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INDEX

Ex.No:1	STUDY OF HEADER FILES WITH RESPECT TO SOCKET PROGRAMMING
Date:	

AIM:

To Study the header files with respect to Socket Programming

1. **stdio.h:**

Has standard input and output library providing simple and efficient buffered stream IOinterface.(scanf, printf, gets, putc etc.)

2. **unistd.h:**

It is a POSIX standard for open system interface. [Portable Operating System Interface]. (fork, pipe, read, write etc.)

3. **string.h:**

This header file is used to perform string manipulation operations on NULL terminatedstrings.(strcpy,strcmp, strlen etc.)

4. **stdlib.h:**

This header file contains the utility functions such as string conversion routines, memoryallocation routines, random number generator, etc. (abort, exit, rand, atoi etc.)

5. **sys/types.h:**

Defines the data type of socket address structure in unsigned long.(clock_t, size_t, dev_t etc.)

6. **sys/socket.h:**

The socket functions can be defined as taking pointers to the generic socket address structure called sockaddr. (SO_REUSEADDR, SO_ERROR, SO_ACCEPTCONN etc.)

7. **netinet/in.h:**

Defines the IPv4 socket address structure commonly called Internet socket address structure called sockaddr_in. (IPPROTO_IP, IPPROTO_ICMP, IPPROTO_TCP etc.)

8. **netdb.h:**

Defines the structure hostent for using the system call gethostbyname to get the network host entry.(HOST_NOT_FOUND, NO_DATA, NO_RECOVERY etc.)

9. time.h:

Has structures and functions to get the system date and time and to perform time manipulation functions. We use the function ctime(), that is defined in this header file , to calculate the current dateand time.

10. sys/stat.h:

Contains the structure stat to test a descriptor to see if it is of a specified type. Also it is used to display file or file system status.stat() updates any time related fields.when copying from 1 file to another.

11. sys/ioctl.h:

Macros and defines used in specifying an ioctl request are located in this header file. We use the function ioctl() that is defined in this header file. ioctl() function is used to perform ARP cache operations.

12. pcap.h:

Has function definitions that are required for packet capturing. Some of the functions are pcap_lookupdev(),pcap_open_live() and pcap_loop(). pcap_lookupdev() is used to initialize the network device. The device to be sniffed is opened using the pcap_open_live(). Pcap_loop() determines the number of packets to be sniffed.

13. net/if_arp.h:

Contains the definitions for Address Resolution Protocol. We use this to manipulate the ARP request structure and its data members arp_pa,arp_dev and arp_ha. The arp_ha structure's datamember sa_data[ ] has the hardware address.

14. errno.h:

It sets an error number when an error and that error can be displayed using perror function. It has symbolic error names. The error number is never set to zero by any library function.

15. arpa/inet.h:

This is used to convert internet addresses between ASCII strings and network byte ordered binaryvalues (values that are stored in socket address structures). It is used for inet_aton, inet_addr,inet_ntoa functions

Result :

Thus the header files of Socket programs are studied

Ex.No:2	STUDY OF BASIC FUNCTIONS OF SOCKET PROGRAMMING
Date:	

Aim :

To discuss some of the basic functions used for socket programming.

1. man socket

NAME:

Socket – create an endpoint for communication.

SYNOPSIS:

```
#include<sys/types.h>
#include<sys/socket.h>
int socket(int domain,int type,int protocol);
 eg: sd=socket(AF_INET,SOCK_STREAM,0);
```

DESCRIPTION:

- Socket creates an endpoint for communication and returns a descriptor.
- The domain parameter specifies a common domain this selects the protocol family whichwill be used for communication.
- These families are defined in <sys/socket.h>.

FORMAT:

NAME	PURPOSE
PF_UNIX,PF_LOCAL	Local Communication.
PF_INET	IPV4 Internet Protocols.
PF_IPX	IPX-Novell Protocols.
PF_APPLETALK	Apple Talk.

- The socket has the indicated type, which specifies the communication semantics.

TYPES:

1.SOCK_STREAM:

- Provides sequenced , reliable, two-way , connection based byte streams.
- An out-of-band data transmission mechanism, may be supported.

2.SOCK_DGRAM:

- Supports datagram (connectionless, unreliable messages of a fixed

maximum length).

3. SOCK_SEQPACKET:

- Provides a sequenced , reliable, two-way connection based data transmission path fordatagrams of fixed maximum length.

4. SOCK_RAW:

- Provides raw network protocol access.

5. SOCK_RDM:

- Provides a reliable datagram layer that doesn't guarantee ordering.

6. SOCK_PACKET:

- Obsolete and shouldn't be used in new programs.

2. man connect:

NAME:

connect – initiate a connection on a socket.

SYNOPSIS:

```
#include<sys/types.h>
#include<sys/socket.h>
int connect(int sockfd,const (struct
sockaddr*)&serv_addr,socklen_t addrlen);eg:
cd=connect(sd,(struct sockaddr*)&servaddr,sizeof(servaddr));
```

DESCRIPTION:

- The file descriptor sockfd must refer to a socket.
- If the socket is of type SOCK_DGRAM then the serv_addr address is the address to which datagrams are sent by default and the only addr from which datagrams arereceived.
- If the socket is of type SOCK_STREAM or SOCK_SEQPACKET , this call attempts tomake a connection to another socket.

RETURN VALUE:

- If the connection or binding succeeds, zero is returned.
- On error , -1 is returned , and error number is set appropriately.

ERRORS:

EBADF	Not a valid Index.
EFAULT	The socket structure address is outside the user'saddress space.
ENOTSOCK	Not associated with a socket.
EISCONN	Socket is already connected.
ECONNREFUSED	No one listening on the remote address.

3. man accept

NAME:

accept/reject job is sent to a destination.

SYNOPSIS:

accept destination(s)
reject[-t] [-h server] [-r reason] destination(s)
eg: ad=accept(sd,(struct sockaddr*)&cliaddr,&clilen);

DESCRIPTION:

- accept instructs the printing system to accept print jobs to the specified destination.
- The –r option sets the reason for rejecting print jobs.
- The –e option forces encryption when connecting to the server.

4. man send

NAME:

send, sendto, sendmsg - send a message from a socket.

SYNOPSIS:

```
#include<sys/types.h>
#include<sys/socket.h>
ssize_t send(int s, const void *buf, size_t len, int flags);
ssize_t sendto(int s, const void *buf, size_t len, int flags, const struct
sock_addr*to, socklen_t tolen);ssize_t sendmsg(int s, const struct msghdr *msg,
int flags);
```

DESCRIPTION:

- The system calls send, sendto and sendmsg are used to transmit a message to anothersocket.
- The send call may be used only when the socket is in a connected state.
- The only difference between send and write is the presence of flags.
- The parameter is the file descriptor of the sending socket.

5. man recv

NAME:

recv, recvfrom, recvmsg – receive a message from a socket.

SYNOPSIS:

```
#include<sys/types.
h>
#include<sys/socke
t.h>
```

ssize_t recv(int s, void *buf, size_t len, int flags);
ssize_t recvfrom(int s, void *buf, size_t len, int flags, struct sockaddr *from, socklen_t* from len);ssize_t recvmsg(int s, struct msghdr *msg, int flags);

DESCRIPTION:

- The recvfrom and recvmsg calls are used to receive messages from a socket, and may beused to recv data on a socket whether or not it is connection oriented.
- If from is not NULL, and the underlying protocol provides the src addr , this src addr isfilled in.
- The recv call is normally used only on a connection socket and is identical to recvfromwith a NULL from parameter.

6. man write

NAME:

write- send a message to another user.

SYNOPSIS:

write user[ttyname]

DESCRIPTION:

- write allows you to communicate with other users, by copying lines from terminal to
  ……
- When you run the write and the user you are writing to get a message of the form:Message from yourname @yourhost on yourtty at hh:mm:…
- Any further lines you enter will be copied to the specified user's terminal.
- If the other user wants to reply they must run write as well.

7. ifconfig

NAME:

ifconfig- configure a network interface.

SYNOPSIS:

ifconfig[interface]
ifconfig interface[aftype] options | address……

DESCRIPTION:

- ifconfig is used to configure the kernel resident network interfaces.
- It is used at boot time to setup interfaces as necessary.
- After that, it is usually only needed when debugging or when system tuning is needed.
- If no arguments are given, ifconfig displays the status of the currently active interfaces.

8. man bind

SYNOPSIS:

bind[-m keymap] [-lp sv psv]

9. man htons/ man

htonlNAME:

htonl, htons, ntohl, ntohs - convert values between host and network byte order.

SYNOPSIS:

```
#include<netinet/in.h>
 uint32_t htonl(uint32_t
 hostlong); uint16_t
          htons(uint32_t
 hostshort);uint32_t
          ntohl(uint32_t
 netlong); uint16_t
          ntohs(uint16_t
 netshort);
```

DESCRIPTION:

- The htonl() function converts the unsigned integer hostlong from host byte order tonetwork byte order.
- The htons() converts the unsigned short integer hostshort from host byte order to networkbyte order.

- The ntohl() converts the unsigned integer netlong from network byte order to host byteorder.

10. man

gethostname

NAME:

gethostname, sethostname- get/set host name.

SYNOPSIS:

```
#include<unistd.h>
int gethostname(char *name,size_t len);
int sethostname(const char *name,size_t len);
```

DESCRIPTION:

- These functions are used to access or to change the host name of the current processor.
- The gethostname() returns a NULL terminated hostname(set earlier by sethostname()) inthe array name that has a length of len bytes.
- In case the NULL terminated then hostname does not fit ,no error is returned, but thehostname is truncated.
- It is unspecified whether the truncated hostname will be NULL terminated.

11. man

gethostbyname

NAME:

gethostbyname, gethostbyaddr, sethostent, endhostent, herror, hstr – error – get network host entry.

SYNOPSIS:

```
#include<netdb.
  h> extern int
  h_errno;
  struct hostent *gethostbyname(const char
*name);#include<sys/socket.h>
```

struct hostent *gethostbyaddr(const char *addr)int len,
int type);struct hostent *gethostbyname2(const char
*name,int af);

DESCRIPTION:

- The gethostbyname() returns a structure of type hostent for the given hostname.
- Name->hostname or IPV4/IPV6 with dot notation.
- gethostbyaddr()- struct of type hostent / host address length
- Address types- AF_INET, AF_INET6.
- sethostent() – stay open is true(1).
- TCP socket connection should be open during queries.
- Server queries for UDP datagrams.
- endhostent()- ends the use of TCP connection.
- Members of hostent structure:
    a) h_name
    b) h_aliases
    c) h_addrtype
    d) h_length
    e) h_addr-list
    f) h_addr.

RESULT:

Thus the basic functions used for Socket Programming was studied successfully.

Ex.No:3	SIMPLE TCP/IP CLIENT SERVER COMMUNICATION
Date:	

Aim:

There are two hosts, Client and Server. The Client accepts the message from the user and sends it to the Server. The Server receives the message and prints it.

TECHNICAL OBJECTIVE:

To implement a simple TCP Client-Server application , where the Client on establishing a connection with the Server, sends a string to the Server. The Server reads the String and prints it.

METHODOLOGY:

Server:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_STREAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET, sin_addr to INADDR_ANY, sin_port to a dynamically assigned port number.
- Bind the local host address to socket using the bind function.
- Listen on the socket for connection request from the client.
- Accept connection request from the client using accept function.
- Within an infinite loop, using the recv function receive message from the client and print it on the console.

Client:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_STREAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET.
- Get the server IP address and port number from the console.
- Using gethostbyname function assign it to a hostent structure, and assign it to sin_addr of the server address structure.
- Request a connection from the server using the connect function.
- Within an infinite loop, read message from the console and send the message to the server using the send function.

CODING:

Server: tcpserver.c

```
#include<sys/types.h>
#include<sys/socket.h>
#include<netinet/in.h>
#include<netdb.h>
#include<arpa/inet.h>
#include<string.h>
#include<string.h>
#include<stdio.h>
int main(int asrgc,char*argv[])
{
```

```
        int bd,sd,ad;
        char buff[1024];
        struct sockaddr_in cliaddr,servaddr;
        socklen_t clilen;
        clilen=sizeof(cliaddr);
        bzero(&servaddr,sizeof(servaddr));

    /*Socket address structure*/
        servaddr.sin_family=AF_INET;
        servaddr.sin_addr.s_addr=htonl(INADDR_ANY);
        servaddr.sin_port=htons(1999);

    /*TCP socket is created, an Internet socket address structure is filled with wildcard address &
    server's well known port*/
        sd=socket(AF_INET,SOCK_STREAM,0);

   /*Bind function assigns a local protocol address to the socket*/
        bd=bind(sd,(struct sockaddr*)&servaddr,sizeof(servaddr));

    /*Listen function specifies the maximum number of connections that kernel should queue for
    this socket*/
        listen(sd,5);
       printf("Server is running….\n");

    /*The server to return the next completed connection from the front of the
    completed connection Queue calls it*/
        ad=accept(sd,(struct sockaddr*)&cliaddr,&clilen);
    while(1)
    {
        bzero(&buff,sizeof(buff));
       /*Receiving the request message from the client*/
       recv(ad,buff,sizeof(buff),0);
       printf("Message received is %s\n",buff);
     }
}
```

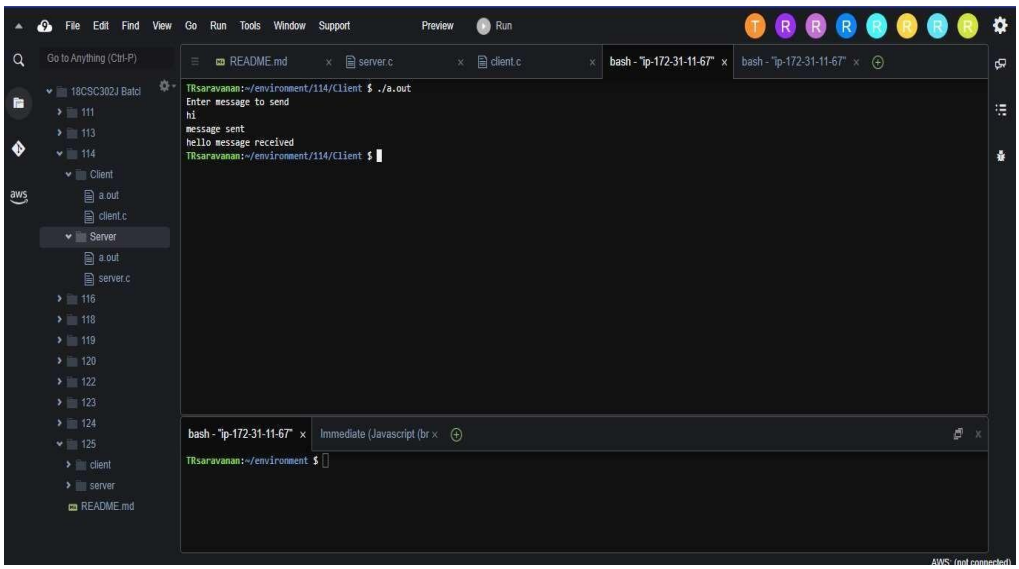
Client: tcpclient.c

```
    #include<stdio.h>
    #include<string.h>
    #include<sys/socket.h>
    #include<sys/types.h>
    #include<unistd.h>
    #include<netinet/in.h>
    #include<netdb.h>
    #include<arpa/inet.h>
    int main(int argc,char * argv[])
    {
        int cd,sd,ad;
        char buff[1024];
        struct sockaddr_in cliaddr,servaddr;
        struct hostent *h;
     /*This function looks up a hostname and it returns a pointer to a hostent
    structure that contains all the IPV4 address*/
```

