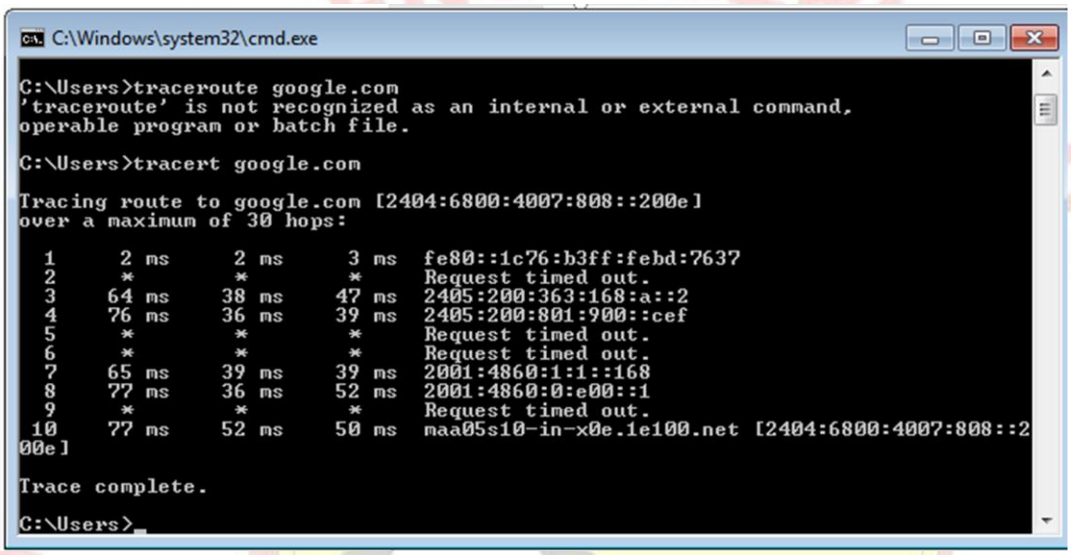
For the first set of packets, the first router receives the packet, decrements the TTL value and drops the packet because it then has TTL value zero. The router sends an ICMP Time Exceeded message back to the source. The next set of packets are given a TTL value of two, so the first router forwards the packets, but the second router drops them and replies with ICMP Time Exceeded.

Proceeding in this way, traceroute uses the returned ICMP Time Exceeded messages to build a list of routers that packets traverse, until the destination is reached and returns an ICMP Echo Reply message.

With the tracert command shown above, we're asking tracert to show us the path from the local computer all the way to the network device with the hostname

www.google.com.

#tracert google.com

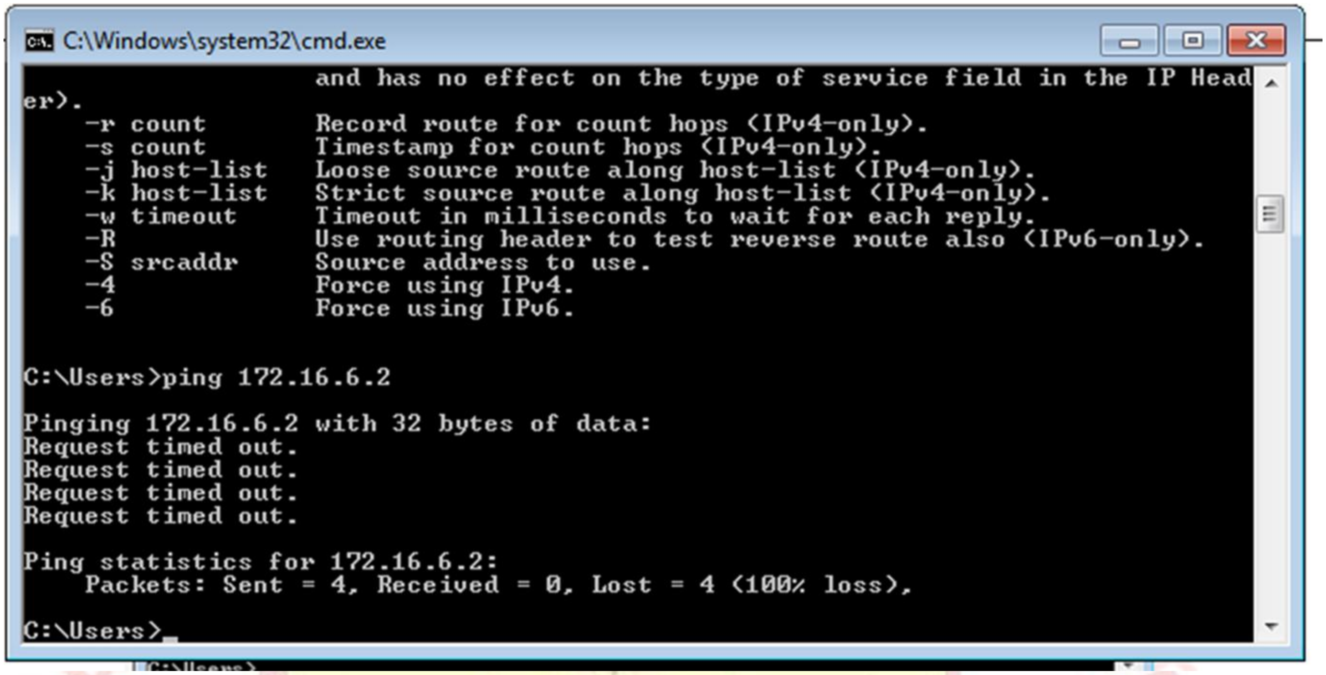


```
C:\Users>traceroute google.com
'traceroute' is not recognized as an internal or external command,
operable program or batch file.

C:\Users>tracert google.com

Tracing route to google.com [2404:6800:4007:808::200e]
over a maximum of 30 hops:

  1     2 ms     2 ms     3 ms  fe80::1c76:b3ff:febd:7637
  2     *        *        *     Request timed out.
  3    64 ms    38 ms    47 ms  2405:200:363:168:a::2
  4    76 ms    36 ms    39 ms  2405:200:801:900::cef
  5     *        *        *     Request timed out.
  6     *        *        *     Request timed out.
  7    65 ms    39 ms    39 ms  2001:4860:1:1::168
  8    77 ms    36 ms    52 ms  2001:4860:0:e00::1
  9     *        *        *     Request timed out.
 10    77 ms    52 ms    50 ms  maa05s10-in-x0e.1e100.net [2404:6800:4007:808::2
00e]

Trace complete.

C:\Users>_
```

6.Ping:

The ping command sends an echo request to a host available on the network. Using this command, you can check if your remote host is responding well or not. Tracking and isolating hardware and software problems. Determining the status of the network and various foreign hosts. The ping command is usually used as a simple way to verify that a computer can communicate over the network with another computer or network device. The ping command operates by sending Internet Control Message Protocol (ICMP) Echo Request messages to the destination computer and waiting for a response

# ping172.16.6.2



```
                      and has no effect on the type of service field in the IP Head
er).
    -r count          Record route for count hops (IPv4-only).
    -s count          Timestamp for count hops (IPv4-only).
    -j host-list      Loose source route along host-list (IPv4-only).
    -k host-list      Strict source route along host-list (IPv4-only).
    -w timeout        Timeout in milliseconds to wait for each reply.
    -R                Use routing header to test reverse route also (IPv6-only).
    -S srcaddr        Source address to use.
    -4                Force using IPv4.
    -6                Force using IPv6.


C:\Users>ping 172.16.6.2

Pinging 172.16.6.2 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.16.6.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users>_
```

VIVA(Pre &Post Lab) QUESTIONS:

1. Define network
2. Define network topology
3. What is OSI Layers.
4. What is the use of netstat command?
5. What is nslookup command?
6. What is the purpose of traceroute command?
7. What is ping command.

RESULT:

Thus the various networks commands like tcpdump, netstat, ifconfig, nslookup and traceroute ping are executed successfully.

Ex.No: 2 Write a HTTP web client program to download a web page using TCP sockets

AIM:

To write a java program for socket for HTTP for web page upload and download .

PRE LAB DISCUSSION:

- HTTP means **H**yper**T**ext **T**ransfer **P**rotocol. HTTP is the underlying protocol used by the World Wide Web and this protocol defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands.
- For example, when you enter a URL in your browser, this actually sends an HTTP command to the Web server directing it to fetch and transmit the requested Web page.
- The other main standard that controls how the World Wide Web works is HTML, which covers how Web pages are formatted and displayed. HTTP functions as a request–response protocol in the client–server computing model.
- A web browser, for example, may be the client and an application running on a computer hosting a website may be the server.
- The client submits an HTTP request message to the server. The server, which provides resources such as HTML files and other content, or performs other functions on behalf of the client, returns a responsemessage to the client.
- The response contains completion status information about the request and may also contain requested content in its message body.

ALGORITHM:

Client:

1. Start.
2. Create socket and establish the connection with the server.
3. Read the image to be uploaded from the disk
4. Send the image read to the server
5. Terminate the connection
6. Stop.

Server:

1. Start
2. Create socket, bind IP address and port number with the created socket and make server a listening server.
3. Accept the connection request from the client
4. Receive the image sent by the client.
5. Display the image.
6. Close the connection.
7. Stop.

PROGRAM

Client

```
import javax.swing.*;
import java.net.*;
import java.awt.image.*;
import javax.imageio.*;
import java.io.*;
import java.awt.image.BufferedImage; import
java.io.ByteArrayOutputStream; import
java.io.File;
import java.io.IOException; import
javax.imageio.ImageIO;
public class Client
{
        public static void main(String args[]) throws Exception
        {
                Socket soc;
                BufferedImage img = null;
                soc=new
            Socket("localhost",4000);
                System.out.println("Client is running.
        ");
                try {
                        System.out.println("Reading image from disk. ");
                        img = ImageIO.read(new File("digital_image_processing.jpg"));
                        ByteArrayOutputStream baos = new ByteArrayOutputStream();
                        ImageIO.write(img, "jpg", baos);
                        baos.flush();
                        byte[]  bytes = baos.toByteArray(); baos.close();
                        System.out.println("Sending image to server.");
                        OutputStream out = soc.getOutputStream();
                        DataOutputStream dos = new DataOutputStream(out);
                        dos.writeInt(bytes.length);
                        dos.write(bytes, 0, bytes.length);
                        System.out.println("Image sent to server. ");
                        dos.close();
                        out.close();
                }
                catch (Exception e)
                {
                        System.out.println("Exception: " + e.getMessage());
                        soc.close();
                }
                soc.close();
        }
}
```

Server

```
import java.net.*;
import java.io.*;
import java.awt.image.*;
import javax.imageio.*;
import javax.swing.*;
class Server
{
        public static void main(String args[]) throws Exception
        {
                ServerSocket server=null;
                Socket socket;
                server=new ServerSocket(4000); System.out.println("Server
                Waiting for image"); socket=server.accept();
                System.out.println("Client connected."); InputStream in =
                                        socket.getInputStream();
                DataInputStream dis = new DataInputStream(in);
                int len = dis.readInt();
                System.out.println("Image Size: " + len/1024 + "KB"); byte[] data = new byte[len];
                dis.readFully(data);
                dis.close();
                in.close();
                InputStream ian = new ByteArrayInputStream(data);
                BufferedImage bImage = ImageIO.read(ian);
                JFrame f = new JFrame("Server");
                ImageIcon icon = new ImageIcon(bImage);
                JLabel l = new JLabel();
                l.setIcon(icon);
                f.add(l);
                f.pack();
                f.setVisible(true);
        }
}
```

OUTPUT:

When you run the client code, following output screen would appear on client side.

```
[illegible]
[illegible]
[illegible]
```

VIVA(Pre &Post Lab) QUESTIONS:

1. What is URL.
2. Why is http required?
3. What id http client?
4. what is WWW?
5. Compare HTTP and FTP.
6. Define Socket.
7. What do you mean by active web page?
8. What are the four Main properties of HTTP?

.

RESULT:

Thus the socket program for HTTP for web page upload and download was developed and executed successfully

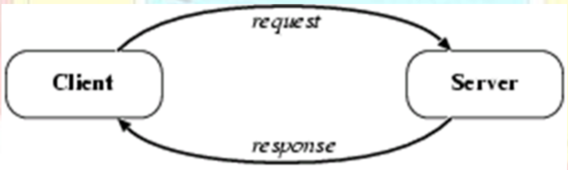
Ex.No: 3 Applications using TCP sockets like: Echo client and echo server, Chat

AIM

To write a java program for application using TCP Sockets Links

PRE LAB DISCUSSION:

- In the TCP Echo client a socket is created. Using the socket a connection is made to the server using the connect() function. After a connection is established, we send messages input from the user and display the data received from the server using send() and read() functions.
- In the TCP Echo server, we create a socket and bind to a advertized port number. After binding the process listens for incoming connections. Then an infinite loop is started to process the client requests for connections. After a connection is requested, it accepts the connection from the client machine and forks a new process.
- The new process receives data from the lient using recv() function and echoes the same data using the send() function. Please note hat this server is capable of handling multiple clients as it forks a new process for every client trying to connect to the server. TCP socket routines enable reliable IP communication using the transmission control protocol (TCP).
- The implementation of the Transmission Control Protocol (TCP) in the Network Component. TCP runs on top of the Internet Protocol (IP). TCP is a connection-oriented and reliable, full duplex protocol supporting a pair of byte streams, one for each direction.
- A TCP connection must be established before exchanging data. TCP retransmits data that do not reach the final destination due to errors or data corruption. Data is delivered in the sequence of its transmission



a.Echo client and echo server

ALGORITHM

Client

1. Start
2. Create the TCP socket
3. Establish connection with the server
4. Get the message to be echoed from the user

5. Send the message to the server
6. Receive the message echoed by the server
7. Display the message received from the server
8. Terminate the connection
9. Stop

Server

1. Start
2. Create TCP socket, make it a listening socket
3. Accept the connection request sent by the client for connection establishment
4. Receive the message sent by the client
5. Display the received message
6. Send the received message to the client from which it receives
7. Close the connection when client initiates termination and server becomes a listening server, waiting for clients.
8. Stop.

PROGRAM:

EchoServer.java

```
 import java.net.*;
 import java.io.*;
 public class EServer
 {
 public static void main(String args[])
 {
  ServerSocket s=null; String line;
  DataInputStream is; PrintStream
  ps; Socket c=null;
try
{
                        s=new ServerSocket(9000);
                }
                catch(IOException e)
                {
                        System.out.println();
                }
                try
                {
                        c=s.accept();
                        is=new DataInputStream(c.getInputStream());
```

```
            ps=new PrintStream(c.getOutputStream());
            while(true)
            {
                line=is.readLine();
                ps.println(line);
            }
        }
        catch(IOException e)
        {
            System.out.println();
        }
    }
}
```

EClient.java

```
import java.net.*;
import java.io.*;
public class EClient
{   public static void main(String arg[])
    {
        Socket c=null; String
        line; DataInputStream
        is,is1; PrintStream os;
        try
        {
            InetAddress ia = InetAddress.getLocalHost();
            c=new Socket(ia,9000);
        }
        catch(IOException e)
        {
            System.out.println(e);
        }
        try
        {
            os=new PrintStream(c.getOutputStream());
            is=new DataInputStream(System.in);
            is1=new DataInputStream(c.getInputStream());
            while(true)
            {
            System.out.println("Client:");
                line=is.readLine();
```

```
                              os.println(line);
                              System.out.println("Server:" + is1.readLine());
                         }
                    }
                    catch(IOException e)
                    {
                         System.out.println("Socket Closed!");
                    }
     }}
```

OUTPUT

Server

```
C:\Program Files\Java\jdk1.5.0\bin>javac EServer.java
C:\Program Files\Java\jdk1.5.0\bin>java EServer
C:\Program Files\Java\jdk1.5.0\bin>
```

Client

```
C:\Program Files\Java\jdk1.5.0\bin>javac EClient.java
C:\Program Files\Java\jdk1.5.0\bin>java EClient
Client:  Hai Server
Server:Hai Server
Client: Hello
Server:Hello
Client:end
Server:end
Client:ds
Socket Closed!
```

B.Chat

ALGORITHM

Client

1. Start
2. Create the UDP datagram socket
3. Get the request message to be sent from the user
4. Send the request message to the server
5. If the request message is “END” go to step 10
6. Wait for the reply message from the server
7. Receive the reply message sent by the server
8. Display the reply message received from the server
9. Repeat the steps from 3 to 8
10. Stop

Server

1. Start
2. Create UDP datagram socket, make it a listening socket
3. Receive the request message sent by the client
4. If the received message is “END” go to step 10
5. Retrieve the client’s IP address from the request message received
6. Display the received message
7. Get the reply message from the user
8. Send the reply message to the client
9. Repeat the steps from 3 to 8.
10. Stop.

<u>**PROGRAM**</u>

<u>**UDPserver.java**</u>

```
import java.io.*;
import java.net.*;
class UDPserver
{
        public static DatagramSocket ds;
        public static byte buffer[]=new byte[1024];
        public static int clientport=789,serverport=790;
        public static void main(String args[])throws Exception
        {
                ds=new DatagramSocket(clientport);
                System.out.println("press ctrl+c to quit the program");
                BufferedReader dis=new BufferedReader(new InputStreamReader(System.in));
                InetAddress ia=InetAddress.geyLocalHost();
                while(true)
                {
                        DatagramPacket p=new DatagramPacket(buffer,buffer.length);
                        ds.receive(p);
                        String psx=new String(p.getData(),0,p.getLength());
                        System.out.println("Client:" + psx);
                        System.out.println("Server:");
                        String str=dis.readLine();
                        if(str.equals("end"))
                                break;
                        buffer=str.getBytes();
                        ds.send(new DatagramPacket(buffer,str.length(),ia,serverport));
                }
        }
}
```

UDPclient.java

```
import java .io.*;
import java.net.*;
class UDPclient
{
        public static DatagramSocket ds;
        public static int clientport=789,serverport=790;
        public static void main(String args[])throws Exception
        {
                byte buffer[]=new byte[1024];
                ds=new DatagramSocket(serverport);
                BufferedReader dis=new BufferedReader(new InputStreamReader(System.in));
                System.out.println("server waiting");
                InetAddress ia=InetAddress.getLocalHost();
                while(true)
                {
                        System.out.println("Client:");
                        String str=dis.readLine();
                        if(str.equals("end"))
                                break;
                        buffer=str.getBytes();
                        ds.send(new  DatagramPacket(buffer,str.length(),ia,clientport));
                        DatagramPacket p=new DatagramPacket(buffer,buffer.length);
                        ds.receive(p);
                        String psx=new String(p.getData(),0,p.getLength());
                        System.out.println("Server:" + psx);
                }
        }
}
```

OUTPUT:

Server

```
C:\Program Files\Java\jdk1.5.0\bin>javac UDPserver.java
C:\Program Files\Java\jdk1.5.0\bin>java UDPserver
press ctrl+c to quit the program
Client:Hai Server
Server:Hello Client
Client:How are You
Server:I am Fine
```

Client

```
C:\Program Files\Java\jdk1.5.0\bin>javac UDPclient.java
C:\Program Files\Java\jdk1.5.0\bin>java
UDPclient server waiting
Client:Hai
Server
Server:Hello
Clie
Client:How
are You
Server:I am
Fine
Client:end
```

VIVA(Pre &Post Lab) QUESTIONS:

1. What is LAN.
2. Mention the roles of Transport layer.
3. State the differences between TCP and UDP
4. What are well-known ports?
5. What are MAC addresses?
6. What is TCP Echo Client Server?
7. Define the three states of TCP Connection establishment and termination.
8. List the types of sockets

RESULT:

Thus the java application program using TCP Sockets was developed and executed successfully.

Ex.No: 4 Simulation of DNS using UDP Sockets

AIM

To write a java program for DNS application

PRE LAB DISCUSSION:

- The Domain Name System (DNS) is a hierarchical decentralized naming system for computers, services, or other resources connected to the Internet or a private network. It associates various information with domain names assigned to each of the participating entities.
- The domain name space refers a hierarchy in the internet naming structure. This hierarchy has multiple levels (from 0 to 127), with a root at the top. The following diagram shows the domain name space hierarchy.
- Name server contains the DNS database. This database comprises of various names and their corresponding IP addresses. Since it is not possible for a single server to maintain entire DNS database, therefore, the information is distributed among many DNS servers.
- Types of Name Servers
- Root Server is the top level server which consists of the entire DNS tree. It does not contain the information about domains but delegates the authority to the other server
- Primary Server stores a file about its zone. It has authority to create, maintain, and update the zone file.
- Secondary Server transfers complete information about a zone from another server which may be primary or secondary server. The secondary server does not have authority to create or update a zone file.
- DNS is a TCP/IP protocol used on different platforms. The domain name space is divided into three different sections: generic domains, country domains, and inverse domain.
- The main function of DNS is to translate domain names into IP Addresses, which computers can understand. It also provides a list of mail servers which accept Emails for each domain name. Each domain name in DNS will nominate a set of name servers to be authoritative for its DNS records.

ALGORITHM

Server

1. Start
2. Create UDP datagram socket
3. Create a table that maps host name and IP address
4. Receive the host name from the client
5. Retrieve the client’s IP address from the received datagram
6. Get the IP address mapped for the host name from the table.
7. Display the host name and corresponding IP address

8. Send the IP address for the requested host name to the client
9. Stop.

Client

1. Start
2. Create UDP datagram socket.
3. Get the host name from the client
4. Send the host name to the server
5. Wait for the reply from the server
6. Receive the reply datagram and read the IP address for the requested host name
7. Display the IP address.
8. Stop.

PROGRAM

DNS Server

```
java 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();
        }}}
```

UDP DNS Client

```
java 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();
```

```
                }
                }
```

OUTPUT

Server

```
javac udpdnsserver.java
java udpdnsserver
Press Ctrl + C to Quit Request for host yahoo.com
Request for host cricinfo.com
Request for host youtube.com
```

Client

```
 >javac udpdnsclient.java
 >java udpdnsclient
Enter the hostname : yahoo.com
IP Address: 68.180.206.184
>java udpdnsclient
Enter the hostname : cricinfo.com
IP Address: 80.168.92.140
 >java udpdnsclient
 Enter the hostname : youtube.com
IP Address: Host Not Found
```

VIVA (Pre & Post Lab) QUESTIONS:

1. What layer is DNS?
2. What is pupose of network layer?
3. What is logical address
4. What type of transport protocol is used for DNS.
5. What is difference between IP address and DNS?
6. What is a DNS and how does it work?
7. Why do we need a Domain Name System?
8. What role does the DNS Resolver play in the DNS System.
9. What is DNS and its types?.
10. List the Two types of DNS message

RESULT:

Thus the java application program using UDP Sockets to implement DNS was developed and executed successfully

Ex.no 5 Use a tool like Wireshark to capture packets and examine the packets.

Aim:

To use a Java program to capture network packets and analyze them. The aim is to understand the structure of packets, extract metadata (e.g., source/destination IP, port, and protocol), and optionally save the data for further analysis.

Algorithm:

1. **Setup Environment:**
   - Install the jNetPcap library (a Java wrapper for the libpcap library).
   - Ensure necessary dependencies are added to the project.
2. **Initialize Packet Capture:**
   - Enumerate available network interfaces.
   - Select the interface to monitor.
3. **Start Capturing Packets:**
   - Open the selected interface for capturing.
   - Define a packet handler to process packets as they arrive.
4. **Process Packets:**
   - Extract key fields from the packet (e.g., headers, payload).
   - Display or save packet details.
5. **Stop Capture:**
   - Terminate the packet capture session.
6. **Output Results:**
   - Show real-time packet details.
   - Optionally, save the captured data to a file.