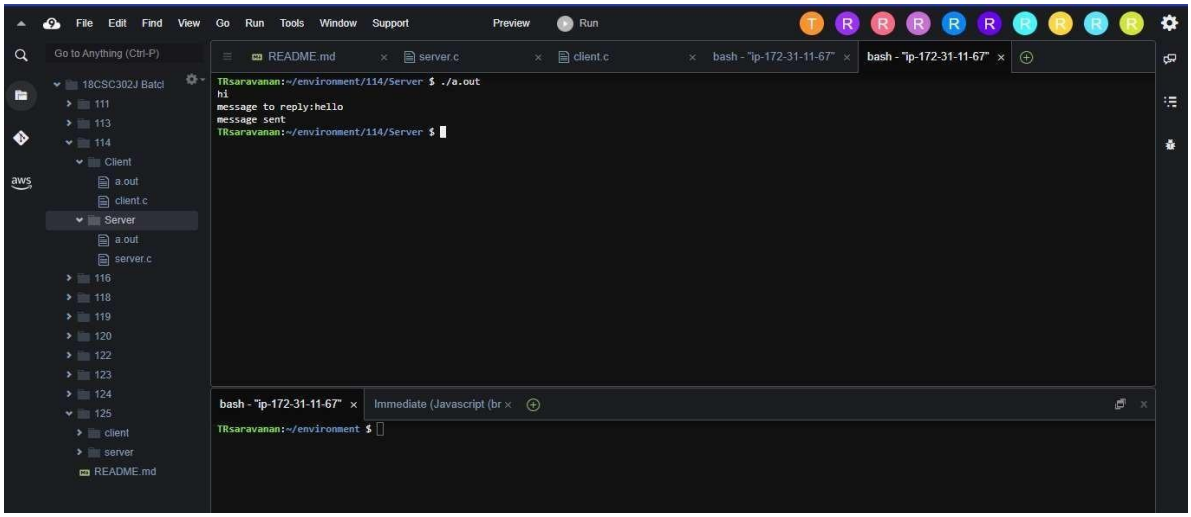
```
        h=gethostbyname(argv[1]);
        bzero(&servaddr,sizeof(servaddr));

    /*Socket address structure*/
        servaddr.sin_family=AF_INET;
        memcpy((char *)&servaddr.sin_addr.s_addr,h->h_addr_list[0],h->h_length);
        servaddr.sin_port = htons(1999);

   /*Creating a socket, assigning IP address and port number for that socket*/
        sd = socket(AF_INET,SOCK_STREAM,0);

    /*Connect establishes connection with the server using server IP address*/
        cd=connect(sd,(struct sockaddr*)&servaddr,sizeof(servaddr));
    while(1)
    {
       printf("Enter the message: \n");

        /*Reads the message from standard input*/
        fgets(buff,100,stdin);

      /*Send function is used on client side to send data given by user on client
      side to the server*/
       send(sd,buff,sizeof(buff)+1,0);
       printf("\n Data Sent ");
       //recv(sd,buff,strlen(buff)+1,0);
       printf("%s",buff);
       }
}
```

OUTPUT :

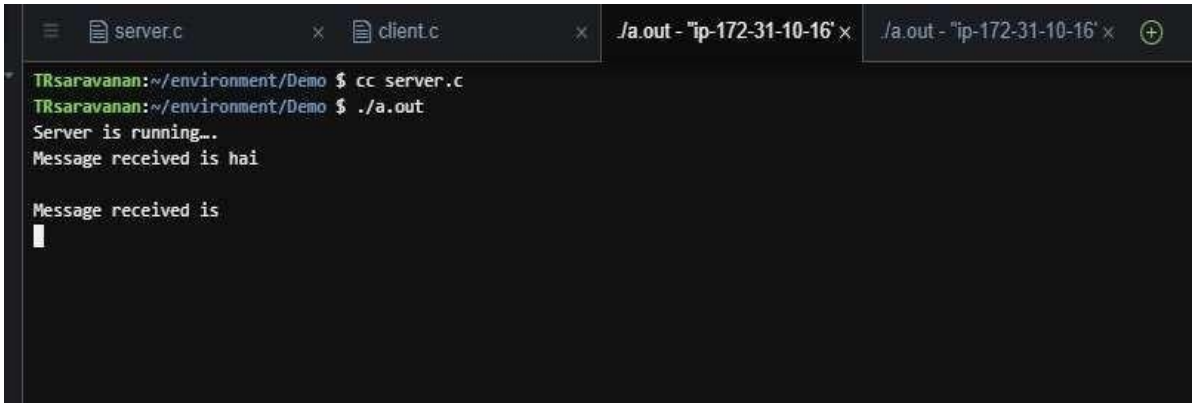
Client Output:

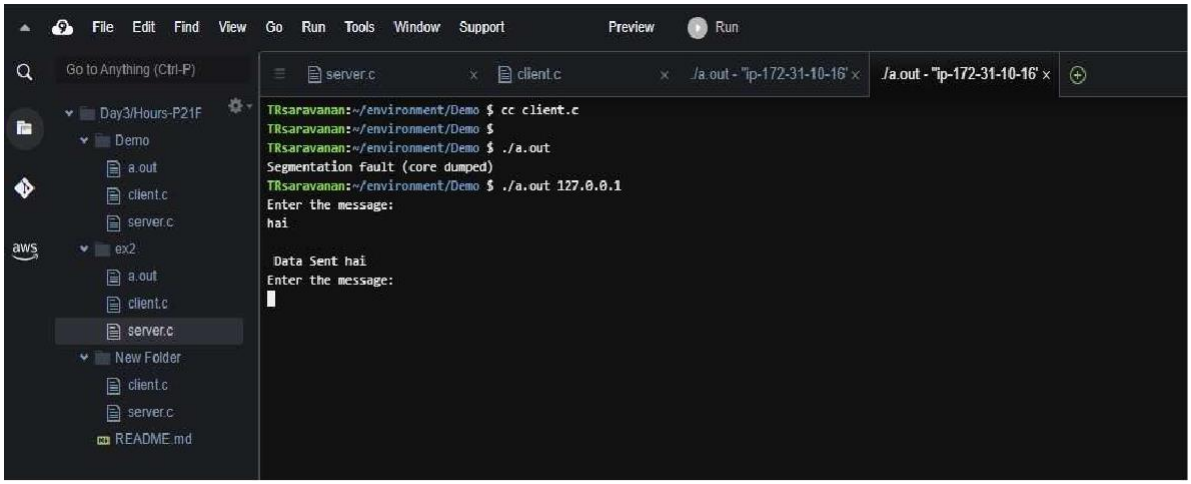


Server Output:



Execution Procedure when we receive Segmentation Fault:





RESULT: Hence, the TPC/IP server client experiment is studied and performed.

Ex.No:3	UDP ECHO CLIENT SERVER COMMUNICATION
Date:	

Aim:

There are two hosts, Client and Server. The Client accepts the message from the user and sends it to the Server. The Server receives the message, prints it and echoes the message back to the Client.

TECHNICAL OBJECTIVE:

To implement an UDP Echo Client-Server application , where the Client on establishing a connection with the Server, sends a string to the Server. The Server reads the String, prints it and echoes it back to the Client.

METHODOLOGY:

Server:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_DGRAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET, sin_addr to INADDR_ANY, sin_port to SERVER_PORT, a macro defined port number.
- Bind the local host address to socket using the bind function.
- Within an infinite loop, receive message from the client using recvfrom function, print it on the console and send (echo) the message back to the client using sendto function.

Client:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_DGRAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET.
- Get the server IP address from the console.
- Using gethostbyname function assign it to a hostent structure, and assign it to sin_addr of the server address structure.
- Within an infinite loop, read message from the console and send the message to the server using the sendto function.
- Receive the echo message using the recvfrom function and print it on the console.

CODING:

Server:

```
#include<sys/socket.h>
#include<stdio.h>
#include<unistd.h>
#include<string.h>
#include<netinet/in.h>
#include<netdb.h>
#include<arpa/inet.h>
#include<sys/types.h>
int main(int argc,char *argv[])
{
        int sd;
```

```
        char buff[1024];
        struct sockaddr_in cliaddr,servaddr;
        socklen_t clilen;
        clilen=sizeof(cliaddr);

/*UDP socket is created, an Internet socket address structure is filled with wildcard
address & server's well known port*/
        sd=socket(AF_INET,SOCK_DGRAM,0);
if (sd<0)
{
        perror ("Cannot open Socket");
        exit(1);
 }
        bzero(&servaddr,sizeof(servaddr));
 /*Socket address structure*/
        servaddr.sin_family=AF_INET;
        servaddr.sin_addr.s_addr=htonl(INADDR_ANY);
        servaddr.sin_port=htons(5669);

 /*Bind function assigns a local protocol address to the socket*/
 if(bind(sd,(struct sockaddr*)&servaddr,sizeof(servaddr))<0)
 {
      perror("error in binding the port");
      exit(1);
 }
        printf("%s","Server is Running…\n");
 while(1)
 {
        bzero(&buff,sizeof(buff));

         /*Read the message from the client*/
        if(recvfrom(sd,buff,sizeof(buff),0,(struct sockaddr*)&cliaddr,&clilen)<0)
        {
                perror("Cannot rec data");
                exit(1);
         }
        printf("Message is received \n",buff);

        /*Sendto function is used to echo the message from server to client side*/
        if(sendto(sd,buff,sizeof(buff),0,(struct sockadddr*)&cliaddr,clilen)<0)
        {
                perror("Cannot send data to client");
                exit(1);
        }
         printf("Send data to UDP Client: %s",buff);
 }
 cloSe(sd);
 return 0;
}
```

Client:

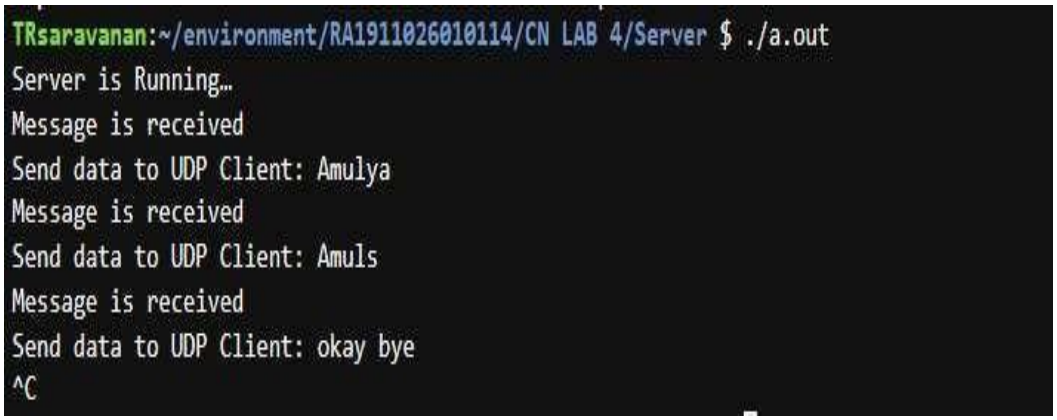
```
#include<sys/types.h>
#include<sys/socket.h>
#include<stdio.h>
#include<unistd.h>
#include<string.h>
#include<netinet/in.h>
#include<netdb.h>
int main(int argc,char*argv[])
{
        int sd;
        char buff[1024];
        struct sockaddr_in servaddr;
        socklen_t len;
        len=sizeof(servaddr);

/*UDP socket is created, an Internet socket address structure is filled with
wildcard address & server's well known port*/
        sd = socket(AF_INET,SOCK_DGRAM,0);
 if(sd<0)
 {
        perror("Cannot open socket");
        exit(1);
 }
        bzero(&servaddr,len);

 /*Socket address structure*/
        servaddr.sin_family=AF_INET;
        servaddr.sin_addr.s_addr=htonl(INADDR_ANY);
        servaddr.sin_port=htons(5669);
 while(1)
 {
        printf("Enter Input data : \n");
        bzero(buff,sizeof(buff));

         /*Reads the message from standard input*/
        fgets(buff,sizeof (buff),stdin);

         /*sendto is used to transmit the request message to the server*/
        if(sendto (sd,buff,sizeof (buff),0,(struct sockaddr*)&servaddr,len)<0)
        {
                perror("Cannot send data");
                exit(1);
         }
        printf("Data sent to UDP Server:%s",buff);
        bzero(buff,sizeof(buff));
        /*Receiving the echoed message from server*/
        if(recvfrom (sd,buff,sizeof(buff),0,(struct sockaddr*)&servaddr,&len)<0)
         {
                perror("Cannot receive data");
               exit(1);
         }
```

```
            printf("Received Data from server: %s",buff);
        }
            close(sd);
            return 0;
    }
```

Sample Output:

Server :

Client :



Result :

Thus, the UDP ECHO client server communication is established by sending the message from the client to the server and server prints it and echoes the message back to the client.

Ex.No:5	CONCURRENT TCP/IP DAY-TIME SERVER
Date:	

Aim:

There are two hosts, Client and Server. The Client requests the concurrent server for the date and time. The Server sends the date and time, which the Client accepts and prints.

TECHNICAL OBJECTIVE:

To implement a TCP/IP day time server (concurrent server) that handles multiple client requests. Once the client establishes connection with the server, the server sends its day-time details to the client which the client prints in its console.

METHODOLOGY:

TCP Server :

- ➢ Create Socket address structure.
- ➢ TCP/UDP socket is created, an Internet socket address structure is filled with wildcard address & server's well known port.
- ➢ Bind function assigns a local protocol address to the socket.
- ➢ Listen function specifies the maximum number of connections that kernel should queue for this socket.
- ➢ The server to return the next completed connection from the front of the completed connection Queue calls it.
- ➢ Receiving the request message from the client.

TCP Client :

- ➢ This function looks up a hostname and it returns a pointer to a hostent structure that contains all the IPV4 address.
- ➢ Create Socket address structure. Creating a socket, assigning IP address and port number for that socket.
- ➢ Connect establishes connection with the server using server IP address.
- ➢ Reads the message from standard input.
- ➢ Send function is used on client side to send data given by user on client side to the server.