Java Code:

```
import org.jnetpcap.Pcap;
import org.jnetpcap.PcapIf;
import org.jnetpcap.packet.PcapPacket;
import org.jnetpcap.packet.PcapPacketHandler;

import java.util.ArrayList;
import java.util.List;

public class PacketCapture {

    public static void main(String[] args) {
        List<PcapIf> devices = new ArrayList<>();
        StringBuilder errbuf = new StringBuilder();

        // Get a list of network devices
        int r = Pcap.findAllDevs(devices, errbuf);
        if (r == Pcap.NOT_OK || devices.isEmpty()) {
            System.err.printf("Can't read list of devices, error: %s\n", errbuf.toString());
            return;
        }

        System.out.println("Available network devices:");
        for (int i = 0; i < devices.size(); i++) {
            System.out.printf("#%d: %s [%s]\n", i, devices.get(i).getName(),
devices.get(i).getDescription());
        }

        // Choose the first device
        PcapIf device = devices.get(0);
        System.out.printf("\nChoosing device: %s\n", device.getName());

        // Open the device for packet capturing
        int snaplen = 64 * 1024;   // Capture all packets, no truncation
        int flags = Pcap.MODE_PROMISCUOUS; // Capture all traffic
        int timeout = 10 * 1000;   // 10 seconds in milliseconds

        Pcap pcap = Pcap.openLive(device.getName(), snaplen, flags, timeout, errbuf);

        if (pcap == null) {
            System.err.printf("Error while opening device for capture: %s\n", errbuf.toString());
            return;
        }

        // Create a packet handler
        PcapPacketHandler<String> packetHandler = (packet, user) -> {
            System.out.printf("Packet captured at %s\n", new
java.util.Date(packet.getCaptureHeader().timestampInMillis()));
            System.out.printf("Packet length: %d bytes\n", packet.getCaptureHeader().caplen());
            System.out.println(packet.toString());
        };

        System.out.println("Starting packet capture...");
        pcap.loop(10, packetHandler, "Packet Capture");
        pcap.close();

        System.out.println("Packet capture completed.");
    }
}
```

Output:

```
Available network devices:
#0: eth0 [Intel(R) Ethernet Connection]
#1: wlan0 [Wireless Network Adapter]
```

```
Choosing device: eth0
Starting packet capture...
Packet captured at Wed Dec 26 2024 15:35:15 GMT+0000
Packet length: 74 bytes
Packet captured at Wed Dec 26 2024 15:35:16 GMT+0000
Packet length: 60 bytes
...
Packet capture completed.
```

Results:

Thus the program captures and processes packets in real-time has been executed.

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

AIM:

To write a java program for simulating ARP and RARP protocols using TCP.

PRE LAB DISCUSSION:

- Address Resolution Protocol (ARP) is a low-level network protocol for translating network layer addresses into link layer addresses.ARP lies between layers 2 and 3 of the OSI model, although ARP was not included in the OSI framework and allows computers to introduce each other across a network prior to communication.Because protocols are basic network communication units, address resolution is dependent on protocols such as ARP, which is the only reliable method of handling required tasks.
- The Address Resolution Protocol (ARP) is a communication protocol used for discovering the link layer address, such as a MAC address, associated with a given internet layer address,
- When configuring a new network computer, each system is assigned an Internet Protocol (IP) address for primary identification and communication. A computer also has a unique media access control (MAC) address identity. Manufacturers embed the MAC address in the local area network (LAN) card. The MAC address is also known as the computer's physical address.
- Address Resolution Protocol (ARP) is used to resolve an IPv4 address (32 bit Logical Address) to the physical address (48 bit MAC Address). Network Applications at the Application Layer use IPv4 Address to communicate with another device.
- Reverse Address Resolution Protocol (RARP) is a network protocol used to resolve a data link layer address to the corresponding network layer address. For example, RARP is used to resolve a Ethernet MAC address to an IP address.
- The client broadcasts a RARP packet with an ethernet broadcast address, and it's own physical address in the data portion. The server responds by telling the client it's IP address. Note there is no name sent. Also note there is no security.
- Media Access Control (MAC) addresses need to be individually configured on the servers by an administrator. RARP is limited to serving only IP addresses.Reverse ARP differs from the Inverse Address Resolution Protocol which is designed to obtain the IP address associated with a local Frame Relay data link connection identifier. InARP is not used in Ethernet.

ALGORITHM:

Client

1. Start the program
2. Create socket and establish connection with the server.
3. Get the IP address to be converted into MAC address from the user.
4. Send this IP address to server.
5. Receive the MAC address for the IP address from the server.
6. Display the received MAC address
7. Terminate the connection

Server

1. Start the program
2. Create the socket, bind the socket created with IP address and port number and make it a listening socket.
3. Accept the connection request when it is requested by the client.
4. Server maintains the table in which IP and corresponding MAC addresses are stored.
5. Receive the IP address sent by the client.
6. Retrieve the corresponding MAC address for the IP address and send it to the client.
7. Close the connection with the client and now the server becomes a listening server waiting for the connection request from other clients
8. Stop

PROGRAM

Client:

```
import java.io.*;
import  java.net.*;
import  java.util.*;
class Clientarp
{
        public static void main(String args[])
        {
        try
        {
              BufferedReader in=new BufferedReader(new InputStreamReader(System.in));
              Socket clsct=new Socket("127.0.0.1",140);
              DataInputStream din=new DataInputStream(clsct.getInputStream());
              DataOutputStream dout=new DataOutputStream(clsct.getOutputStream());
              System.out.println("Enter the Logical address(IP):");
              String  str1=in.readLine();
              dout.writeBytes(str1+'\n');
             String str=din.readLine();
```

```
                System.out.println("The Physical Address is: "+str);
                clsct.close();
        }
        catch (Exception e)
        {
         System.out.println(e);
        }}
}
```

Server:

```
import java.io.*;
import java.net.*;
import java.util.*;
class Serverarp
{
        public static void main(String args[])
        {
        try
        {
                ServerSocket obj=new
                ServerSocket(140); Socket
                obj1=obj.accept();
                while(true)
                {
                        DataInputStream din=new DataInputStream(obj1.getInputStream());
                        DataOutputStream dout=new DataOutputStream(obj1.getOutputStream());
                        String str=din.readLine();
                        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(str.equals(ip[i]))
                                {
                                        dout.writeBytes(mac[i]+'\n');
                                        break;
                                }
                        }
                        obj.close();
                }
        }
        catch(Exception e)
        {
           System.out.println(e);
            }}
}
```

Output:

```
E:\networks>java Serverarp
E:\networks>java Clientarp
Enter the Logical address(IP):
165.165.80.80
The Physical Address is: 6A:08:AA:C2
```

(b) Program for Reverse Address Resolution Protocol (RARP) using UDP

ALGORITHM:

Client

1. Start the program
2. Create datagram socket
3. Get the MAC address to be converted into IP address from the user.
4. Send this MAC address to server using UDP datagram.
5. Receive the datagram from the server and display the corresponding IP address.
6. Stop

Server

1. Start the program.
2. Server maintains the table in which IP and corresponding MAC addresses are stored.
3. Create the datagram socket
4. Receive the datagram sent by the client and read the MAC address sent.
5. Retrieve the IP address for the received MAC address from the table.
6. Display the corresponding IP address.
7. Stop

PROGRAM:

Client:

```
import java.io.*;
import java.net.*;
import java.util.*;
class Clientrarp
{
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=new DatagramPacket(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 Serverrarp
{
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=new DatagramPacket(sendbyte,sendbyte.length,addr,port);
server.send(sender);
break;
}
}
break;
}
}
catch(Exception e)
{
System.out.println(e);
}
}
}
```

Output:

```
I:\ex>java Serverrarp
I:\ex>java Clientrarp
Enter the Physical address (MAC):
6A:08:AA:C2
The Logical Address is(IP): 165.165.80.80
```

VIVA(Pre & Post lab) QUESTIONS:

1. What is the main purpose of ARP?
2. What do you mean by MTU (Maximum transfer Unit)?
3. What is the multiplexing
4. What does TTL shows?
5. What layer is ARP?
6. What is the function of RARP?
7. Difference between ARP and RARP.

RESULT :

Thus the program for implementing to display simulating ARP and RARP protocols was executed successfully and output is verified.

Ex.No: 7 Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS

Aim:

To Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS

NET WORK SIMULATOR (NS2)

Ns overview

- Ns programming: A Quick start
- Case study I: A simple Wireless network
- Case study II: Create a new agent in Ns

Ns overview

- Ns Status
- Periodical release (ns-2.26, Feb 2003)
- Platform support
- FreeBSD, Linux, Solaris, Windows and Mac

Ns unctionalities

Routing, Transportation, Traffic sources,Queuing disciplines, QoS

Wireless

Ad hoc routing, mobile IP, sensor-MAC
Tracing, visualization and various utilitie
NS(Network Simulators)

Most of the commercial simulators are GUI driven, while some network simulators are CLI driven. The network model / configuration describes the state of the network (nodes,routers, switches, links) and the events (data transmissions, packet error etc.). An important output of simulations are the trace files. Trace files log every packet, every event that occurred in the simulation and are used for analysis. Network simulators can also provide other tools to facilitate visual analysis of trends and potential trouble spots.

Most network simulators use discrete event simulation, in which a list of pending "events" is stored, and those events are processed in order, with some events triggering future events—such as the event of the arrival of a packet at one node triggering the event of the arrival of that packet at a downstream node.

Simulation of networks is a very complex task. For example, if congestion is high, then estimation of the average occupancy is challenging because of high variance. To estimate the likelihood of a buffer overflow in a network, the time required for an accurate answer can be extremely large. Specialized techniques such as "control variates" and "importance sampling" have been developed to speed simulation.**Examples of network simulators**

There are many both free/open-source and proprietary network simulators. Examples of notable network simulation software are, ordered after how often they are mentioned in research papers:

1. ns (open source)
2. OPNET (proprietary software)
3. NetSim (proprietary software)

Uses of network simulators

Network simulators serve a variety of needs. Compared to the cost and time involved in setting up an entire test bed containing multiple networked computers, routers and data links, network simulators are relatively fast and inexpensive. They allow engineers, researchers to test scenarios that might be particularly difficult or expensive to emulate using real hardware - for instance, simulating a scenario with several nodes or experimenting with a new protocol in the network. Network simulators are particularly useful in allowing researchers to test new networking protocols or changes to existing protocols in a controlled and reproducible environment. A typical network simulator encompasses a wide range of networking technologies and can help the users to build complex networks from basic building blocks such as a variety of nodes and links. With the help of simulators, one can design hierarchical networks using various types of nodes like computers, hubs, bridges, routers, switches, links, mobile units etc.

Various types of Wide Area Network (WAN) technologies like TCP, ATM, IP etc. and Local Area Network (LAN) technologies like Ethernet, token rings etc., can all be simulated with a typical simulator and the user can test, analyze various standard results apart from devising some novel protocol or strategy for routing etc. Network simulators are also widely used to simulate battlefield networks in Network-centric warfare

There are a wide variety of network simulators, ranging from the very simple to the very complex. Minimally, a network simulator must enable a user to represent a network topology, specifying the nodes on the network, the links between those nodes and the traffic between the nodes. More complicated systems may allow the user to specify everything about the protocols used to handle traffic in a network. Graphical applications allow users to easily visualize the workings of their simulated environment. Text-based applications may provide a less intuitive interface, but may permit more advanced forms of customization.

Packet loss

occurs when one or morepacketsof data travelling across a computer networkfail to reachtheir destination. Packet loss is distinguished as one of the three main error types encountered in digital communications; the other two being bit errorand spurious packets caused due to noise.

Packets can be lost in a network because they may be dropped when a queue in the network node overflows. The amount of packet loss during the steady state is another important property of a congestion control scheme. The larger the value of packet loss, the more difficult it is for transportlayer protocols to maintain high bandwidths, the sensitivity to loss of individual packets, as well as to frequency and patterns of loss among longer packet sequences is strongly dependent on the application itself.

Throughput

This is the main performance measure characteristic, and most widely used. Incommunicationnetworks, such asEthernetorpacket radio, throughputor network throughputis the average rate of successfulmessage delivery over a communication channel. The throughput is usually measured inbitsper second (bit/s orbps), andsometimes indata packetsper second or data packets pertime slotThis measure how soon the receiver is able to get a certain amount of data send by the sender. It is determined as the ratio of the total data received to the end to end delay. Throughput is an important factor which directly impacts the network performance

Delay

Delay is the time elapsed while a packet travels from one point e.g., source premise or network ingress to destination premise or network degrees. The larger the valueof delay, the more difficult it is for transport layer protocols to maintain highbandwidths. We will calculate end to end delay

Queue Length

A queuing system in networks can be described as packets arriving for service, waiting for service if it is not immediate, and if having waited for service, leaving thesystem after being served. Thus queue length is very important characteristic to determine that how well the active queue management of the congestion control
algorithm has been working.

Result:

Thus the study of NS2 and Simulation of Congestion Control Algorithms using NS performance is done successfully

Ex.No: 08 **Study of TCP/UDP performance using Simulation tool.**

AIM:

To simulate the performance of TCP/UDP using NS2.

PRE LAB DISCUSSION:

- TCP is reliable protocol. That is, the receiver always sends either positive or negative acknowledgement about the data packet to the sender, so that the sender always has bright clue about whether the data packet is reached the destination or it needs to resend it.
- TCP ensures that the data reaches intended destination in the same order it was sent.
- TCP is connection oriented. TCP requires that connection between two remote points be established before sending actual data.
- TCP provides error-checking and recovery mechanism.
- TCP provides end-to-end communication.
- TCP provides flow control and quality of service.
- TCP operates in Client/Server point-to-point mode.
- TCP provides full duplex server, i.e. it can perform roles of both receiver and sender.
- The User Datagram Protocol (UDP) is simplest Transport Layer communication protocol available of the TCP/IP protocol suite. It involves minimum amount of communication mechanism. UDP is said to be an unreliable transport protocol but it uses IP services which provides best effort delivery mechanism.UDP is used when acknowledgement of data does not hold any significance.
- UDP is good protocol for data flowing in one direction.
- UDP is simple and suitable for query based communications.
- UDP is not connection oriented.
- UDP does not provide congestion control mechanism.
- UDP does not guarantee ordered delivery of data.
- UDP is stateless.
- UDP is suitable protocol for streaming applications such as VoIP, multimedia streaming.

TCP Performance
Algorithm

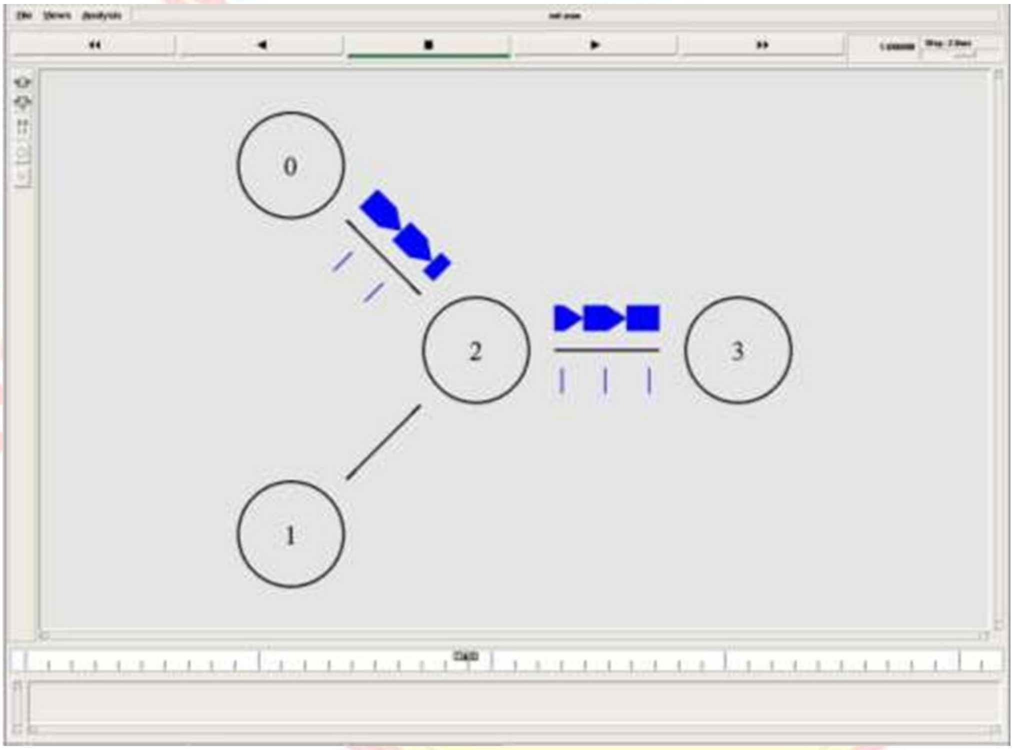
1. Create a Simulator object.
2. Set routing as dynamic.
3. Open the trace and nam trace files.
4. Define the finish procedure.
5. Create nodes and the links between them.
6. Create the agents and attach them to the nodes.
7. Create the applications and attach them to the tcp agent.

8. Connect tcp and tcp sink.
9. Run the simulation.

PROGRAM:

```
set ns [new Simulator]
$ns color 0 Blue
$ns color 1 Red
$ns color 2 Yellow
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set f [open tcpout.tr w]
$ns trace-all $f
set nf [open tcpout.nam w]
$ns namtrace-all $nf
$ns duplex-link $n0 $n2 5Mb 2ms DropTail
$ns duplex-link $n1 $n2 5Mb 2ms DropTail
$ns duplex-link $n2 $n3 1.5Mb 10ms DropTail
$ns duplex-link-op $n0 $n2 orient right-up
$ns duplex-link-op $n1 $n2 orient right-down
$ns duplex-link-op $n2 $n3 orient right
$ns duplex-link-op $n2 $n3 queuePos 0.5
set tcp [new Agent/TCP]
$tcp set class_ 1
set sink [new Agent/TCPSink]
$ns attach-agent $n1 $tcp
$ns attach-agent $n3 $sink
$ns connect $tcp $sink
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ns at 1.2 "$ftp start"
$ns at 1.35 "$ns detach-agent $n1 $tcp ; $ns detach-agent $n3 $sink"
$ns at 3.0 "finish"
proc finish {} {
        global ns f nf
        $ns flush-trace
        close $f
        close $nf
        puts "Running nam.."
        exec xgraph tcpout.tr -geometry 600x800 &
        exec nam tcpout.nam &
        exit 0
}
$ns run
```

Output



UDP Performance

ALGORITHM :

1. Create a Simulator object.
2. Set routing as dynamic.
3. Open the trace and nam trace files.
4. Define the finish procedure.
5. Create nodes and the links between them.
6. Create the agents and attach them to the nodes.
7. Create the applications and attach them to the UDP agent.
8. Connect udp and null agents.
9. Run the simulation.

PROGRAM:

```
set ns [new Simulator]
$ns color 0 Blue
$ns color 1 Red
$ns color 2 Yellow
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set f [open udpout.tr w]
$ns trace-all $f
set nf [open udpout.nam w]
$ns namtrace-all $nf
$ns duplex-link $n0 $n2 5Mb 2ms DropTail
$ns duplex-link $n1 $n2 5Mb 2ms DropTail
$ns duplex-link $n2 $n3 1.5Mb 10ms DropTail
$ns duplex-link-op $n0 $n2 orient right-up
$ns duplex-link-op $n1 $n2 orient right-down
$ns duplex-link-op $n2 $n3 orient right
$ns duplex-link-op $n2 $n3 queuePos 0.5
set udp0 [new Agent/UDP]
$ns attach-agent $n0 $udp0
set cbr0 [new Application/Traffic/CBR]
$cbr0 attach-agent $udp0
```

```
set udp1 [new Agent/UDP]
$ns attach-agent $n3 $udp1

$udp1 set class_ 0
set cbr1 [new Application/Traffic/CBR]
$cbr1 attach-agent $udp1
set null0 [new Agent/Null]
$ns attach-agent $n1 $null0
set null1 [new Agent/Null]
$ns attach-agent $n1 $null1
$ns connect $udp0 $null0
$ns connect $udp1 $null1
$ns at 1.0 "$cbr0 start"
$ns at 1.1 "$cbr1 start"
puts [$cbr0 set packetSize_]
puts [$cbr0 set interval_]
$ns at 3.0 "finish"
proc finish {} {
        global ns f nf
        $ns flush-trace
        close $f
        close $nf
        puts "Running nam.."
        exec nam udpout.nam &
        exit 0
}
$ns run
```

Output:

VIVA (Pre & Post)Lab Questions

1. How is a TCP connection closed?
2. What is Flow control in TCP?
3. What protocol is TCP?
4. How is TCP Reliable?
5. What is TCP?
6. Explain the three way Handshake process?
7. What are the 6 TCP flags?
8. Explain how TCP avoids a network meltdown?

RESULT :

Thus the study of TCP/UDP performance is done successfully.

Ex.No: 9 Simulation of Distance Vector/ Link State Routing algorithm.

AIM:

To simulate the Distance vector and link state routing protocols using NS2.

PRE LAB DISCUSSION:

LINK STATE ROUTING

Routing is the process of selecting best paths in a network. In the past, the term routing was also used to mean forwarding network traffic among networks. However this latter function is much better described as simply forwarding. Routing is performed for many kinds of networks, including the telephone network (circuit switching), electronic data networks (such as the Internet), and transportation networks. This article is concerned primarily with routing in electronic data networks using packet switching technology.

In packet switching networks, routing directs packet forwarding (the transit of logically addressed network packets from their source toward their ultimate destination) through intermediate nodes. Intermediate nodes are typically network hardware devices such as routers, bridges, gateways, firewalls, or switches. General-purpose computers can also forward packets and perform routing, though they are not specialized hardware and may suffer from limited performance. The routing process usually directs forwarding on the basis of routing tables which maintain a record of the routes to various network destinations. Thus, constructing routing tables, which are held in the router's memory, is very important for efficient routing. Most routing algorithms use only one network path at a time. Multipath routing techniques enable the use of multiple alternative paths.

In case of overlapping/equal routes, the following elements are considered in order to decide which routes get installed into the routing table (sorted by priority):

1. *Prefix-Length*: where longer subnet masks are preferred (independent of whether it is within a routing protocol or over different routing protocol)
2. *Metric*: where a lower metric/cost is preferred (only valid within one and the same routing protocol)
3. *Administrative distance*: where a lower distance is preferred (only valid between different routing protocols)

Routing, in a more narrow sense of the term, is often contrasted with bridging in its assumption that network addresses are structured and that similar addresses imply proximity within the network. Structured addresses allow a single routing table entry to represent the route to a group of devices. In large networks, structured addressing (routing, in the narrow sense) outperforms unstructured addressing (bridging). Routing has become the dominant form of addressing on the Internet. Bridging is still widely used within localized environments.

b. Flooding

Flooding is a simple routing algorithm in which every incoming packet is sent through every outgoing link except the one it arrived on. Flooding is used in bridging and in systems such as Usenet and peer-to-peer file sharing and as part of some routing protocols, including OSPF, DVMRP, and those used in ad-hoc wireless networks.There are generally two types of flooding available, Uncontrolled Flooding and Controlled Flooding. Uncontrolled Flooding is the fatal law of flooding. All nodes have neighbours and route packets indefinitely. More than two neighbours creates a broadcast storm.

Controlled Flooding has its own two algorithms to make it reliable, SNCF (Sequence Number Controlled Flooding) and RPF (Reverse Path Flooding). In SNCF, the node attaches its own address and sequence number to the packet, since every node has a memory of addresses and sequence numbers. If it receives a packet in memory, it drops it immediately while in RPF, the node will only send the packet forward. If it is received from the next node, it sends it back to the sender.

Distance vector Routing:

In computer communication theory relating to packet-switched networks, a **distance-vector routing protocol** is one of the two major classes of routing protocols, the other major class being the link-state protocol. Distance-vector routing protocols use the Bellman–Ford algorithm, Ford–Fulkerson algorithm, or DUAL FSM (in the case of Cisco Systems's protocols) to calculate paths.

A distance-vector routing protocol requires that a router informs its neighbors of topology changes periodically. Compared to link-state protocols, which require a router to inform all the nodes in a network of topology changes, distance-vector routing protocols have less computational complexity and message overhead.

The term *distance vector* refers to the fact that the protocol manipulates *vectors* (arrays) of distances to other nodes in the network. The vector distance algorithm was the original ARPANET routing algorithm and was also used in the internet under the name of RIP (Routing Information Protocol).Examples of distance-vector routing protocols include RIPv1 and RIPv2 and IGRP.