Server:

```
#include<netinet/in.h>
#include<sys/socket.h>
#include<stdio.h>
#include<string.h>
#include<time.h>
#include<stdlib.h>
int main()
{
        struct sockaddr_in sa;
        struct sockaddr_in cli;
```

```
        int sockfd,conntfd;
        int len,ch;
        char str[100];
        time_t tick;
        sockfd=socket(AF_INET,SOCK_STREAM,0);
    if(sockfd<0)
    {
        printf("error in socket\n");
        exit(0);
    }
    else
        printf("Socket opened");
        bzero(&sa,sizeof(sa));
        sa.sin_port=htons(5600);
        sa.sin_addr.s_addr=htonl(0);
    if(bind(sockfd,(struct sockaddr*)&sa,sizeof(sa))<0)
    {
        printf("Error in binding\n");
    }
    else
        printf("Binded Successfully");
        listen(sockfd,50);
    for(;;)
    {
        len=sizeof(ch);
        conntfd=accept(sockfd,(struct sockaddr*)&cli,&len);
        printf("Accepted");
        tick=time(NULL);
        snprintf(str,sizeof(str),"%s",ctime(&tick));
        printf("%s",str);write(conntfd,str,100);
    }
    }
```

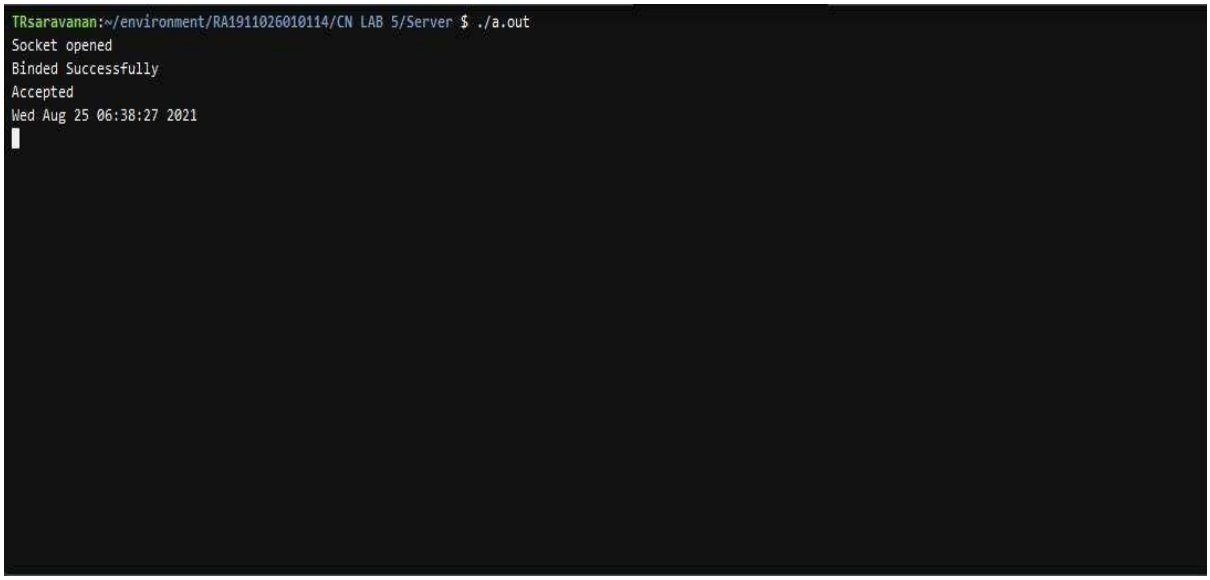
Client:

```
    #include <netinet/in.h>
    #include <sys/socket.h>
    #include <stdio.h>
    #include <stdlib.h>
    int main()
    {
        struct sockaddr_in sa,cli;
        int n,sockfd;
        int len;char buff[100];
        sockfd=socket(AF_INET,SOCK_STREAM,0);
        if(sockfd<0)
    {
```

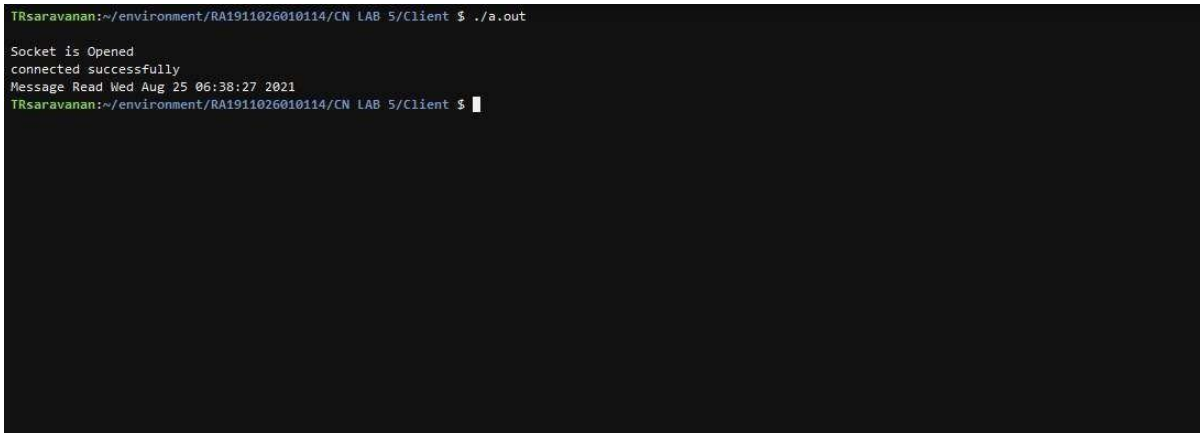
```
            printf("\nError in Socket");
            exit(0);
    }
    else
            printf("\nSocket is Opened");
            bzero(&sa,sizeof(sa));
            sa.sin_family=AF_INET;
            sa.sin_port=htons(5600);
    if(connect(sockfd,(struct sockaddr*)&sa,sizeof(sa))<0)
    {
            printf("\nError in connection failed");
            exit(0);
    }
    else
            printf("\nconnected successfully");
    if(n=read(sockfd,buff,sizeof(buff))<0)
    {
            printf("\nError in Reading");
            exit(0);
    }
    else
    {
            printf("\nMessage Read %s",buff);
    }
    }
```

Sample Output:

Server Side :



Client Side :



Result :

Thus the concurrent daytime client- server communication is established by sending the request message from the client to the concurrent server and the server sends its time to all the clients and displays it.

Ex.No:6	HALF DUPLEX CHAT USING TCP/IP
Date:	

Aim :

There are two hosts, Client and Server. Both the Client and the Server exchange message i.e. they send messages or receive message from the other. There is only a single way communication between them.

TECHNICAL OBJECTIVE:

To implement a half duplex application, where the Client establishes a connection with the Server. The Client can send and the server well receive messages at the same time.

Server:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_STREAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET, sin_addr to INADDR_ANY, sin_port to dynamically assigned port number.
- Bind the local host address to socket using the bind function.
- Listen on the socket for connection request from the client.
- Accept connection request from the Client using accept function.
- Fork the process to receive message from the client and print it on the console.
- Read message from the console and send it to the client.

Client:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_STREAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET.
- Get the server IP address and the Port number from the console.
- Using gethostbyname function assign it to a hostent structure, and assign it to sin_addr of the server address structure.
- Request a connection from the server using the connect function.
- Fork the process to receive message from the server and print it on the console.
- Read message from the console and send it to the server.

Codes:

Server:

```
#include "stdio.h"
#include "stdlib.h"
#include "string.h"
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <unistd.h>
#include "netdb.h"
#include "arpa/inet.h"
```

```
#define MAX 1000
#define BACKLOG 5
int main()
{
        char serverMessage[MAX];
        char clientMessage[MAX];
        int  socketDescriptor = socket(AF_INET, SOCK_STREAM, 0);
        struct sockaddr_inserverAddress;
        serverAddress.sin_family = AF_INET;
        serverAddress.sin_port = htons(5214);
        serverAddress.sin_addr.s_addr = INADDR_ANY;
        bind(socketDescriptor, (struct sockaddr*)&serverAddress, sizeof(serverAddress));
        listen(socketDescriptor, BACKLOG);
        int clientSocketDescriptor = accept(socketDescriptor, NULL, NULL);
while (1)
{
        printf("\ntext message here .. :");
        scanf("%s", serverMessage);
        send(clientSocketDescriptor, serverMessage, sizeof(serverMessage) , 0);
        recv(clientSocketDescriptor, &clientMessage, sizeof(clientMessage), 0) ;
        printf("\nCLIENT: %s", clientMessage);

 }
        close(socketDescriptor);
        return 0;
}
```

Client:

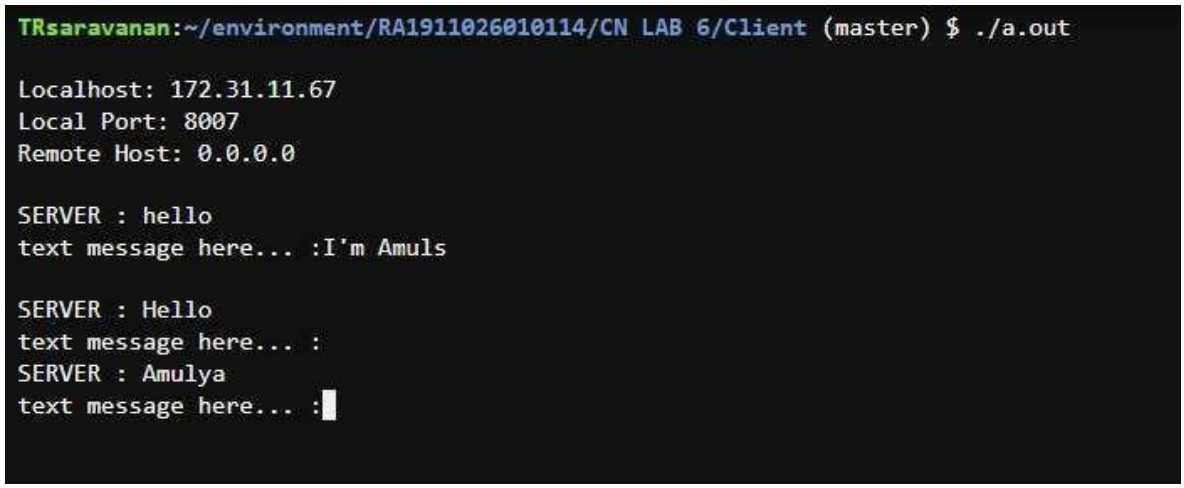
```
#include "stdio.h"
#include "stdlib.h"
#include "string.h"
#include <sys/types.h>
#include <sys/socket.h>
include <netinet/in.h>
#include <unistd.h>
#include "netdb.h"
#include "arpa/inet.h"
#define h_addrh_addr_list[0]
#define PORT 5214
#define MAX 1000
int main(){
char clientResponse[MAX];
int socketDescriptor = socket(AF_INET, SOCK_STREAM, 0);
char hostname[MAX], ipaddress[MAX];
struct hostent *hostIP;
f(gethostname(hostname,sizeof(hostname))==0){
        hostIP = gethostbyname(hostname);
}
else{
        printf("ERROR:FCC4539 IP Address Not ");
}
struct sockaddr_inserverAddress;
serverAddress.sin_family = AF_INET;
```

```
serverAddress.sin_port = htons(PORT);
serverAddress.sin_addr.s_addr = INADDR_ANY;
connect(socketDescriptor, (struct sockaddr *)&serverAddress, sizeof(serverAddress));
printf("\nLocalhost: %s\n", inet_ntoa(*(struct in_addr*)hostIP->h_addr));
printf("Local Port: %d\n", PORT);
printf("Remote Host: %s\n", inet_ntoa(serverAddress.sin_addr));
while (1)
{
        recv(socketDescriptor, serverResponse, sizeof(serverResponse), 0);
        printf("\nSERVER : %s", serverResponse);
        printf("\ntext message here... :");
        scanf("%s", clientResponse);
        send(socketDescriptor, clientResponse, sizeof(clientResponse), 0);
}
close(socketDescriptor);
return 0;
}
```

Sample Output:

Server:

Client:



Result :

Thus the chat application full duplex communication is established by sending the request from the client to the server, server gets the message and gives response to the client and prints it.

Ex.No:7	FULL DUPLEX CHAT USING TCP/IP
Date:	

Aim:

There are two hosts, Client and Server. Both the Client and the Server exchange message i.e. they send messages to and receive message from the other. There is a two way communication between them.

TECHNICAL OBJECTIVE:

To implement a full duplex application, where the Client establishes a connection with the Server. The Client and Server can send as well as receive messages at the same time. Both the Client and Server exchange messages.

Algorithm :

Server:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_STREAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET, sin_addr to INADDR_ANY, sin_port to dynamically assigned port number.
- Bind the local host address to socket using the bind function.
- Listen on the socket for connection request from the client.
- Accept connection request from the Client using accept function.
- Fork the process to receive message from the client and print it on the console.
- Read message from the console and send it to the client.

Client:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_STREAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET.
- Get the server IP address and the Port number from the console.
- Using gethostbyname function assign it to a hostent structure, and assign it to sin_addr of the server address structure.
- Request a connection from the server using the connect function.
- Fork the process to receive message from the server and print it on the console.
- Read message from the console and send it to the server.

Codes:

Server:

```
#include<sys/types.h>
#include<sys/socket.h>
#include<stdio.h>
#include<unistd.h>
#include<netdb.h>
#include<arpa/inet.h>
#include<netinet/in.h>
#include<string.h>
```

```
int main(int argc,char *argv[])
{
        int clientSocketDescriptor,socketDescriptor;
        struct sockaddr_inserverAddress,clientAddress;
        socklen_tclientLength;
        char recvBuffer[8000],sendBuffer[8000];
        pid_tcpid;
        bzero(&serverAddress,sizeof(serverAddress));
        /*Socket address structure*/
        serverAddress.sin_family=AF_INET;
        serverAddress.sin_addr.s_addr=htonl(INADDR_ANY);
        serverAddress.sin_port=htons(9652);
        /*TCP socket is created, an Internet socket address structure is filled with
        wildcard address & server's well known port*/
        socketDescriptor=socket(AF_INET,SOCK_STREAM,0);
        /*Bind function assigns a local protocol address to the socket*/
        bind(socketDescriptor,(struct sockaddr*)&serverAddress,sizeof(serverAddress));
        /*Listen function specifies the maximum number of connections that kernel should queue
        for this socket*/
        listen(socketDescriptor,5);
        printf("%s\n","Server is running ...");
        /*The server to return the next completed connection from the front of the
        completed connection Queue calls it*/
        clientSocketDescriptor=accept(socketDescriptor,(struct
        sockaddr*)&clientAddress,&clientLength);
        /*Fork system call is used to create a new process*/
        cpid=fork();
        if(cpid==0)
        {
                while(1)
                {
                        bzero(&recvBuffer,sizeof(recvBuffer));
                        /*Receiving the request from client*/
                        recv(clientSocketDescriptor,recvBuffer,sizeof(recvBuffer),0);
                        printf("\nCLIENT : %s\n",recvBuffer);
                }
        }
        else
        {
        while(1)
        {
                bzero(&sendBuffer,sizeof(sendBuffer));
                printf("\nType a message here ...  ");
                /*Read the message from client*/
```

```
                fgets(sendBuffer,80000,stdin);
                /*Sends the message to client*/
                send(clientSocketDescriptor,sendBuffer,strlen(sendBuffer)+1,0);
                printf("\nMessage sent !\n");
        }
        }
        return 0;
        }
```

Client:

```
        #include  "stdio.h"
        #include "stdlib.h"
        #include "string.h"
        //headers for socket and related functions
        #include <sys/types.h>
        #include <sys/socket.h>
        //for including structures which will store information needed
        #include <netinet/in.h>
        #include <unistd.h>
        //for gethostbyname
        #include "netdb.h"
        #include "arpa/inet.h"
        int main()
        {
                int socketDescriptor;
                struct sockaddr_inserverAddress;
                char sendBuffer[8000],recvBuffer[8000];
                pid_tcpid;
                bzero(&serverAddress,sizeof(serverAddress));
                serverAddress.sin_family=AF_INET;
                serverAddress.sin_addr.s_addr=inet_addr("127.0.0.1");
                serverAddress.sin_port=htons(9652);
                /*Creating a socket, assigning IP address and port number for that socket*/
                socketDescriptor=socket(AF_INET,SOCK_STREAM,0);
                /*Connect establishes connection with the server using server IP address*/
                connect(socketDescriptor,(struct sockaddr*)&serverAddress,sizeof(serverAddress));
                /*Fork is used to create a new process*/
                cpid=fork();
                if(cpid==0)
                {
                        while(1)
                        {
                                bzero(&sendBuffer,sizeof(sendBuffer));
                                printf("\nType a message here ...  ");
                                /*This function is used to read from server*/
                                fgets(sendBuffer,80000,stdin);
```

```
                        /*Send the message to server*/
                        send(socketDescriptor,sendBuffer,strlen(sendBuffer)+1,0);
                        printf("\nMessage sent !\n");
        }
        }
        else
        {
                while(1)
                {
                        bzero(&recvBuffer,sizeof(recvBuffer));
                        /*Receive the message from server*/
                        recv(socketDescriptor,recvBuffer,sizeof(recvBuffer),0);
                        printf("\nSERVER : %s\n",recvBuffer);
                }
        }
        return 0;
        }
```

Output:

Server:

```
RA1911026010118:~/environment/RA1911026010114/CN LAB 7/Server (master) $ cc server.c
RA1911026010118:~/environment/RA1911026010114/CN LAB 7/Server (master) $ ./a.out
Server is running ...

Type a message here ...
CLIENT : hello


CLIENT : amuls
```

Client:

```
RA1911026010118:~/environment/RA1911026010114/CN LAB 7/Client (master) $ cc client.c
RA1911026010118:~/environment/RA1911026010114/CN LAB 7/Client (master) $ ./a.out

Type a message here ...  hello

Message sent !

Type a message here ...  amuls

Message sent !

Type a message here ...
```

Result:

Thus the chat application full duplex communication is established by sending the request from the client to the server, server gets the message and gives response to the client and prints it.