Method

Routers using distance-vector protocol do not have knowledge of the entire path to a destination. Instead they use two methods:

1. Direction in which router or exit interface a packet should be forwarded.
2. Distance from its destination

Distance-vector protocols are based on calculating the direction and distance to any link in a network. "Direction" usually means the next hop address and the exit interface. "Distance" is a measure of the cost to reach a certain node. The least cost route between any two nodes is the route with minimum distance. Each node maintains a vector (table) of minimum distance to every node. The cost of reaching a destination is calculated using various route metrics. RIP uses the hop count of the destination whereas IGRP takes into account other information such as node delay and available bandwidth.

Updates are performed periodically in a distance-vector protocol where all or part of a router's routing table is sent to all its neighbors that are configured to use the same distance- vector routing protocol. RIP supports cross-platform distance vector routing whereas IGRP is a Cisco Systems proprietary distance vector routing protocol. Once a router has this information it is able to amend its own routing table to reflect the changes and then inform its neighbors of the changes. This process has been described as _routing by rumor‘ because routers are relying on the information they receive from other routers and cannot determine if the information is actually valid and true. There are a number of features which can be used to help with instability and inaccurate routing information.

EGP and BGP are not pure distance-vector routing protocols because a distance-vector protocol calculates routes based only on link costs whereas in BGP, for example, the local route preference value takes priority over the link cost.

Count-to-infinity problem

The Bellman–Ford algorithm does not prevent routing loops from happening and suffers from the **count-to-infinity problem**. The core of the count-to-infinity problem is that if A tells B that it has a path somewhere, there is no way for B to know if the path has B as a part of it. To see the problem clearly, imagine a subnet connected like A–B–C–D–E–F, and let the metric between the routers be "number of jumps". Now suppose that A is taken offline. In the vector-update-process B notices that the route to A, which was distance 1, is down – B does not receive the vector update from A. The problem is, B also gets an update from C, and C is still not aware of the fact that A is down – so it tells B that A is only two jumps from C (C to B to A), which is false. This slowly propagates through the network until it reaches infinity (in which case the algorithm corrects itself, due to the relaxation property of Bellman–Ford).

ALGORITHM:

1. Create a Simulator object.
2. Set routing as dynamic.
3. Open the trace and nam trace files.
4. Define the finish procedure.
5. Create nodes and the links between them.
6. Create the agents and attach them to the nodes.
7. Create the applications and attach them to the udp agent.
8. Connect udp and null..
9. At 1 sec the link between node 1 and 2 is broken.
10. At 2 sec the link is up again.
11. Run the simulation.

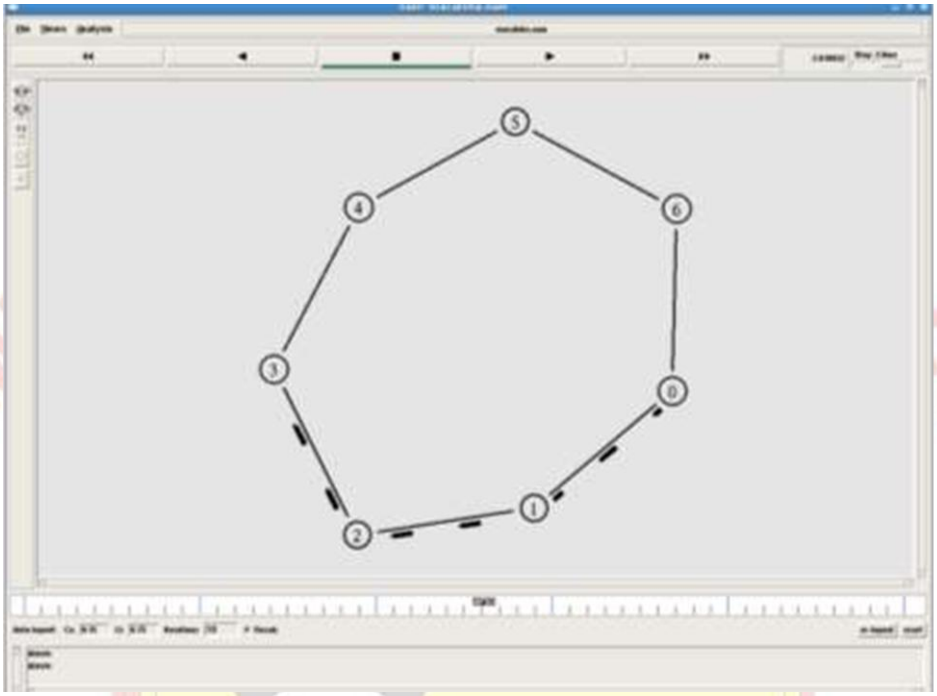
LINK STATE ROUTING PROTOCOL

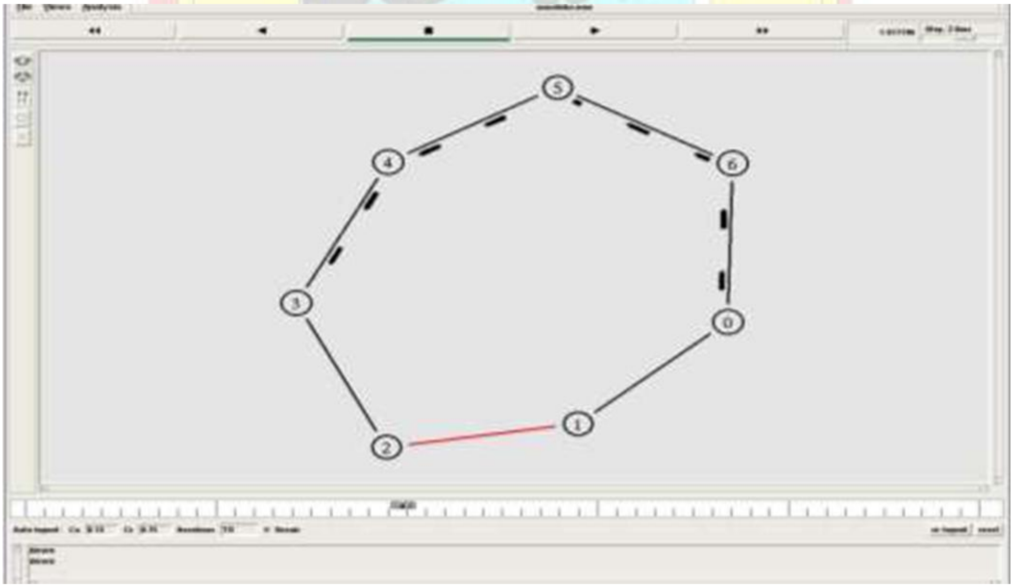
PROGRAM

```
set ns [new Simulator]
$ns rtproto LS
set nf [open linkstate.nam w]
$ns namtrace-all $nf
set f0 [open linkstate.tr w]
$ns trace-all $f0
proc finish {} {
        global ns f0 nf
        $ns flush-trace
        close $f0
        close $nf
        exec nam linkstate.nam &
        exit 0
}
for {set i 0} {$i <7} {incr i} {
        set n($i) [$ns node]
}
for {set i 0} {$i <7} {incr i} {
        $ns duplex-link $n($i) $n([expr ($i+1)%7]) 1Mb 10ms DropTail
}
set udp0 [new Agent/UDP]
$ns attach-agent $n(0) $udp0
set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 500
$cbr0 set interval_ 0.005
$cbr0 attach-agent $udp0
set null0 [new Agent/Null]
$ns attach-agent $n(3) $null0
$ns connect $udp0 $null0
$ns at 0.5 "$cbr0 start"
$ns rtmodel-at 1.0 down $n(1) $n(2)
$ns rtmodel-at 2.0 up $n(1) $n(2)
$ns at 4.5 "$cbr0 stop"
```

```
$ns at 5.0 "finish"
$ns run
```

Output:





DISTANCE VECTOR ROUTING ALGORITHM

ALGORITHM:

1. Create a simulator object
2. Set routing protocol to Distance Vector routing
3. Trace packets on all links onto NAM trace and text trace file
4. Define finish procedure to close files, flush tracing and run NAM
5. Create eight nodes
6. Specify the link characteristics between nodes
7. Describe their layout topology as a octagon
8. Add UDP agent for node n1
9. Create CBR traffic on top of UDP and set traffic parameters.
10. Add a sink agent to node n4
11. Connect source and the sink
12. Schedule events as follows:
    a. Start traffic flow at 0.5
    b. Down the link n3-n4 at 1.0
    c. Up the link n3-n4 at 2.0
    d. Stop traffic at 3.0
    e. Call finish procedure at 5.0
13. Start the scheduler
14. Observe the traffic route when link is up and down
15. View the simulated events and trace file analyze it
16. Stop

PROGRAM

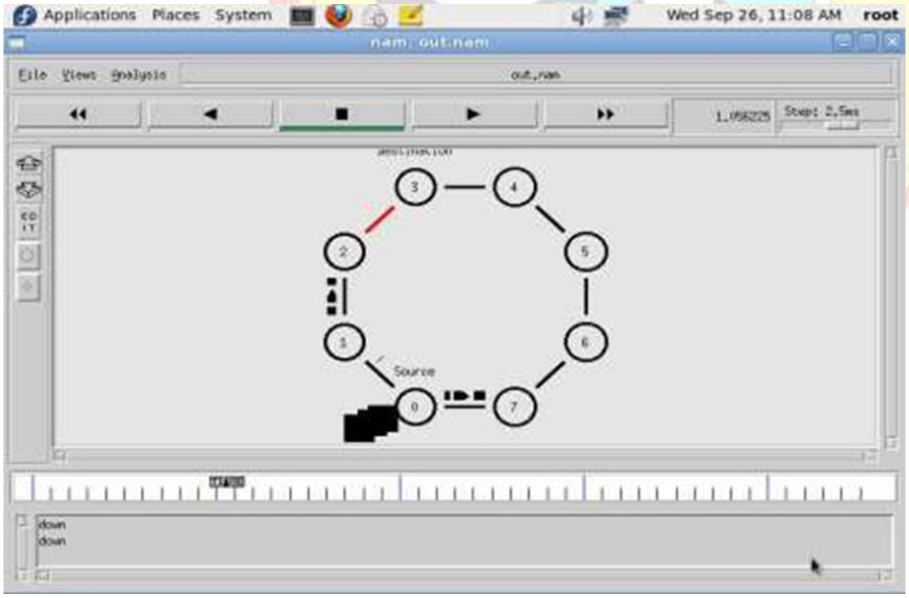
```
#Distance vector routing protocol – distvect.tcl
#Create a simulator object
set ns [new Simulator]
#Use distance vector routing
$ns rtproto DV
#Open the nam trace file
set nf [open out.nam w]
$ns namtrace-all $nf
# Open tracefile
set nt [open trace.tr w]
$ns trace-all $nt
#Define 'finish' procedure
```

```
proc finish {}
{
        global ns nf
        $ns flush-trace
        #Close the trace file
        close $nf
        #Execute nam on the trace file
        exec nam -a out.nam &
        exit 0
}
# Create 8 nodes
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
set n6 [$ns node]
set n7 [$ns node]
set n8 [$ns node]
# Specify link characterestics
$ns duplex-link $n1 $n2 1Mb 10ms DropTail
$ns duplex-link $n2 $n3 1Mb 10ms DropTail
$ns duplex-link $n3 $n4 1Mb 10ms DropTail
$ns duplex-link $n4 $n5 1Mb 10ms DropTail
$ns duplex-link $n5 $n6 1Mb 10ms DropTail
$ns duplex-link $n6 $n7 1Mb 10ms DropTail
$ns duplex-link $n7 $n8 1Mb 10ms DropTail
$ns duplex-link $n8 $n1 1Mb 10ms DropTail
# specify layout as a octagon
$ns duplex-link-op $n1 $n2 orient left-up
$ns duplex-link-op $n2 $n3 orient up
$ns duplex-link-op $n3 $n4 orient right-up
$ns duplex-link-op $n4 $n5 orient right
$ns duplex-link-op $n5 $n6 orient right-down
$ns duplex-link-op $n6 $n7 orient down
$ns duplex-link-op $n7 $n8 orient left-down
$ns duplex-link-op $n8 $n1 orient left
#Create a UDP agent and attach it to node n1
set udp0 [new Agent/UDP]
$ns attach-agent $n1 $udp0
#Create a CBR traffic source and attach it to udp0
```

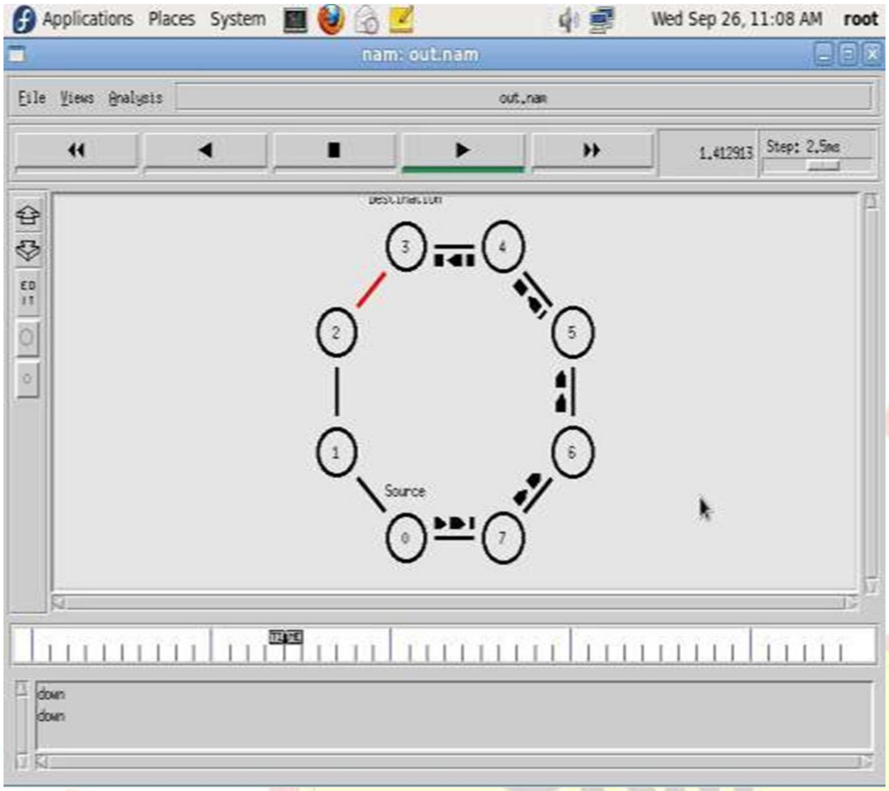
```
set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 500
$cbr0 set interval_ 0.005
$cbr0 attach-agent $udp0
#Create a Null agent (a traffic sink) and attach it to node n4
set null0 [new Agent/Null]
$ns attach-agent $n4 $null0
#Connect the traffic source with the traffic sink
$ns connect $udp0 $null0
#Schedule events for the CBR agent and the network dynamics
$ns at 0.0 "$n1 label Source"
$ns at 0.0 "$n4 label Destination"
$ns at 0.5 "$cbr0 start"
$ns rtmodel-at 1.0 down $n3 $n4
$ns rtmodel-at 2.0 up $n3 $n4
$ns at 4.5 "$cbr0 stop"
#Call the finish procedure after 5 seconds of simulation time
$ns at 5.0 "finish"
#Run the simulation
$ns run
```

OUTPUT

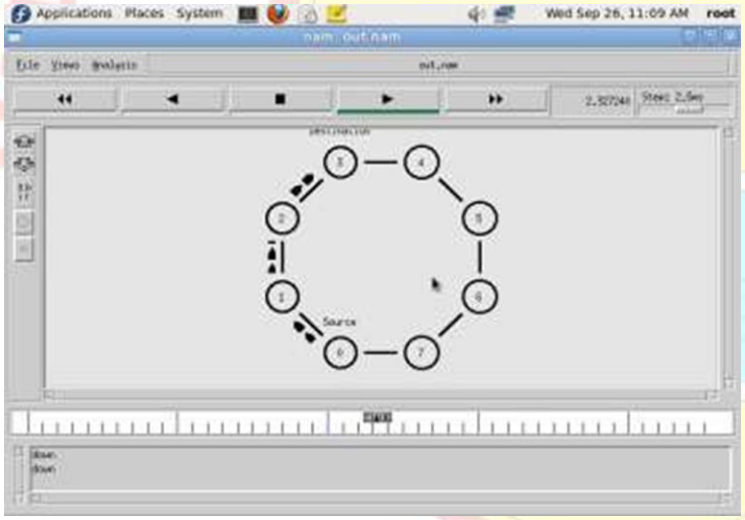
$ ns distvect.tcl



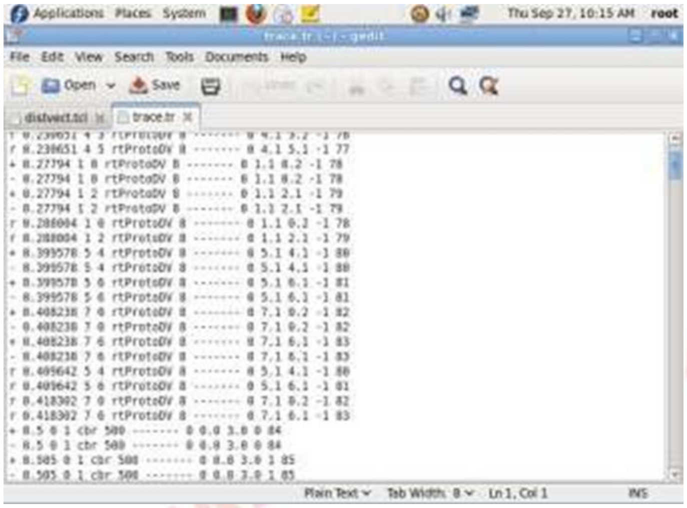
```
down
down
```



```
down
down
```



```
down
down
```



Applications Places System
Thu Sep 27, 10:15 AM root
trace.tr (~/) - gedit
File Edit View Search Tools Documents Help
Open Save
distvect.tcl
trace.tr
Plain Text Tab Width: 8 Ln 1, Col 1 INS

```
r 0.239651 4 3 rtProtoDV 8 ------- 0 4.1 3.2 -1 76
r 0.239651 4 5 rtProtoDV 8 ------- 0 4.1 5.1 -1 77
+ 0.27794 1 0 rtProtoDV 8 ------- 0 1.1 0.2 -1 78
- 0.27794 1 0 rtProtoDV 8 ------- 0 1.1 0.2 -1 78
+ 0.27794 1 2 rtProtoDV 8 ------- 0 1.1 2.1 -1 79
- 0.27794 1 2 rtProtoDV 8 ------- 0 1.1 2.1 -1 79
r 0.288004 1 0 rtProtoDV 8 ------- 0 1.1 0.2 -1 78
r 0.288004 1 2 rtProtoDV 8 ------- 0 1.1 2.1 -1 79
+ 0.399578 5 4 rtProtoDV 8 ------- 0 5.1 4.1 -1 80
- 0.399578 5 4 rtProtoDV 8 ------- 0 5.1 4.1 -1 80
+ 0.399578 5 6 rtProtoDV 8 ------- 0 5.1 6.1 -1 81
- 0.399578 5 6 rtProtoDV 8 ------- 0 5.1 6.1 -1 81
+ 0.408238 7 0 rtProtoDV 8 ------- 0 7.1 0.2 -1 82
- 0.408238 7 0 rtProtoDV 8 ------- 0 7.1 0.2 -1 82
+ 0.408238 7 6 rtProtoDV 8 ------- 0 7.1 6.1 -1 83
- 0.408238 7 6 rtProtoDV 8 ------- 0 7.1 6.1 -1 83
r 0.409642 5 4 rtProtoDV 8 ------- 0 5.1 4.1 -1 80
r 0.409642 5 6 rtProtoDV 8 ------- 0 5.1 6.1 -1 81
r 0.418302 7 0 rtProtoDV 8 ------- 0 7.1 0.2 -1 82
r 0.418302 7 6 rtProtoDV 8 ------- 0 7.1 6.1 -1 83
+ 0.5 0 1 cbr 500 ------- 0 0.0 3.0 0 84
- 0.5 0 1 cbr 500 ------- 0 0.0 3.0 0 84
+ 0.505 0 1 cbr 500 ------- 0 0.0 3.0 1 85
- 0.505 0 1 cbr 500 ------- 0 0.0 3.0 1 85
```

VIVA (Pre &Post Lab) Questions:

1. What do you mean by the term “no. of hops”?
2. List the basic functions of routers.
3. Explain multicast routing.
4. What os OSPF
5. What are the advantages of distance vector routing?
6. Describe the process of routing packets.
7. What are some of the merits used by routing protocols?
8. Distinguish between bridges and routers

RESULT:

Thus the simulation for Distance vector and link state routing protocols was done using NS2.

Ex.No 10 Simulation of error correction code (like CRC)

AIM:

To implement and check the error detection/error correction techniques in networks using a c program.

1. Theory

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.
- What happens when an error is detected?
- Two basic approaches:
  - Notify the sender that message is corrupt so the sender can retransmit it; (most often used in every day applications)
  - Use an error-correcting code to reconstruct the correct message

Transmission Errors

· External electromagnetic signals can cause incorrect delivery of data

- · Data can be received incorrectly
- · Data can be lost
- · Unwanted data can be generated

· Any of these problems are called *transmission errors*

Error Detection

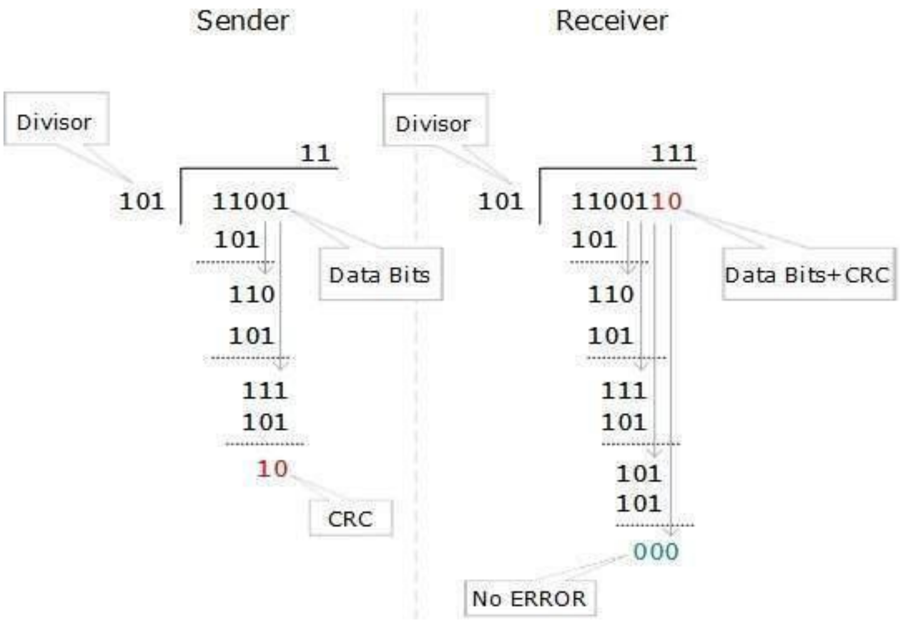
- Detecting Transmission Errors: basic idea is to add redundant information to a frame that can determine if errors have been introduced.

Error Correction or Error Detection?

- When error is detected, frame is discarded and resent, using bandwidth and causing latency, waiting for its arrival.
- Error correction requires additional bit to be sent with every frame.
- Correction is useful when
  - 1) errors are probable or
  - 2) the cost of retransmission is too high

Cyclic Redundancy Check (CRC)

CRC is a different approach to detect if the received frame contains valid data. This technique involves binary division of the data bits being sent. The divisor is generated using polynomials. The sender performs a division operation on the bits being sent and calculates the remainder. Before sending the actual bits, the sender adds the remainder at the end of the actual bits. Actual data bits plus the remainder is called a codeword. The sender transmits data bits as code words.