Ex.No:8	IMPLEMENTATION OF FILE TRANSFER PROTOCOL
Date:	

Aim :

There are two hosts, Client and Server. The Client sends the name of the file it needs from the Server and the Server sends the contents of the file to the Client, where it is stored in a file.

TECHNICAL OBJECTIVE:

To implement FTP application, where the Client on establishing a connection with the Server sends the name of the file it wishes to access remotely. The Server then sends the contents of the file to the Client, where it is stored.

METHODOLOGY:

Server :

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_STREAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET, sin_addr to INADDR_ANY, sin_port to dynamically assigned port number.
- Bind the local host address to socket using the bind function.
- Listen on the socket for connection request from the client.
- Accept connection request from the Client using accept function.
- Within an infinite loop, receive the file from the client.
- Open the file, read the file contents to a buffer and send the buffer to the Client.

TCP Client :

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_STREAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin_family to AF_INET, sin_addr to INADDR_ANY, sin_port to dynamically assigned port number.
- Bind the local host address to socket using the bind function.
- Listen on the socket for connection request from the client.
- Accept connection request from the Client using accept function.
- Within an infinite loop, send the name of the file to be viewed to the Server.
- Read the file contents, store it in a file and print it on the console.

Codes :

Server:

```
#include  "stdio.h"
#include "stdlib.h"
#include "string.h"
//headers for socket and related functions
#include <sys/types.h>
```

```
#include <sys/socket.h>
#include <sys/stat.h>
//for including structures which will store information needed
#include <netinet/in.h>
#include <unistd.h>
//for gethostbyname
#include "netdb.h"
#include "arpa/inet.h"
// defining constants
#define PORT 6969
#define BACKLOG 5
int main()
{
        int size;
        int socketDescriptor = socket(AF_INET, SOCK_STREAM, 0);
        struct sockaddr_in serverAddress, clientAddress;
        socklen_t clientLength;
        struct stat statVariable;
        char buffer[100], file[1000];
        FILE *filePointer;
        bzero(&serverAddress, sizeof(serverAddress));
       serverAddress.sin_family = AF_INET;
       serverAddress.sin_addr.s_addr = htonl(INADDR_ANY);
       serverAddress.sin_port = htons(PORT);
        bind(socketDescriptor, (struct sockaddr *)&serverAddress, sizeof(serverAddress));
       listen(socketDescriptor,BACKLOG);
       printf("%s\n","Server is running ...");
       int clientDescriptor = accept(socketDescriptor,(struct
       sockaddr*)&clientAddress,&clientLength);
       while(1){
               bzero(buffer,sizeof(buffer));
               bzero(file,sizeof(file));
               recv(clientDescriptor,buffer,sizeof(buffer),0);
               filePointer = fopen(buffer,"r");
               stat(buffer,&statVariable);
               size=statVariable.st_size;
               fread(file,sizeof(file),1,filePointer);
               send(clientDescriptor,file,sizeof(file),0);
}
       return 0;
}
```

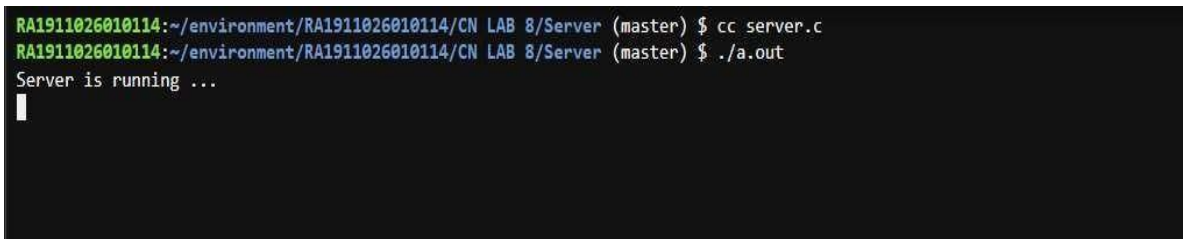
Client:

```
#include  "stdio.h"
#include "stdlib.h"
#include "string.h"
```

```
//headers for socket and related functions
#include <sys/types.h>
#include <sys/socket.h>
#include <sys/stat.h>
//for including structures which will store information needed
#include <netinet/in.h>
#include <unistd.h>
//for gethostbyname
#include "netdb.h"
#include "arpa/inet.h"
// defining constants
#define PORT 6969
int main()
{
        int serverDescriptor = socket(AF_INET, SOCK_STREAM, 0);
        struct sockaddr_in serverAddress;
        char buffer[100], file[1000];
        bzero(&serverAddress, sizeof(serverAddress));
        erverAddress.sin_family = AF_INET;
        serverAddress.sin_addr.s_addr = inet_addr("127.0.0.1");
        serverAddress.sin_port = htons(PORT);
        connect(serverDescriptor,(struct sockaddr*)&serverAddress,sizeof(serverAddress));
while (1){
        printf("File name : ");
        scanf("%s",buffer);
        send(serverDescriptor,buffer,strlen(buffer)+1,0);
        printf("%s\n","File Output : ");
        recv(serverDescriptor,&file,sizeof(file),0);
        printf("%s",file);
        }
return 0;
}
```

Output:

Server:



Client:

```
RA1911026010114:~/environment/RA1911026010114/CN LAB 8/Client (master) $ cc client.c
RA1911026010114:~/environment/RA1911026010114/CN LAB 8/Client (master) $ ./a.out
File name : send.txt
File Output :
We are from SRM
File name :
```

Result :

Thus the FTP client-server communication is established and data is transferred between the client and server machines.

Ex.No:9	REMOTE COMMAND EXECUTION USING UDP
Date:	

Aim:

There are two hosts, Client and Server. The Client sends a command to the Server, which executes the command and sends the result back to the Client.

TECHNICAL OBJECTIVE:

Remote Command execution is implemented through this program using which Client is able to execute commands at the Server. Here, the Client sends the command to the Server for remote execution. The Server executes the command and the send result of the execution back to the Client.

METHODOLOGY:

Server:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_DGRAM.
- Initialize server address to 0 using the bzero function.
- Assign the sin _family to AF_INET, sin_addr to INADDR_ANY, sin _port to dynamicallyassigned port number.
- Bind the local host using the bind() system call.
- Within an infinite loop, receive the command to be executed from the client.
- Append text "> temp.txt" to the command.
- Execute the command using the "system()" system call.
- Send the result of execution to the Client using a file buffer.

Client:

- Include the necessary header files.
- Create a socket using socket function with family AF_INET, type as SOCK_DGRAM.
- Initialize server address to O using the bzero function.
- Assign the sin family to AF_INET.
- Get the server IP address and the Port number from the console.
- Using gethostbyname() function assign it to a hostent structure, and assign it to sin_addr of the server address structure.
- Obtain the command to be executed in the server from the user.
- Send the command to the server.
- Receive the output from the server and print it on the console.

Codes:

Server:

```
#include <sys/types.h>
#include <sys/socket.h>
#include <stdio.h>
#include <stdlib.h>
#include <netdb.h>
#include <netinet/in.h>
#include <string.h>
#include <sys/stat.h>
#include <arpa/inet.h>
#include <unistd.h>
#define MAX 1000
int main()
{
        int serverDescriptor = socket(AF_INET, SOCK_DGRAM, 0);
         int size;
        char buffer[MAX], message[] = "Command Successfully executed !";
        struct sockaddr_in clientAddress, serverAddress;
        socklen_t clientLength = sizeof(clientAddress);
        bzero(&serverAddress, sizeof(serverAddress));
        serverAddress.sin_family = AF_INET;
        serverAddress.sin_addr.s_addr = htonl(INADDR_ANY);
        serverAddress.sin_port = htons(8079);
        bind(serverDescriptor, (struct sockaddr *)&serverAddress, sizeof(serverAddress));
while (1)
{
        bzero(buffer, sizeof(buffer));
        recvfrom(serverDescriptor, buffer, sizeof(buffer), 0, (struct sockaddr *)&clientAddress,
        &clientLength);
        system(buffer);
        printf("Command Executed ... %s ", buffer);
        sendto(serverDescriptor, message, sizeof(message), 0, (struct sockaddr *)&clientAddress,
        clientLength);
}
        close(serverDescriptor);
        return 0;
}
```

Client:

```
#include <sys/types.h>
#include <sys/socket.h>
#include <stdio.h>
#include <unistd.h>
```

```
#include <netdb.h>
#include <netinet/in.h>
#include <string.h>
#include <arpa/inet.h>
#define MAX 1000
int main()
{
        int serverDescriptor = socket(AF_INET, SOCK_DGRAM, 0);
        char buffer[MAX], message[MAX];
        struct sockaddr_in cliaddr, serverAddress;
        socklen_t serverLength = sizeof(serverAddress);
        bzero(&serverAddress, sizeof(serverAddress));
        serverAddress.sin_family = AF_INET;
        serverAddress.sin_addr.s_addr = inet_addr("127.0.0.1");
        serverAddress.sin_port = htons(8079);
        bind(serverDescriptor, (struct sockaddr *)&serverAddress, sizeof(serverAddress));
while (1)
{
        printf("\nCOMMAND FOR EXECUTION ... ");
        fgets(buffer, sizeof(buffer), stdin);
        sendto(serverDescriptor, buffer, sizeof(buffer), 0, (struct sockaddr *)&serverAddress,
        serverLength);
        printf("\nData Sent !");
        recvfrom(serverDescriptor, message, sizeof(message), 0, (struct sockaddr
        *)&serverAddress, &serverLength);
        printf("UDP SERVER : %s", message);
}
return 0;
}
```

Output:

Server:

```
RA1911026010114:~/environment/RA1911026010114/CN LAB 9/SERVER (master) $ cc server.c
RA1911026010114:~/environment/RA1911026010114/CN LAB 9/SERVER (master) $ ./a.out
Command Executed ... vi text.txt
a.out  server.c  text.txt
 Command Executed ... ls
Hi my name is Amulya
Nice to meet you.
How are you?
Have a great day.
Bye bye

 Command Executed ... cat text.txt
```

Client:

```
RA1911026010114:~/environment/RA1911026010114/CN LAB 9/CLIENT (master) $ cc client.c
RA1911026010114:~/environment/RA1911026010114/CN LAB 9/CLIENT (master) $ ./a.out

COMMAND FOR EXECUTION ... vi text.txt

Data Sent !UDP SERVER : Command Successfully executed !
COMMAND FOR EXECUTION ... ls

Data Sent !UDP SERVER : Command Successfully executed !
COMMAND FOR EXECUTION ... cat text.txt

Data Sent !UDP SERVER : Command Successfully executed !
COMMAND FOR EXECUTION ...
```

Result :

Thus the Remote Command Execution between the client and server is implemented.

Ex.No:10	ARP IMPLEMENTATION USING UDP
Date:	

Aim :

There is a single host. The IP address of any Client in the network is given as input and the corresponding hardware address is got as the output.

TECHNICAL OBJECTIVE:

Address Resolution Protocol (ARP) is implemented through this program. The IP address of any Client is given as the input. The ARP cache is looked up for the corresponding hardware address. This is returned as the output. Before compiling that Client is pinged.

METHODOLOGY:

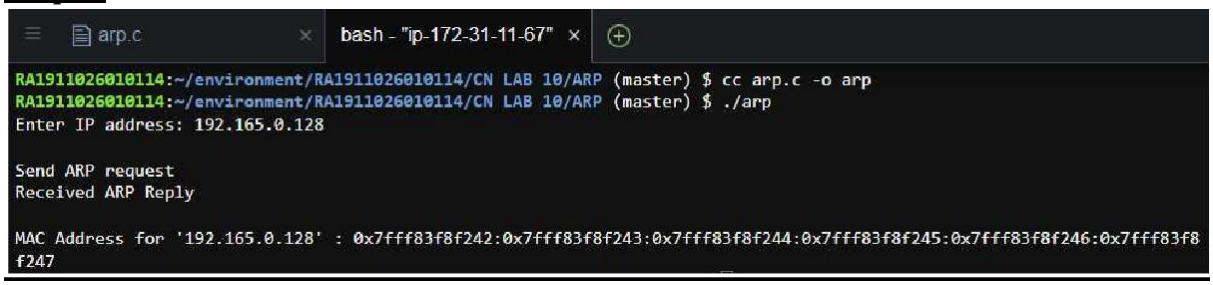
- Start
- Declare the variables and structure for the socket
- Specify the family, protocol, IP address and port number
- Create a socket using socket() function
- Call memcpy() and strcpy functions
- Display the MAC address
- Stop.

Code:

```
#include<sys/types.h>
#include<sys/socket.h>
#include<net/if_arp.h>
#include<sys/ioctl.h>
#include<stdio.h>
#include<string.h>
#include<unistd.h>
#include<math.h>
#include<complex.h>
#include<arpa/inet.h>
#include<netinet/in.h>
#include<netinet/if_ether.h>
#include<net/ethernet.h>
#include<stdlib.h>
int main()
{
        struct sockaddr_in sin={0};
        struct arpreq myarp={{0}};
        unsigned char *ptr;
        int sd;
        sin.sin_family=AF_INET;
        printf("Enter IP address: ");
        char ip[20];
        scanf("%s", ip);
```

```
if(inet_pton(AF_INET,ip,&sin.sin_addr)==0)
{
        printf("IP address Entered '%s' is not valid \n",ip);
        exit(0);
}
memcpy(&myarp.arp_pa,&sin,sizeof(myarp.arp_pa));
strcpy(myarp.arp_dev,"echo");
d=socket(AF_INET,SOCK_DGRAM,0);
printf("\nSend ARP request\n");
if(ioctl(sd,SIOCGARP,&myarp)==1)
{
        printf("No Entry in ARP cache for '%s'\n",ip);
        exit(0);
}
ptr=&myarp.arp_pa.sa_data[0];
printf("Received ARP Reply\n");
printf("\nMAC Address for '%s' : ",ip);
printf("%p:%p:%p:%p:%p:%p\n",ptr,(ptr+1),(ptr+2),(ptr+3),(ptr+4),(ptr+5));
return 0;
}
```

Output:



Result :

Henceforth, Address Resolution Protocol (ARP) is implemented using UDP

Ex.No:11	STUDY OF IPV6 ADDRESSING & SUBNETTING
Date:	

AIM:

To Study the IPV6 Addressing and Subnetting

What is IPv6:

As the number of internet devices—also known as the Internet of Things (IoT)—increases around the world, more IP addresses are needed for these devices to communicate data. Consider smartphones, smartwatches, refrigerators, washing machines, smart TVs, and other electronic devices that require an IP address. All of these devices are now linked to the internet and have a unique IP address assigned to them. We'll focus on IPv6, its characteristics, and why it'll be the Internet Protocol standard in this quick overview.

Before we go into the technicalities, there are a few things to know about IPv6:

1. IPv6 addresses are 128-bit (2128) and allow for 3.4 x 1038 unique IP addresses.
2. IPv6 is written in hexadecimal notation, with the colons separating eight groups of 16 bits, for a total of 8 x 16 = 128, or bits. The following is an example of an IPv6 address:

➢ **Syntax of IPv6 Addresses:**

IPv4 addresses are represented in dotted-decimal format. The 32-bit address is divided along 8-bit boundaries. Each set of 8 bits is converted to its decimal equivalent and separated by periods. In contrast, IPv6 addresses are 128 bits divided along 16-bit boundaries. Each 16-bit block is converted to a 4-digit hexadecimal number and separated by colons. The resulting representation is called colon-hexadecimal.