At the other end, the receiver performs division operation on codewords using the same CRC divisor. If the remainder contains all zeros the data bits are accepted, otherwise it is considered as there some data corruption occurred in transit.

PROCEDURE:

- Start the process.
- Give the data which is the message.
- Compile and run the program.
- Enter the received hamming code.
- The error is corrected codeword.

Program:

```
import java.util.*;

class GfG {

   // Returns XOR of 'a' and 'b' (bitwise comparison)
   static String findXor(String a, String b) {
      int n = b.length();
      StringBuilder result = new StringBuilder();

      // Compare each bit (skip first bit as per original logic)
      for (int i = 1; i < n; i++) {
         if (a.charAt(i) == b.charAt(i)) {
            result.append('0');
         } else {
            result.append('1');
         }
      }
```

```
        return result.toString();
    }

    // Performs Modulo-2 division (CRC division)
    static String mod2div(String dividend, String divisor) {
        int n = dividend.length();
        int pick = divisor.length();
        String tmp = dividend.substring(0, pick);

        while (pick < n) {
            if (tmp.charAt(0) == '1') {
                // XOR with divisor and bring down next bit
                tmp = findXor(divisor, tmp) + dividend.charAt(pick);
            } else {
                // XOR with zeros and bring down next bit
                tmp = findXor(String.format("%0" + pick + "d", 0), tmp)
                      + dividend.charAt(pick);
            }
            pick += 1;
        }

        // Final XOR step
        if (tmp.charAt(0) == '1') {
            tmp = findXor(divisor, tmp);
        } else {
            tmp = findXor(String.format("%0" + pick + "d", 0), tmp);
        }

        return tmp;
    }

    // Appends CRC remainder to original data
    public static String encodeData(String data, String key) {
        int n = key.length();
        String str = data + String.join("", Collections.nCopies(n - 1, "0"));
        String remainder = mod2div(str, key);
        return data + remainder;
    }

    // Checks if received data has errors
    public static int receiver(String code, String key) {
        String remainder = mod2div(code, key);
        return remainder.contains("1") ? 0 : 1;
    }

    public static void main(String[] args) {
        String data = "100100";
        String key = "1101";

        System.out.println("Sender Side");
        System.out.println("Data: " + data);
```

```
      System.out.println("Key: " + key);
      String code = encodeData(data, key);
      System.out.println("Encoded Data: " + code + "\n");

      System.out.println("Receiver Side");
      if (receiver(code, key) == 1) {
        System.out.println("Data is correct (No errors detected)");
      } else {
        System.out.println("Data is incorrect (Error detected)");
      }
    }
  }
```

```
OutPut
Sender Side
Data: 100100
Key: 1101
Encoded Data: 100100001


Receiver Side
Data is correct (No errors detected)
```

Ex.no.11

TOPIC BEYOND SYLLABUS

a.Simulation of Go Back N protocol

AIM:

To Simulate and to study of Go Back N protocol

PRE LAB DISCUSSION:

- Go Back N is a connection oriented transmission. The sender transmits the frames continuously. Each frame in the buffer has a sequence number starting from 1 and increasing up to the window size.
- The sender has a window i.e. a buffer to store the frames. This buffer size is the number of frames to be transmitted continuously.
- A station may send multiple frames as allowed by the window size.
- Receiver sends an ACK i if frame i has an error. After that, the receiver discards all incoming frames until the frame with error is correctly retransmitted.
- Go-Back-N Automatic Repeat reQuest (Go-Back-N ARQ), is a data link layer protocol that uses a sliding window method for reliable and sequential delivery of data frames. It is a case of sliding window protocol having to send window size of N and receiving window size of 1.
- Go – Back – N ARQ uses the concept of protocol pipelining, i.e. sending multiple frames before receiving the acknowledgment for the first frame. The frames are sequentially numbered and a finite number of frames. The maximum number of frames that can be sent depends upon the size of the sending window. If the acknowledgment of a frame is not received within an agreed upon time period, all frames starting from that frame are retransmitted.
- The size of the sending window determines the sequence number of the outbound frames. If the sequence number of the frames is an n-bit field, then the range of sequence numbers that can be assigned is 0 to 2n−1. Consequently, the size of the sending window is 2n−1. Thus in order to accommodate a sending window size of 2n−1, an n-bit sequence number is chosen.
- The sequence numbers are numbered as modulo-n. For example, if the sending window size is 4, then the sequence numbers will be 0, 1, 2, 3, 0, 1, 2, 3, 0, 1, and so on. The number of bits in the sequence number is 2 to generate the binary sequence 00, 01, 10, 11.
- The size of the receiving window is 1

ALGORITHM :

1. The source node transmits the frames continuously.
2. Each frame in the buffer has a sequence number starting from 1 and increasing up to the window size.
3. The source node has a window i.e. a buffer to store the frames. This buffer size is the number of frames to be transmitted continuously.

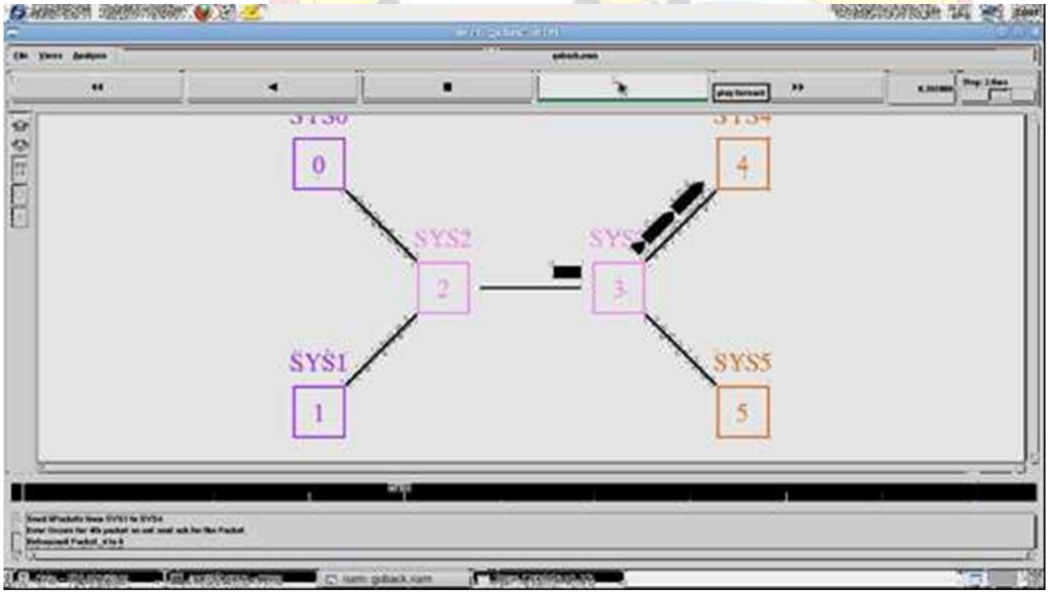
4. The size of the window depends on the protocol designer.
5. For the first frame, the receiving node forms a positive acknowledgement if the frame is received without error.
6. If subsequent frames are received without error (up to window size) cumulative positive acknowledgement is formed.
7. If the subsequent frame is received with error, the cumulative acknowledgment error-free frames are transmitted. If in the same window two frames or more frames are received with error, the second and the subsequent error frames are neglected. Similarly even the frames received without error after the receipt of a frame with error are neglected.
8. The source node retransmits all frames of window from the first error frame.
9. If the frames are errorless in the next transmission and if the acknowledgment is error free, the window slides by the number of error-free frames being transmitted.
10. If the acknowledgment is transmitted with error, all the frames of window at source are retransmitted, and window doesn’t slide.
11. This concept of repeating the transmission from the first error frame in the window is called as GOBACKN transmission flow control protocol.

PROGRAM :

```
#send packets one by one
set ns [new Simulator] set n0 [$ns node]
set n1 [$ns node] set n2 [$ns node] set n3 [$ns node] set n4 [$ns node] set n5 [$ns node] $n0
color "purple" $n1 color "purple" $n2 color "violet" $n3 color "violet" $n4 color "chocolate" $n5
color "chocolate" $n0 shape box ;
$n1 shape box ; $n2 shape box ; $n3 shape box ; $n4 shape box ; $n5 shape box ;
$ns at 0.0 "$n0 label SYS0"
$ns at 0.0 "$n1 label SYS1"
$ns at 0.0 "$n2 label SYS2"
$ns at 0.0 "$n3 label SYS3"
$ns at 0.0 "$n4 label SYS4"
 $ns at 0.0 "$n5 label SYS5"
set nf [open goback.nam w] $ns namtrace-all $nf
set f [open goback.tr w] $ns trace-all $f
$ns duplex-link $n0 $n2 1Mb 20ms DropTail $ns duplex-link-op $n0 $n2 orient right-down $ns
queue-limit $n0 $n2 5
$ns duplex-link $n1 $n2 1Mb 20ms DropTail $ns duplex-link-op $n1 $n2 orient right-up $ns
duplex-link $n2 $n3 1Mb 20ms DropTail $ns duplex-link-op $n2 $n3 orient right
$ns duplex-link $n3 $n4 1Mb 20ms DropTail $ns duplex-link-op $n3 $n4 orient right-up $ns
duplex-link $n3 $n5 1Mb 20ms DropTail $ns duplex-link-op $n3 $n5 orient right-down
Agent/TCP set_nam_tracevar_true
set tcp [new Agent/TCP] $tcp set fid 1
$ns attach-agent $n1 $tcp
set sink [new Agent/TCPSink] $ns attach-agent $n4 $sink $ns connect $tcp $sink
set ftp [new Application/FTP] $ftp attach-agent $tcp
$ns at 0.05 "$ftp start"
$ns at 0.06 "$tcp set windowlnit 6"
$ns at 0.06 "$tcp set maxcwnd 6"
```

```
$ns at 0.25 "$ns queue-limit $n3 $n4 0"
$ns at 0.26 "$ns queue-limit $n3 $n4 10"
$ns at 0.305 "$tcp set windowlnit 4"
$ns at 0.305 "$tcp set maxcwnd 4"

$ns at 0.368 "$ns detach-agent $n1 $tcp ; $ns detach-agent $n4 $sink"
$ns at 1.5 "finish"
$ns at 0.0 "$ns trace-annotate \"Goback N end\""
$ns at 0.05 "$ns trace-annotate \"FTP starts at 0.01\""
$ns at 0.06 "$ns trace-annotate \"Send 6Packets from SYS1 to SYS4\""
$ns at 0.26 "$ns trace-annotate \"Error Occurs for 4th packet so not sent ack for the Packet\""
$ns at 0.30 "$ns trace-annotate \"Retransmit Packet_4 to 6\""
$ns at 1.0 "$ns trace-annotate \"FTP stops\""
proc finish {} {
global ns nf
$ns flush-trace
close $nf
puts "filtering..."
#exec tclsh../bin/namfilter.tcl goback.nam
#puts "running nam..."
exec nam goback.nam &
exit 0
}
$ns run.
```

OUTPUT



```
Send 6Packets from SYS1 to SYS4
Error Occurs for 4th packet so not sent ack for the Packet
Retransmit Packet_4 to 6
```

VIVA (Pre & Post Lab)QUESTIONS:

1.What is Go back-N protocol?
2.What is Go back-N protocol ARQ?
3.What is flow control?
4.What is fixed size framing?

RESULT:

Thus the Go back N and Selective Repeat protocols were Simulated and studied

b.CARRIER SENSE MULTIPLE ACCESS

AIM:

To write a ns2 program for implementing carrier sense multiple access.

PRE LAB DISCUSSION

Carrier Sensed Multiple Access (CSMA) : CSMA is a network access method used on shared network topologies such as Ethernet to control access to the network. Devices attached to the network cable listen (carrier sense) before transmitting. If the channel is in use, devices wait before transmitting. MA (Multiple Access) indicates that many devices can connect to and share the same network.

All devices have equal access to use the network when it is clear.In other words, a station that wants to communicate "listen" first on the media communication and awaits a "silence" of a preset time (called the Distributed Inter Frame Space or DIFS). After this compulsory period, the station starts a countdown for a random period considered. The maximum duration of this countdown is called the collision window (Window Collision, CW). If no equipment speaks before the end of the countdown, the station simply deliver its package.

However, if it is overtaken by another station, it stops immediately its countdown and waits for the next silence. then continued his account countdown where it left off. This is summarized in Figure. The waiting time random has the advantage of allowing a statistically equitable distribution of speaking time between the various network equipment, while making little unlikely (but not impossible) that both devices speak exactly the same time.

The countdown system prevents a station waiting too long before issuing its package. It's a bit what place in a meeting room when no master session (and all the World's polite) expected a silence, then a few moments before speaking, to allow time for someone else to speak. The time is and randomly assigned, that is to say, more or less equally.

ALGORITHM:

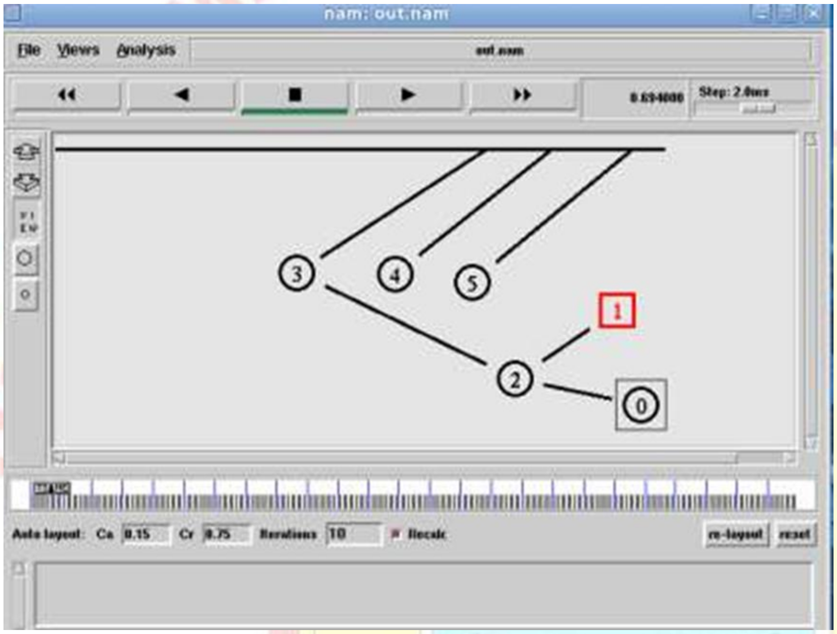
1. Start the program.
2. Declare the global variables ns for creating a new simulator.

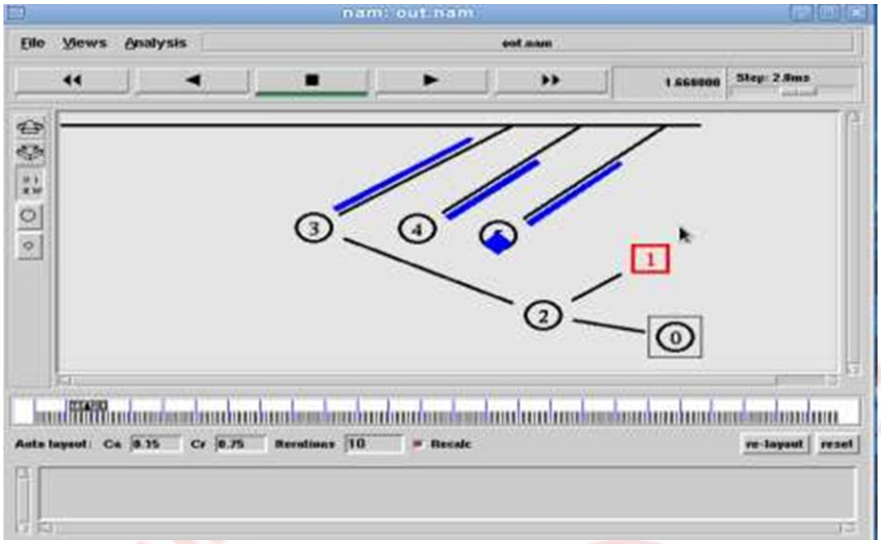
3. Set the color for packets.
4. Open the network animator file in the write mode.
5. Open the trace file and the win file in the write mode.
6. Transfer the packets in network.
7. Create the capable no of nodes.
8. Create the duplex-link between the nodes including the delay time,bandwidth and dropping queue mechanism.
9. Give the position for the links between the nodes.
10. Set a tcp connection for source node.
11. Set the destination node using tcp sink.
12. Set the window size and the packet size for the tcp.
13. Set up the ftp over the tcp connection.
14. Set the udp and tcp connection for the source and destination.
15. Create the traffic generator CBR for the source and destination files.
16. Define the plot window and finish procedure.
17. In the definition of the finish procedure declare the global variables.
18. Close the trace file and namefile and execute the network animation file.
19. At the particular time call the finish procedure.
20. Stop the program.

PROGRAM:

```
set ns [new Simulator]
$ns color 1 blue
$ns color 2 red
set fi1 [open out.tr w]
set winfile [open WinFile w]
$ns trace-all $fi1
set fi2 [open out.nam w]
$ns namtrace-all $fi2
proc finish {}
{
        global ns fi1 fi2
        $ns flush-trace
        close $fi1
        close $fi2
        exec nam out.nam &
        exit 0
}
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
$n1 color red
$n1 shape box
$ns duplex-link $n0 $n2 2Mb 10ms DropTail
$ns duplex-link $n1 $n2 2Mb 10ms DropTail
$ns simplex-link $n2 $n3 0.3Mb 100ms DropTail
$ns simplex-link $n3 $n2 0.3Mb 100ms DropTail
set lan [$ns newLan "$n3 $n4 $n5" 0.5Mb 40ms LL Queue/DropTail MAC/Csma/Cd Channel]
set tcp [new Agent/TCP/Newreno]
$ns attach-agent $n0 $tcp
set sink [new Agent/TCPSink/DelAck]
$ns attach-agent $n4 $sink
$ns connect $tcp $sink
$tcp set fid_ 1
$tcp set window_ 8000
$tcp set packetsize_ 552
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP
set udp [new Agent/UDP]
$ns attach-agent $n1 $udp
set null [new Agent/Null]
$ns attach-agent $n5 $null
$ns connect $udp $null
$udp set fid_ 2
set cbr [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set type_ CBR
$cbr set packet_size_ 1000
$cbr set rate_ 0.01mb
$cbr set random_ false
$ns at 0.1 "$cbr start"
$ns at 1.0 "$ftp start"
$ns at 24.0 "$ftp stop"
$ns at 24.5 "$cbr stop"
proc plotwindow { tcpSource file }
{
        global ns
        set time 0.1
        set now [$ns now]
        set cwnd [$tcpSource set cwnd_]
        set wnd [$tcpSource set window_]
        puts $file "$now $cwnd"
        $ns at [expr $now+$time] "plotwindow $tcpSource $file"
}
$ns at 1.0 "plotwindow $tcp $winfile"
$ns at 5 "$ns trace-annotate \"packet drop\""
$ns at 125.0 "finish"
$ns run
```

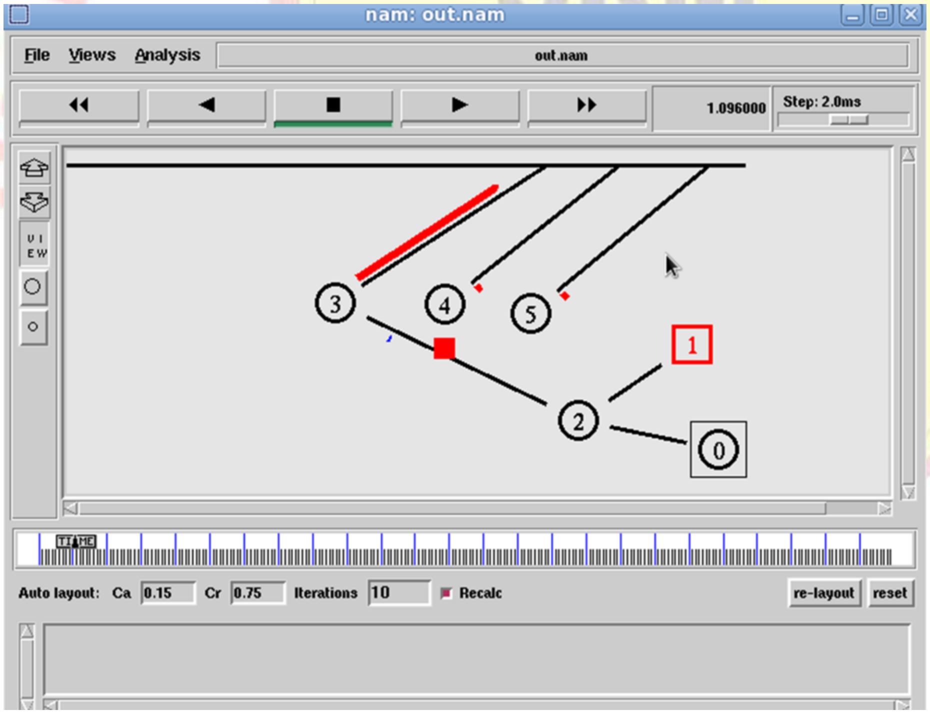
OUTPUT:





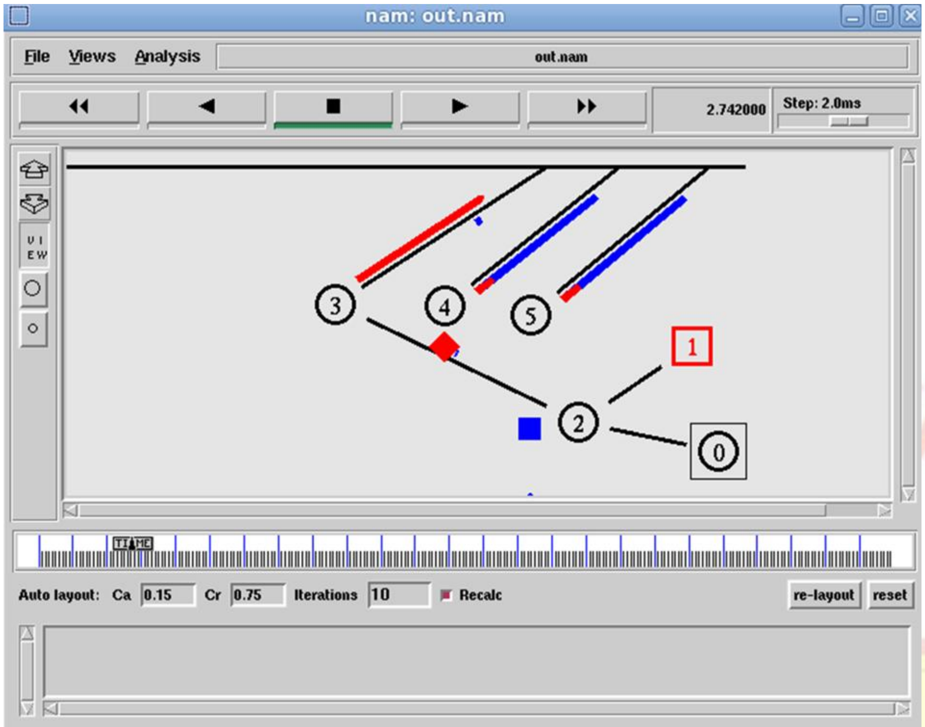
1.660000 Step: 2.0ms

Auto layout: Ca 0.15 Cr 0.75 Iterations 10 Recalc



1.096000 Step: 2.0ms

Auto layout: Ca 0.15 Cr 0.75 Iterations 10 Recalc



Auto layout: Ca 0.15 Cr 0.75 Iterations 10 ☒ Recalc

VIVA (Pre & Post)Lab QUESTIONS:

1. What is CSMA/CD?
2. Differenciate between CSMA/CD and CSMA/CA.
3. What is CSMA and its types?
4. What is meant by p-persistent CSMA?
5. What u meant by Exponatonal Back OFF?
6. What is the access method used by wireless LAN?

RESULT

Thus the carrier sense multiple access are implemented and executed successfully.