– The preferred form is x:x:x:x:x:x:x:x, where the x's are the hexadecimal values of the eight 16-bit pieces of the address. For example:

```
FEDC:BA98:7654:3210:FEDC:BA98:7654:3210

1080:0:0:0:8:800:200C:417A
```

➢ **The Addressing Space:**

The amount of memory dedicated to all potential addresses for a computational object, such as a device, a file, a server, or a networked computer, is known as address space. A range of physical or virtual addresses accessible to a processor or reserved for a process is referred to as address space. Each address defines an entity's location as a unique identifier of single entities (unit of memory that can be addressed separately). Each computer device and process is given address space on the computer, which is a piece of the processor's address space. The address space of a processor is always constrained by the width of its address bus and registers. Flat address space, in which addresses are expressed as continuously growing integers starting at zero, and segmented address space, in which addresses are written as discrete segments enhanced by offsets, are the two types of address space (values added to produce secondary addresses). Thunking is a procedure that allows address space to be changed from one format to another in some systems.

In terms of IP address space, there has been concern that IPv4 (Internet Protocol Version 4) had not anticipated the enormous growth of the Internet, and that its 32-bit address space would not be adequate. For that reason, IPv6 has been developed with 128-bit address space.

Allocation of the IPv6 addressing space:

Allocation	Prefix (binary)	Fraction of Address Space
Reserved	0000 0000	1/256
Unassigned	0000 0001	1/256
Reserved for NSAP addresses	0000 001	1/128
Reserved for IPX addresses	0000 010	1/128
Unassigned	0000 011	1/128
Unassigned	0000 1	1/32
Unassigned	0001	1/16
Aggregatable global unicast addresses	001	1/8
Unassigned	010	1/8
Unassigned	011	1/8
Reserved for Geographic-based addresses	100	1/8
Unassigned	101	1/8
Unassigned	110	1/8
Unassigned	1110	1/16
Unassigned	1111 0	1/32
Unassigned	1111 10	1/64
Unassigned	1111 110	1/128
Unassigned	1111 1110 0	1/512
Link Local addresses	1111 1110 10	1/1024

- **Types of IPv6 Addresses:**

Generally, IPv6 addresses is classified into 3. They are:

1. Unicast: This type is the address of a single interface. A packet forwarded to a unicast address is delivered only to the interface identified by that address.
2. Anycast: This type is the address of a set of interfaces typically belonging to different nodes. A packet forwarded to an anycast address is delivered to only one interface of the set (the nearest to the source node, according to the routing metric).
3. Multicast: This type is the address of a set of interfaces that typically belong to different nodes. A packet forwarded to a multicast address is delivered to all interfaces belonging to the set.

1. Unicast Addresses:

A unicast address identifies a single interface. When a network device sends a packet to a unicast address, the packet goes only to the specific interface identified by that address. Unicast addresses support a global address scope and two types of local address scopes.

A unicast address consists of *n* bits for the prefix, and 128 – *n* bits for the interface ID.

- Global unicast address—A unique IPv6 address assigned to a host interface. These addresses have a global scope and essentially the same purposes as IPv4 public addresses. Global unicast addresses are routable on the Internet.
- Link-local IPv6 address—An IPv6 address that allows communication between neighboring hosts that reside on the same link. Link-local addresses have a local scope, and cannot be used outside the link. They always have the prefix FE80::/10.
- Loopback IPv6 address—An IPv6 address used on a loopback interfaces. The IPv6 loopback address is 0:0:0:0:0:0:0:1, which can be notated as ::1/128.
- Unspecified address—An IPv6 unspecified address is 0:0:0:0:0:0:0:0, which can be notated as ::/128.

1. Aggregatable Global Unicast Addresses:
   Aggregate global unicast addresses are used for global communication. These addresses are similar in function to IPv4 addresses under classless interdomain routing (CIDR). The following table shows their format.

3 bits	45 bits	16 bits	64 bits
001	global routing prefix	subnet ID	interface ID

2. Geographic-Based Addresses:
   Geography addresses are those determined by country of origin. This type of address is only available in the IPv4 address category. The data address table includes a ‘scope’ and a ‘authority‘

Scope	Authority
Multiregional	IANA
Europe	RIPE-NCC
Northern America	INTERNIC
Asia and Pacific	APNIC

3. Link Local Addresses:
   A link-local address is a network address that is valid only for communications within the network segment or the broadcast domain that the host is connected to. Link-local addresses are most often assigned automatically with a process known as stateless address autoconfiguration or link-local address autoconfiguration,[1] also known as automatic private IP addressing (APIPA) or auto-IP.

4. Site Local Addresses:

Site-local addresses are designed to be used for addressing inside of a site without the need for a global prefix. A site-local address cannot be reached from another site. A site-local address is not automatically assigned to a node. It must be assigned using automatic or manual configuration.

5. The Unspecified Address:
   The address 0:0:0:0:0:0:0:0 is called the unspecified address. It will not be assigned to any node. It indicates the absence of an address. One example of its use is in the Source Address field of any IPv6 packets sent by an initializing host before it has learned its own address.

6. The Loopback Address:
   The IP address 127.0.0.1 is called a loopback address. Packets sent to this address never reach the network but are looped through the network interface card only. This can be used for diagnostic purposes to verify that the internal path through the TCP/IP protocols is working.

7. NSAP Addresses:
   Short for Network Service Access Point, NSAP is an address consisting of up to 20 octets that identify a computer or network connected to an ATM network. NSAP is defined in ISO/IEC 8348.

8. IPX Addresses:
   Internetwork Packet Exchange (IPX) is the network layerprotocol in the IPX/SPXprotocol suite. IPX is derived from Xerox Network Systems' IDP. It may act as a transport layer protocol as well.

2. Anycast Address:

An anycast address identifies a set of interfaces that typically belong to different nodes. Anycast addresses are similar to multicast addresses, except that packets are sent only to one interface, not to all interfaces. The routing protocol used in the network usually determines which interface is physically closest within the set of anycast addresses and routes the packet along the shortest path to its destination.

There is no difference between anycast addresses and unicast addresses except for the subnet-router address. For an anycast subnet-router address, the low-order bits, typically 64 or more, are zero. Anycast addresses are taken from the unicast address space.

3. Multicast Addresses:

A multicast address identifies a set of interfaces that typically belong to different nodes. When a network device sends a packet to a multicast address, the device broadcasts the packet to all interfaces identified by that address. IPv6 does not support broadcast addresses, but instead uses multicast addresses in this role.

Multicast addresses support 16 different types of address scope, including node, link, site, organization, and global scope. A 4-bit field in the prefix identifies the address scope.

The following types of multicast addresses can be used in an IPv6 subscriber access network:

- Solicited-node multicast address—Neighbor Solicitation (NS) messages are sent to this address.
- All-nodes multicast address—Router Advertisement (RA) messages are sent to this address.
- All-routers multicast address—Router Solicitation (RS) messages are sent to this address.

➢ **Which addresses are generally used for a node?**

1. Addresses of a Host:

- Its Link Local address for each interface
- Unicast addresses assigned to interfaces
- The loopback address
- All-Nodes multicast address
- Neighbor Discovery multicast addresses associated with all uni-cast and anycast addresses assigned to interfaces
- Multicast Addresses of groups to which the node belongs

2. Addresses of a Router:

- Its Link Local address for each interface
- Unicast addresses assigned to interfaces
- The loopback address
- The Subnet Router anycast address for all links on which it has interfaces
- Other anycast addresses assigned to interfaces
- All-nodes multicast address
- All-routers multicast address
- Neighbor Discovery multicast addresses associated with all uni-cast and anycast addresses assigned to interfaces
- Multicast addresses of groups to which the node belongs

Result :

Hence Study of IPV6 Addressing & Subnetting is completed sucessfully

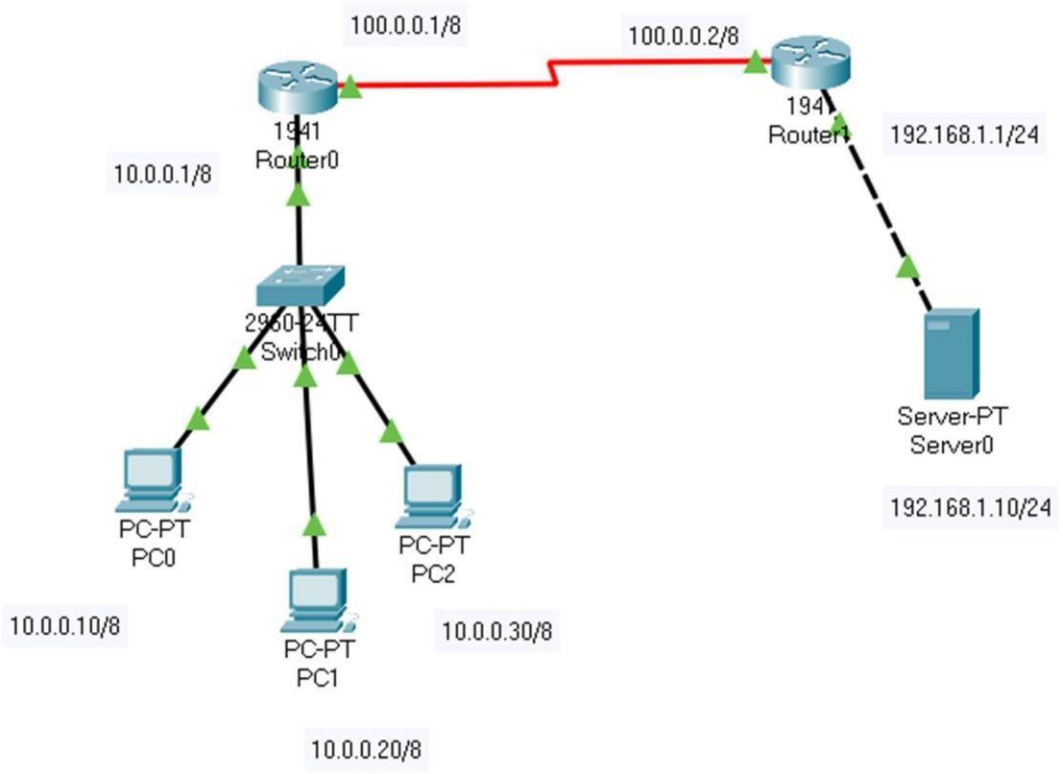
Ex.No:12	IMPLEMENTATION OF NETWORK ADDRESS TRANSLATION
Date:	

Aim:

To study and perform Network Address Translation (NAT) using cisco packet tracer.

Procedure:

1. Assign the following topology with respective IP addresses to pc, routers, servers and connection between them.



2. Configure static NAT configuration

Since static NAT use manual translation, we have to map each inside local IP address (which needs a translation) with inside global IP address. Following command is used to map the inside local IP address with inside global IP address.

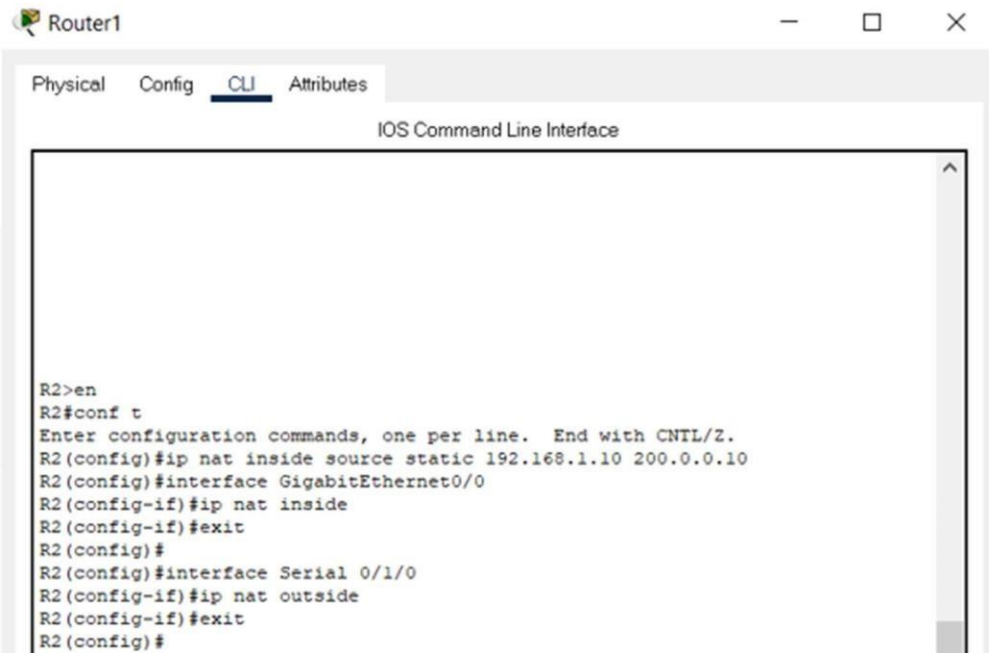
```
Router(config)#ip nat inside source static [inside local ip address] [inside global IP address]
```

And use the following commands to define inside and outside network connection for your local and global IP addresses.

```
Router(config-if)#ip nat inside
Router(config-if)#ip nat outside
```

Static NAT configuration for Router0 connected with 3 pc's:

Static NAT configuration for Router0 connected with server:



3. Configure the IP routing

IP routing is the process which allows router to route the packet between different networks.

IP routing on router0:

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip route 200.0.0.0 255.255.255.0 100.0.0.2
R1(config)#no shutdown
                ^
```

IP routing on router1:

```
R2(config)#
R2(config)#ip route 50.0.0.0 255.0.0.0 100.0.0.1
```

4. Testing Static NAT Configuration

To test this setup click on any PC and Desktop and click Command Prompt.

- Run ipconfig command.
- Run ping 200.0.0.10 command.
- Run ping 192.168.1.10 command

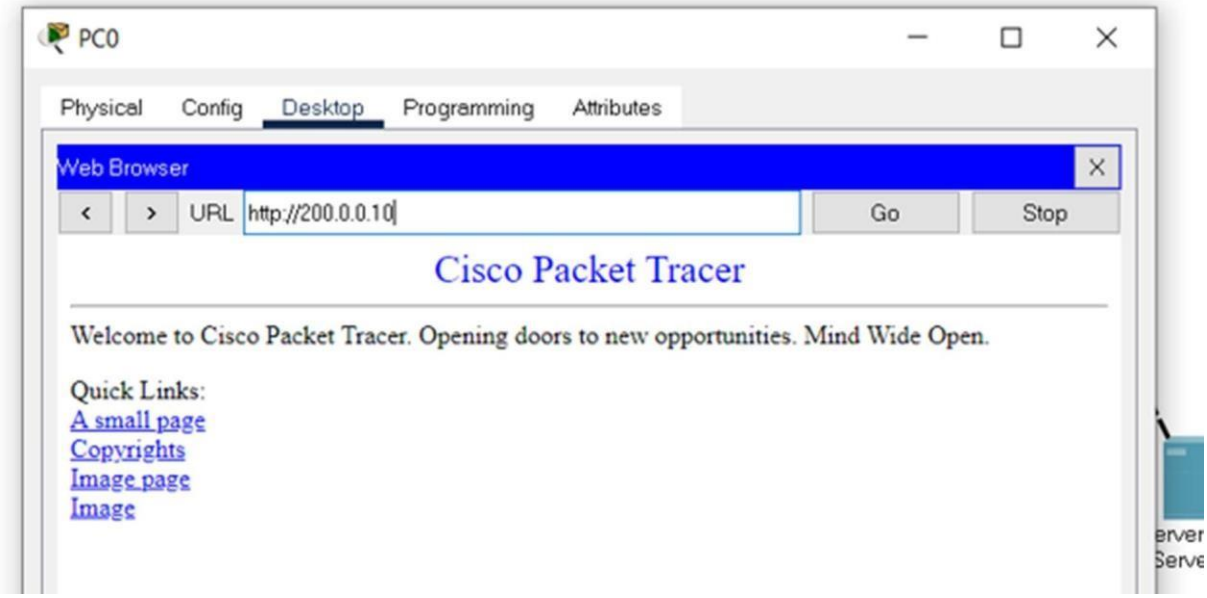
First command verifies that we are testing from correct NAT device.

Second command checks whether we are able to access the remote device or not. A ping reply confirms that we are able to connect with remote device on this IP address.

Third command checks whether we are able to access the remote device on its actual IP address or not. A ping error confirms that we are not able to connect with remote device on this IP address.

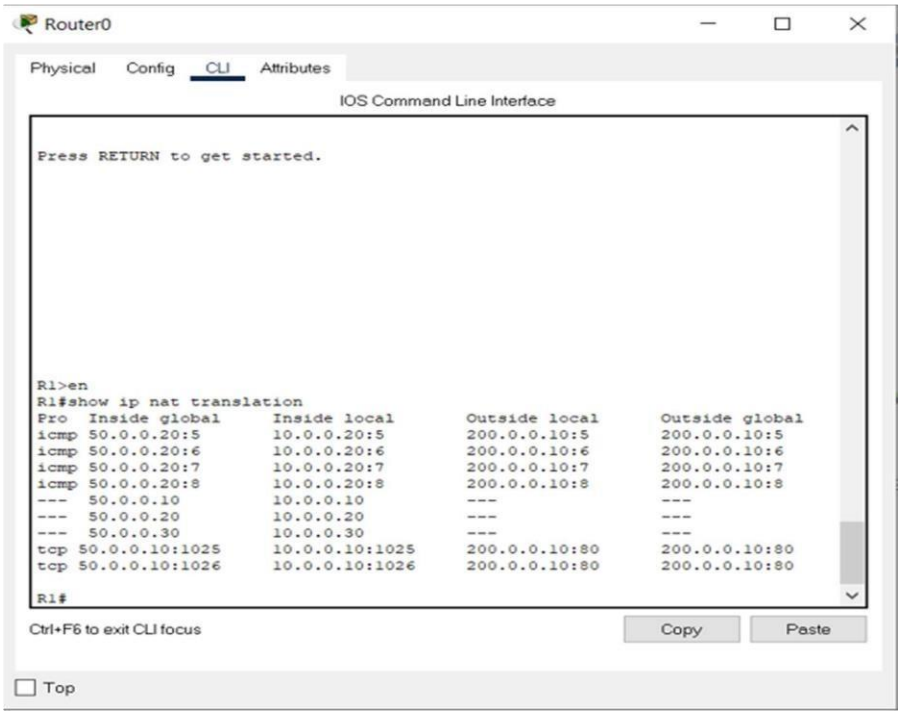

PC0
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Reply from 10.0.0.1: Destination host unreachable.
Ping statistics for 192.168.1.10:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>ipconfig
FastEthernet0 Connection:(default port)
Connection-specific DNS Suffix..:
Link-local IPv6 Address.....: FE80::260:47FF:FE93:623B
IPv6 Address.....: ::
IPv4 Address.....: 10.0.0.10
Subnet Mask.....: 255.0.0.0
Default Gateway.....: ::
10.0.0.1
Bluetooth Connection:
Connection-specific DNS Suffix..:
Link-local IPv6 Address.....: ::
IPv6 Address.....: ::
IPv4 Address.....: 0.0.0.0
Subnet Mask.....: 0.0.0.0
Default Gateway.....: ::
0.0.0.0
C:\>ping 200.0.0.10
Pinging 200.0.0.10 with 32 bytes of data:
Reply from 200.0.0.10: bytes=32 time=10ms TTL=126
Reply from 200.0.0.10: bytes=32 time=1ms TTL=126
Reply from 200.0.0.10: bytes=32 time=2ms TTL=126
Reply from 200.0.0.10: bytes=32 time=8ms TTL=126
Ping statistics for 200.0.0.10:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 1ms, Maximum = 10ms, Average = 5ms
C:\>ping 192.168.1.10
Pinging 192.168.1.10 with 32 bytes of data:
Reply from 10.0.0.1: Destination host unreachable.
Reply from 10.0.0.1: Destination host unreachable.
Reply from 10.0.0.1: Destination host unreachable.
Reply from 10.0.0.1: Destination host unreachable.
Ping statistics for 192.168.1.10:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>
Top

Another way of testing is via browser:



We can also verify this translation on router with ***show ipnat translation*** command.

For router0:



For router1:

```
R2#show ip nat translation
Pro  Inside global     Inside local       Outside local      Outside global
---  200.0.0.10        192.168.1.10       ---                ---
tcp 200.0.0.10:80      192.168.1.10:80    50.0.0.10:1025     50.0.0.10:1025
tcp 200.0.0.10:80      192.168.1.10:80    50.0.0.10:1026     50.0.0.10:1026

R2#
```

Result:

Henceforth, Network Address Translation (NAT) using cisco packet tracer implemented and verified.

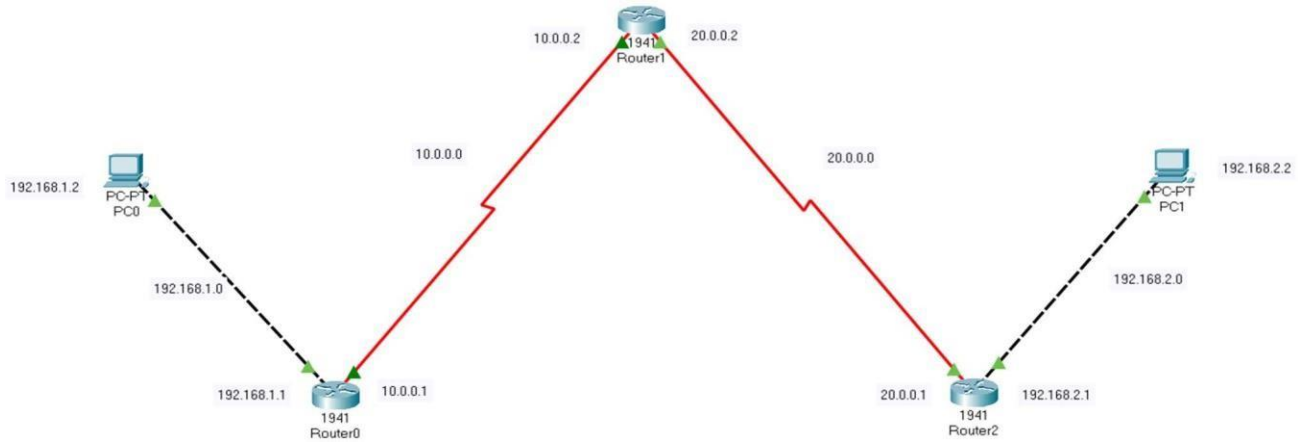
Ex.No:13	IMPLEMENTATION OF VPN
Date:	

AIM :

To configure VPN using routers in Cisco Packet Tracer.

PROCEDURE :

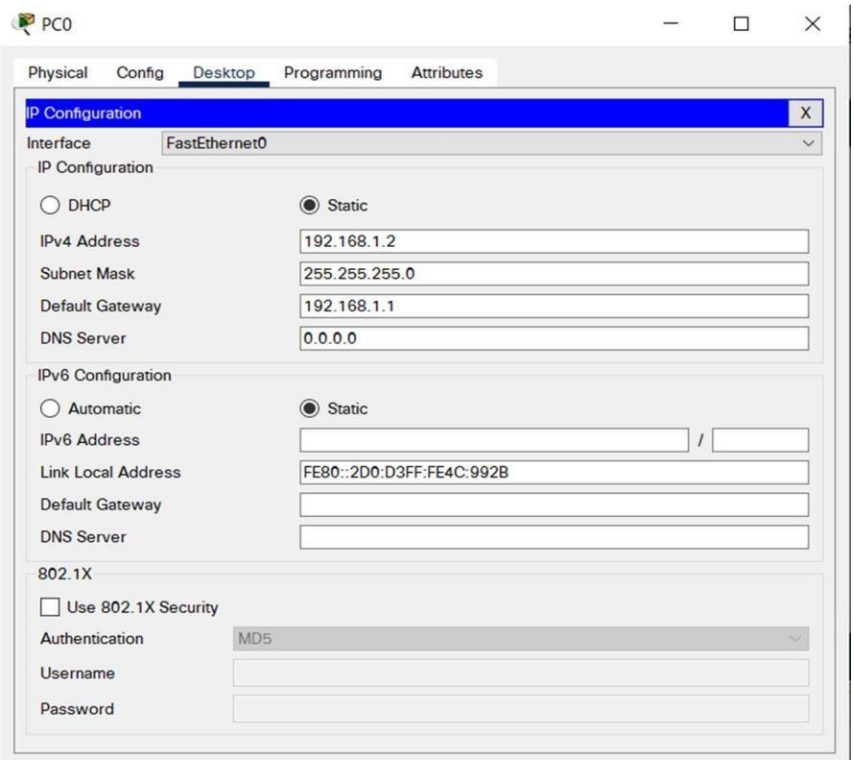
1 . Connect the devices as shown in the below figure.



2 . Initial IP configuration.

Device / Interface	IP Address	Connected with
PC0 / Fa0	192.168.1.2 /24	Router1 / Gig0/0
PC1 / Fa0	192.168.2.2 /24	Router2 / Gig0/0
Router1 / Se0/1/0	10.0.0.1 /8	Router 2 / Se0/1/0
Router2 / Se0/1/0	10.0.0.2 /8	Router 1 / Se0/1/0
Router2 / Se0/1/1	20.0.0.1 /8	Router3 / Se0/1/0
Router3 / Se0/1/0	20.0.0.2 /8	Router2 / Se0/1/1

3 .To assign IP address in Laptop click Laptop and click Desktop and IP configuration and Select Static and set IP address as given in above table.



Following the same way, configure the IP address in PC1.

4. We have to assign ip address on each and every interface of router

CONFIGURATION ON ROUTER1:

```
Router>enable

Router#config t

Router(config)#int gig0/0

Router(config-if)#ip add 192.168.1.1 255.255.255.0

Router(config-if)#no shut

Router(config-if)#exit

Router(config)#int se0/1/0

Router(config-if)#ip address 10.0.0.1 255.0.0.0

Router(config-if)#no shut
```

CONFIGURATION ON ROUTER2:

```
Router>enable
Router#config t
Router(config)#int se0/1/0
Router(config-if)#ip add 10.0.0.2 255.0.0.0
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#int se0/1/1
Router(config-if)#ip add 20.0.0.1 255.0.0.0
Router(config-if)#no shut
```

CONFIGURATION ON ROUTER3:

```
Router>enable
Router#config t
Router(config)#int se0/1/0
Router(config-if)#ip add 20.0.0.2 255.0.0.0
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#int gig0/0
Router(config-if)#ip add 192.168.2.1 255.255.255.0
Router(config-if)#no shut
```

5. Now it's time to do routing. Here we have to configure default routing.

DEFAULT ROUTING CONFIGURATION ON ROUTER1:

```
Router>enable
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip route 0.0.0.0 0.0.0.0 10.0.0.2
Router(config)#
```

DEFAULT ROUTING CONFIGURATION ON ROUTER3:

```
Router>enable
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip route 0.0.0.0 0.0.0.0 20.0.0.1
Router(config)#
```

6. NOW CHECK THE CONNECTION BY PINGING EACH OTHER.

First we go to Router1 and ping with Router3:

```
Router#ping 20.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 26/28/33 ms
```

Now we go to Router3 and test the network by pinging Router1 interface.

```
Router#ping 10.0.0.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.1, timeout is 2 seconds:
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 25/28/32 ms
```

You can clearly see both routers pinging each other successfully.

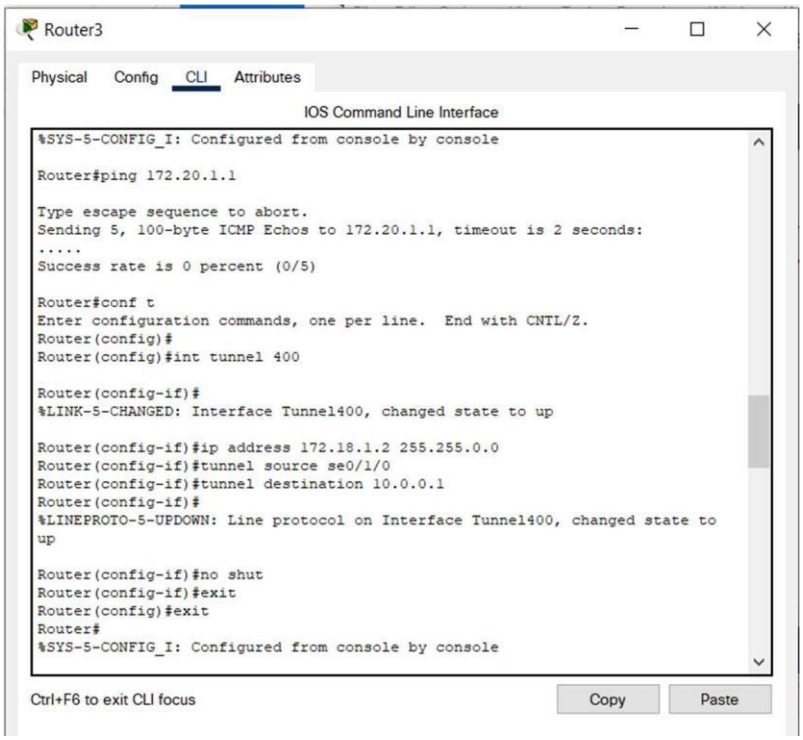
7. NOW CREATE VPN TUNNEL between Router1 and Router3:

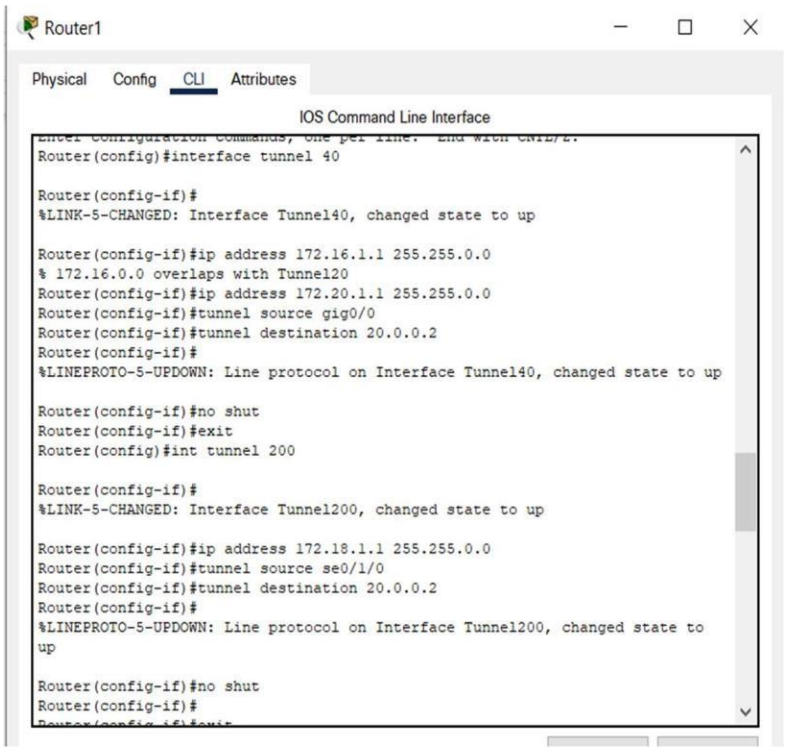
FIRST CREATE A VPN TUNNEL ON ROUTER1:

```
Router#config t
Router(config)#interface tunnel 200
Router(config-if)#ip address 172.18.1.1 255.255.0.0
Router(config-if)#tunnel source se0/1/0
Router(config-if)#tunnel destination 20.0.0.2
Router(config-if)#no shut
```

NOW CREATE A VPN TUNNEL ON ROUTER R3:

```
Router#config t
Router(config)#interface tunnel 400
Router(config-if)#ip address 172.18.1.2 255.255.0.0
Router(config-if)#tunnel source se0/1/0
Router(config-if)#tunnel destination 10.0.0.1
Router(config-if)#no shut
```


Router3
Physical
Config
CLI
Attributes
IOS Command Line Interface
%SYS-5-CONFIG_I: Configured from console by console
Router#ping 172.20.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.20.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#int tunnel 400
Router(config-if)#
%LINK-5-CHANGED: Interface Tunnel400, changed state to up
Router(config-if)#ip address 172.18.1.2 255.255.0.0
Router(config-if)#tunnel source se0/1/0
Router(config-if)#tunnel destination 10.0.0.1
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel400, changed state to up
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
Ctrl+F6 to exit CLI focus
Copy
Paste


Router1
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router(config)#interface tunnel 40
Router(config-if)#
%LINK-5-CHANGED: Interface Tunnel40, changed state to up
Router(config-if)#ip address 172.16.1.1 255.255.0.0
% 172.16.0.0 overlaps with Tunnel20
Router(config-if)#ip address 172.20.1.1 255.255.0.0
Router(config-if)#tunnel source gig0/0
Router(config-if)#tunnel destination 20.0.0.2
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel40, changed state to up
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#int tunnel 200
Router(config-if)#
%LINK-5-CHANGED: Interface Tunnel200, changed state to up
Router(config-if)#ip address 172.18.1.1 255.255.0.0
Router(config-if)#tunnel source se0/1/0
Router(config-if)#tunnel destination 20.0.0.2
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel200, changed state to up
Router(config-if)#no shut
Router(config-if)#

8. Now test communication between these two routers again by pinging each other:

Router1

```
Router#ping 172.18.1.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 172.18.1.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 30/32/36 ms

Router#
```

Router2

```
Router#ping 172.18.1.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 172.18.1.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 33/45/83 ms
```

9. Now do routing for created VPN Tunnel on Both Router1 and Router3:

```
Router(config)#ip route 192.168.2.0 255.255.255.0 172.18.1.2

Router(config)#ip route 192.168.1.0 255.255.255.0 172.18.1.1
```

10. TEST VPN TUNNEL CONFIGURATION:

Now we have to test whether tunnel is created or not for Router1

```
Router#show interfaces Tunnel 200

Tunnel200 is up, line protocol is up (connected)

Hardware is Tunnel

Internet address is 172.18.1.1/16
```

MTU 17916 bytes, BW 100 Kbit/sec, DLY 50000 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation TUNNEL, loopback not set

Keepalive not set

Tunnel source 10.0.0.1 (FastEthernet0/1), destination 20.0.0.2

Tunnel protocol/transport GRE/IP

Key disabled, sequencing disabled

Checksumming of packets disabled

Tunnel TTL 255

Fast tunneling enabled

Tunnel transport MTU 1476 bytes

Tunnel transmit bandwidth 8000 (kbps)

Tunnel receive bandwidth 8000 (kbps)

Last input never, output never, output hang never

Last clearing of "show interface" counters never

Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 1

Queueing strategy: fifo

Output queue: 0/0 (size/max)

5 minute input rate 32 bits/sec, 0 packets/sec

5 minute output rate 32 bits/sec, 0 packets/sec

52 packets input, 3508 bytes, 0 no buffer

Received 0 broadcasts, 0 runts, 0 giants, 0 throttles

0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort

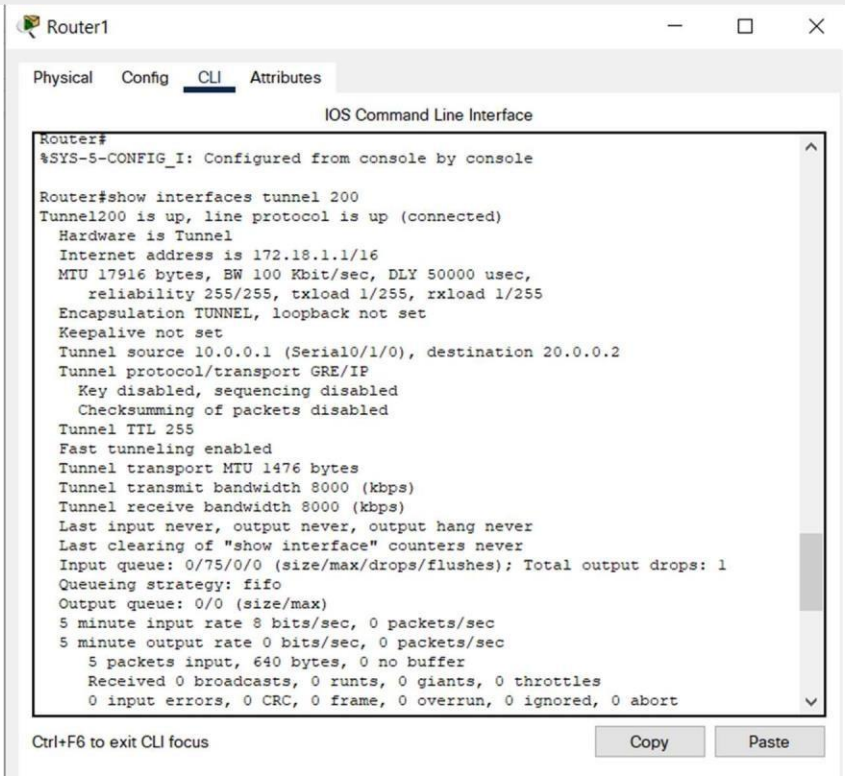
0 input packets with dribble condition detected

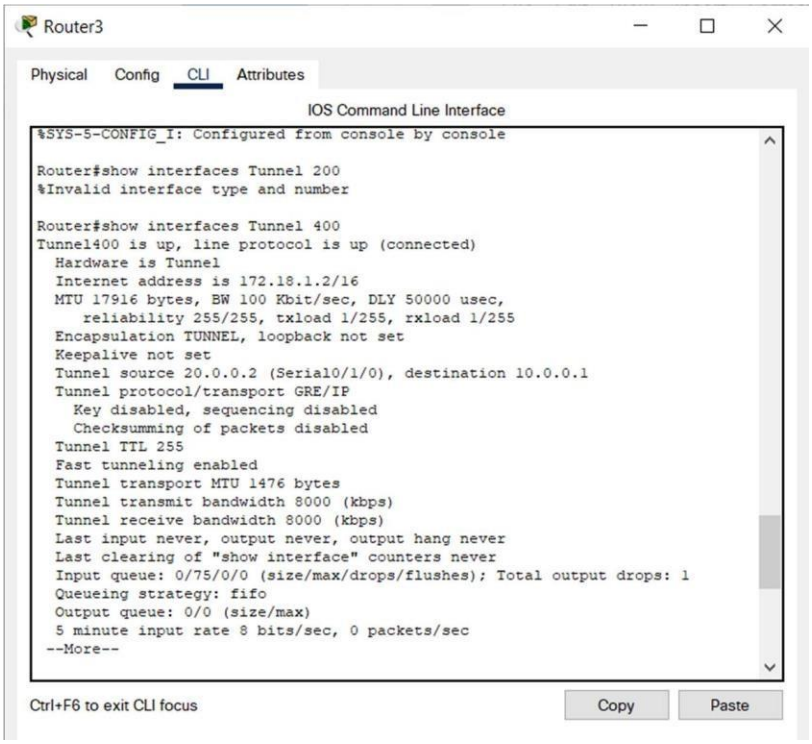
52 packets output, 3424 bytes, 0 underruns

0 output errors, 0 collisions, 0 interface resets

0 unknown protocol drops

0 output buffer failures, 0 output buffers swapped out





Now going to Router3 and test VPN Tunnel Creation:

```
Router #show interface Tunnel 400
Tunnel400 is up, line protocol is up (connected)
Hardware is Tunnel
Internet address is 172.18.1.2/16
MTU 17916 bytes, BW 100 Kbit/sec, DLY 50000 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation TUNNEL, loopback not set
Keepalive not set
Tunnel source 20.0.0.2 (FastEthernet0/0), destination 10.0.0.1
Tunnel protocol/transport GRE/IP
Key disabled, sequencing disabled
Checksumming of packets disabled
Tunnel TTL 255
Fast tunneling enabled
Tunnel transport MTU 1476 bytes
Tunnel transmit bandwidth 8000 (kbps)
Tunnel receive bandwidth 8000 (kbps)
Last input never, output never, output hang never
Last clearing of "show interface" counters never
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 1
Queueing strategy: fifo


Output queue: 0/0 (size/max)
5 minute input rate 32 bits/sec, 0 packets/sec
```

5 minute output rate 32 bits/sec, 0 packets/sec

52 packets input, 3424 bytes, 0 no buffer

Received 0 broadcasts, 0 runts, 0 giants, 0 throttles

0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort

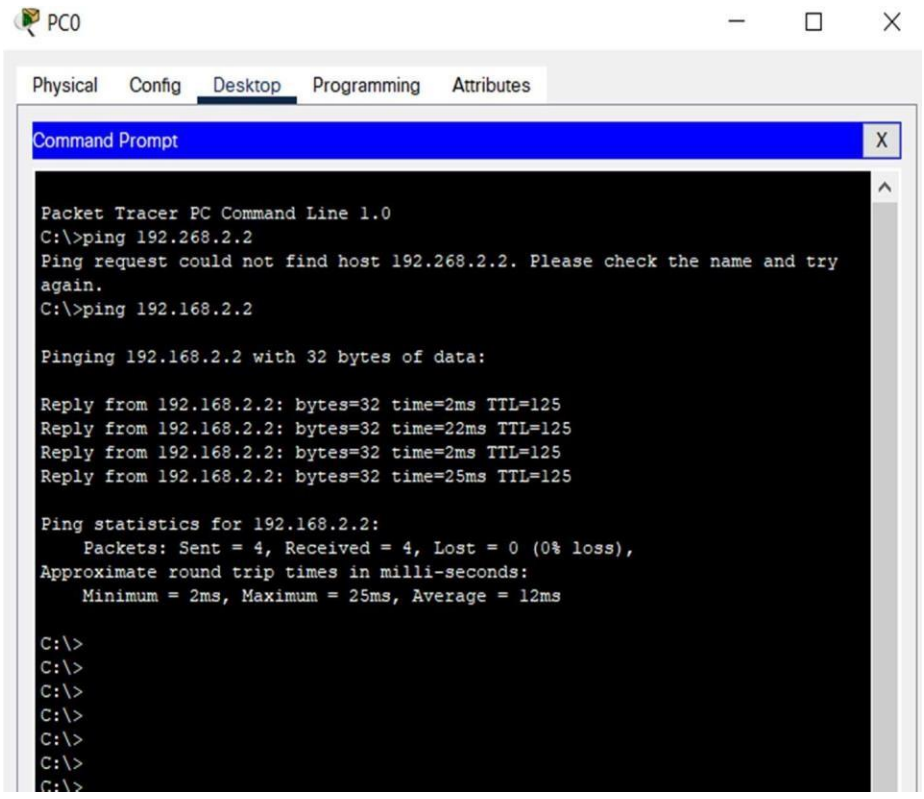
0 input packets with dribble condition detected

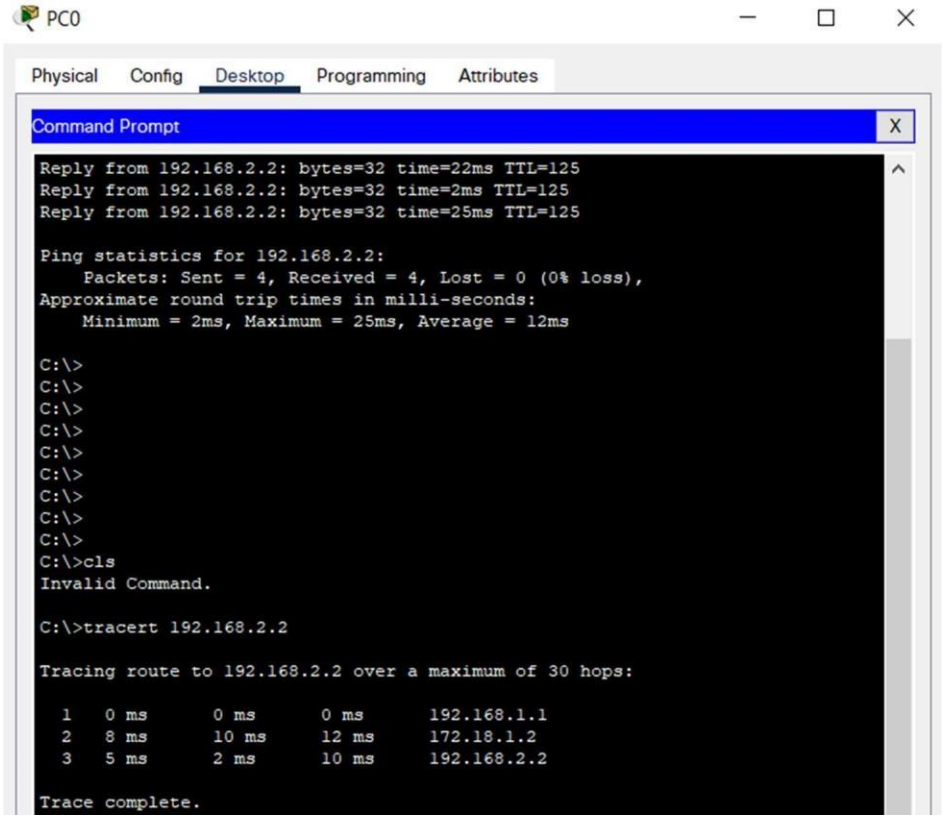
53 packets output, 3536 bytes, 0 underruns

0 output errors, 0 collisions, 0 interface resets

0 unknown protocol drops

11. Trace the VPN tunnel path.





RESULT:

Hence successfully, configured VPN using routers in Cisco Packet Tracer.

Ex.No:14	COMMUNICATION USING HDLC
Date:	

AIM:

To configure HDLC Protocol using routers in Cisco Packet Tracer.

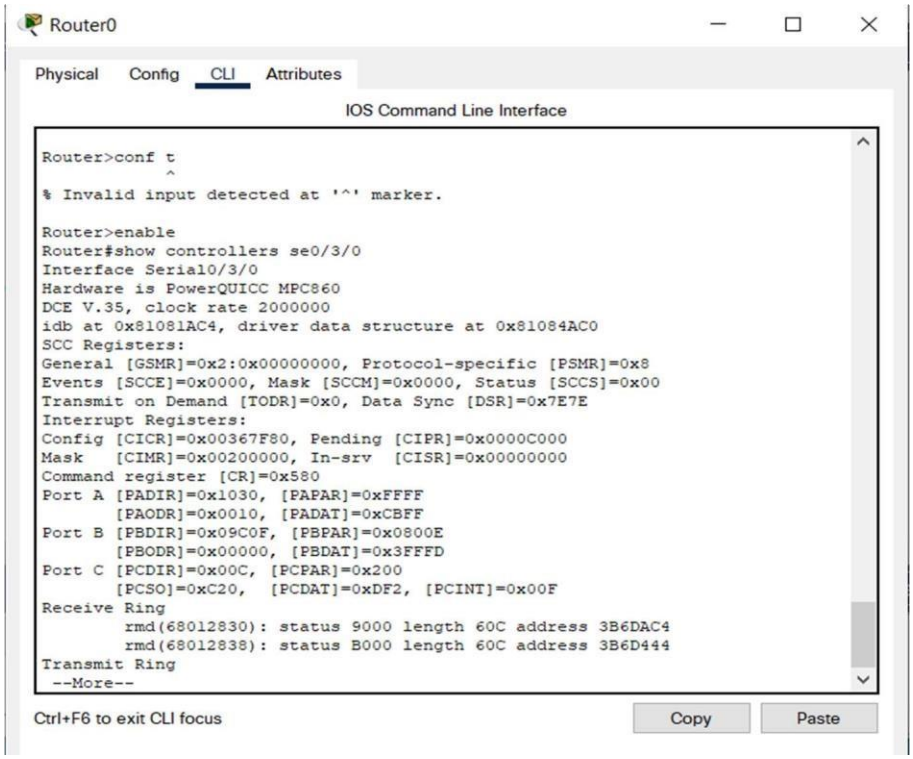
PROCEDURE:

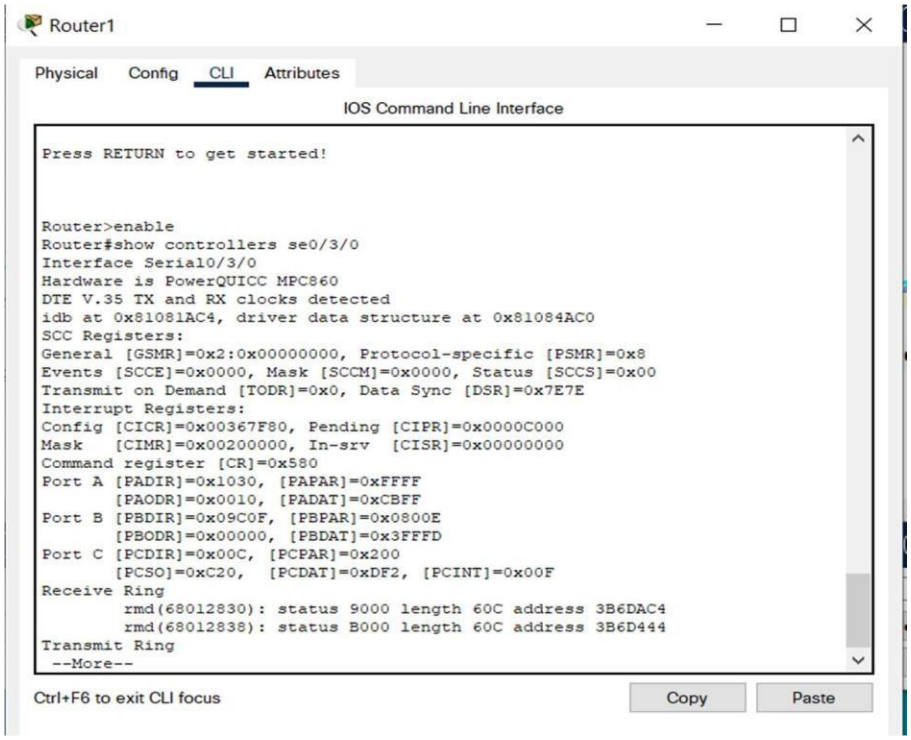
1. Connect the devices as shown in the below figure.

2 . Initial IP configuration.

Device / Interface	IP Address	Connected with
PC0 / Fa0	10.0.0.2 /8	Router0 / Fa0/0
PC1 / Fa0	20.0.0.2 /8	Router1 / Fa0/0
Router0 / Se0/3/0	192.168.1.2 /30	Router1 / Se0/3/0
Router1 / Se0/3/0	192.168.1.3 /30	Router0 / Se0/3/0

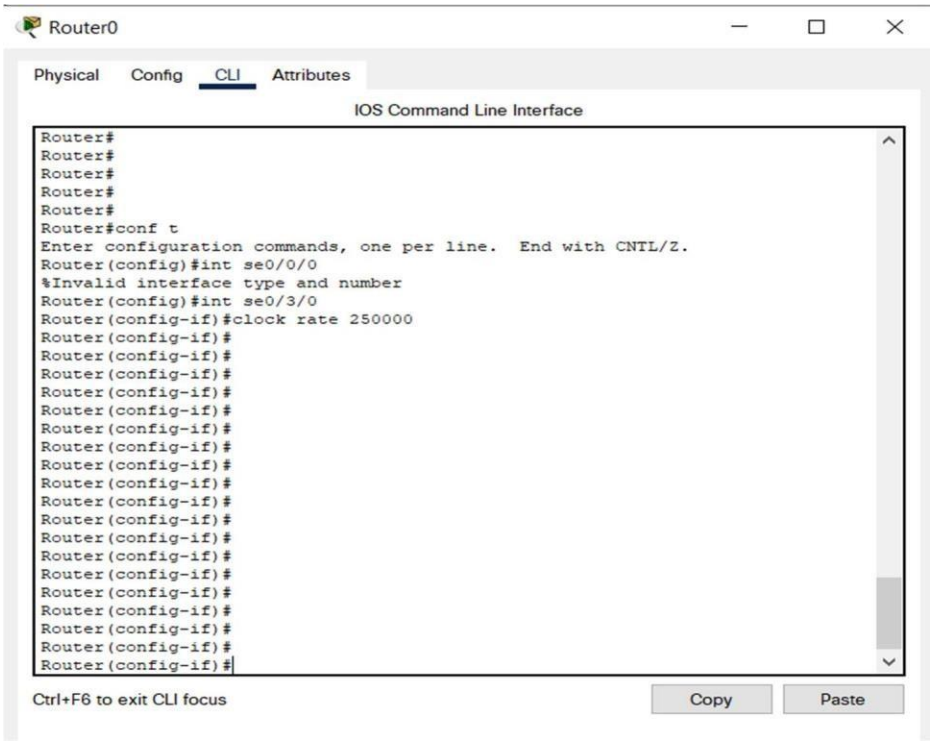
3 . Use the connected laptops to find the DCE and DTE routers



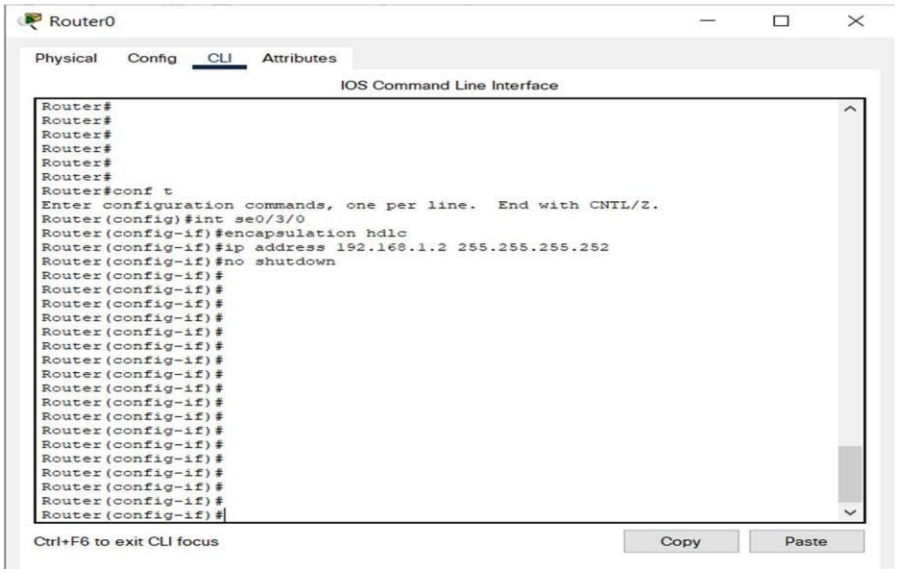


4. Configure the routers with the following parameters

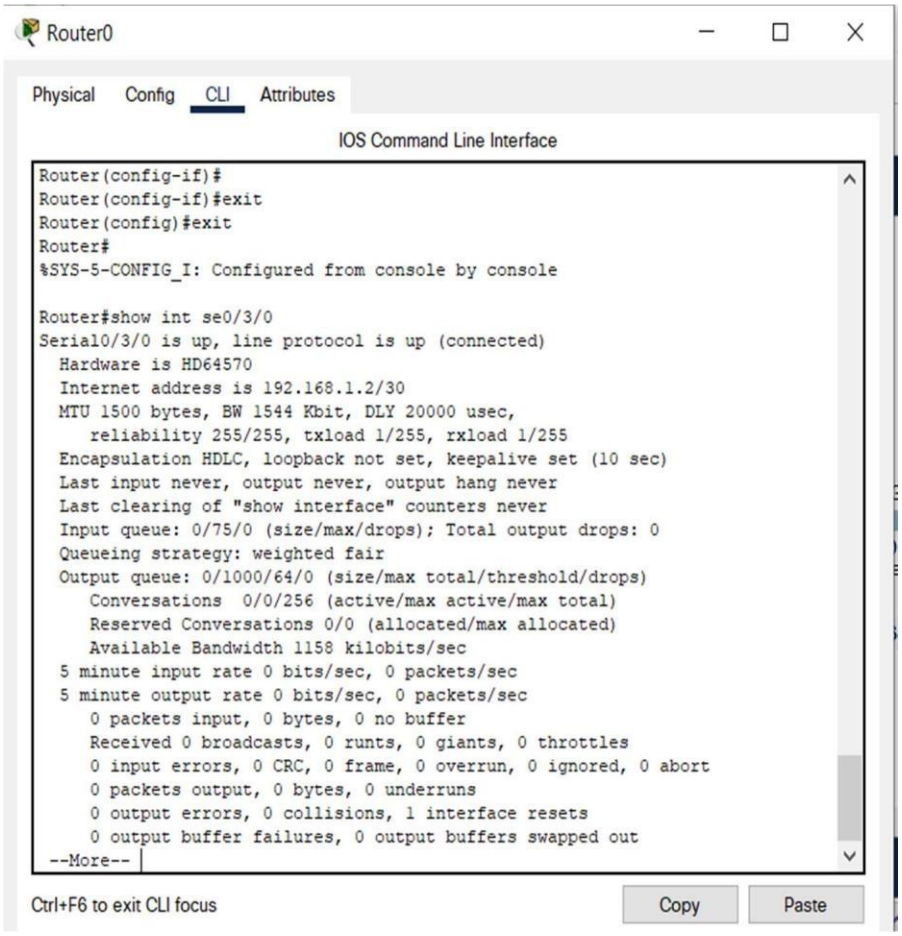
Router0 being the DCE, clock rate has to be configured on Router0 serial 0/3/0 interface.



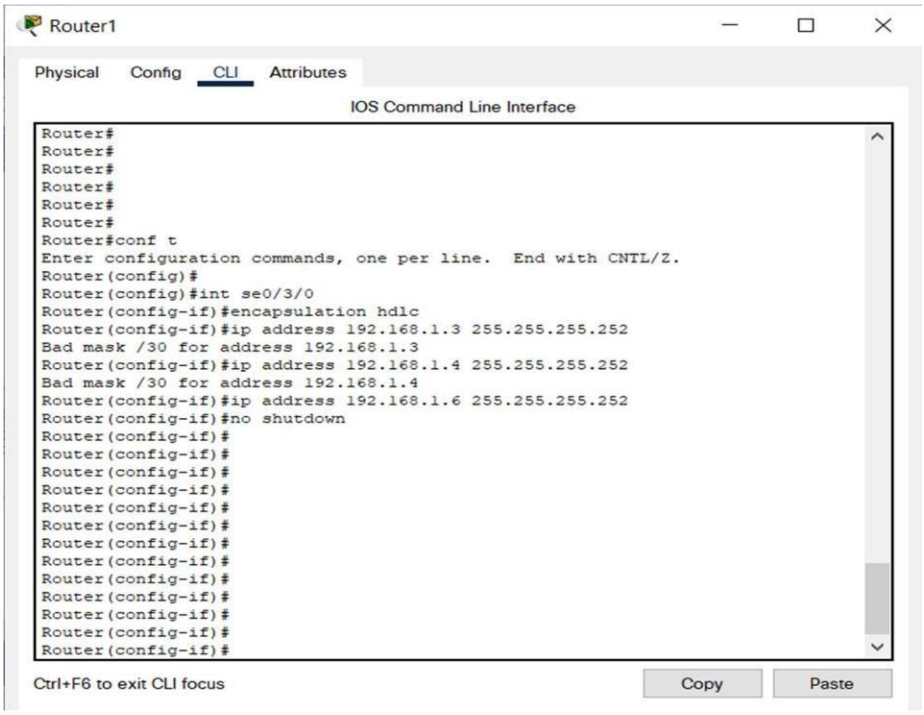
5. Then, configure HDLC encapsulation and IP address on Router0 serial 0/3/0 interface. The **encapsulation hdlc** configures HDLC protocol on the serial interface. Router0 being the DCE side of the serial link, the 192.168.1.3 /30 IP address is configured on Router0 serial 0/3/0 interface. Don't forget to enable the interface with a no shutdown command.



6. The show interfaces serial 0/3/0 confirms that HDLC encapsulation is enabled on the interface : Encapsulation HDLC, loopback not set, keepalive set (10 sec)



7. Finally, configure HDLC encapsulation and IP address on Router1 serial 0/3/0 interface. The link comes up as both routers are correctly configured.



8. NOW CHECK THE CONNECTION BY PINGING EACH OTHER.

First we go to Router0 and ping with Router1:

Router#ping 192.168.1.6

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 198.168.1.6, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 26/28/33 ms

Now we go to Router1 and test the network by pinging the Router0 interface.

Router#ping 192.168.1.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.1.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 25/28/32 ms

RESULT :

Hence successfully, configured HDLC Protocol using routers in Cisco Packet Tracer.

Ex.No:15	COMMUNICATION USING HDLC
Date:	

AIM:

To configure PPP using routers in Cisco Packet Tracer.

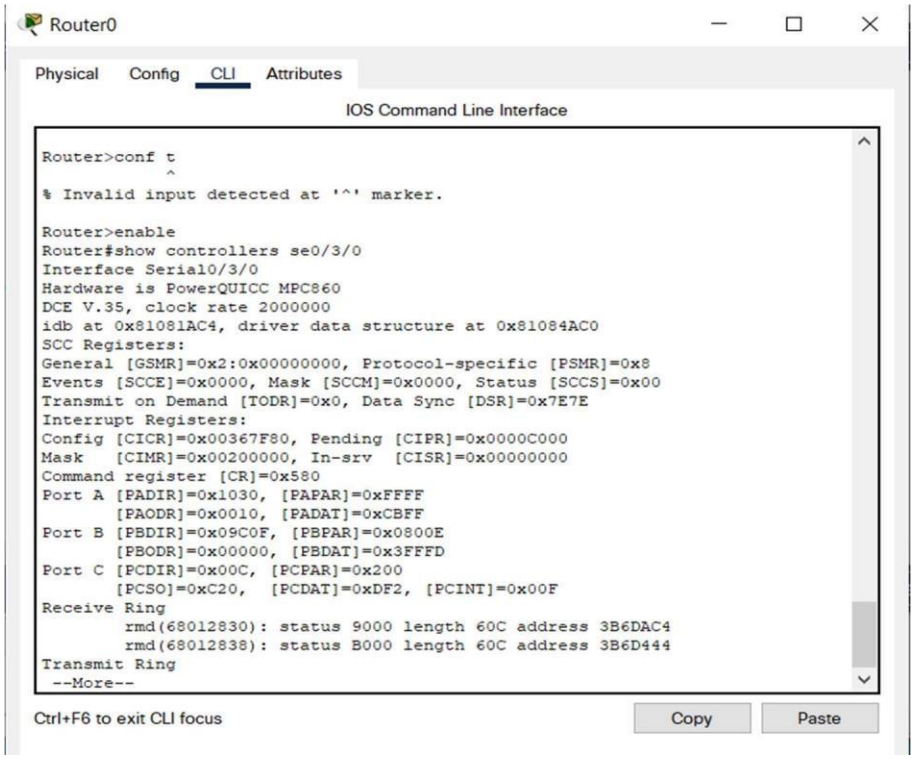
PROCEDURE:

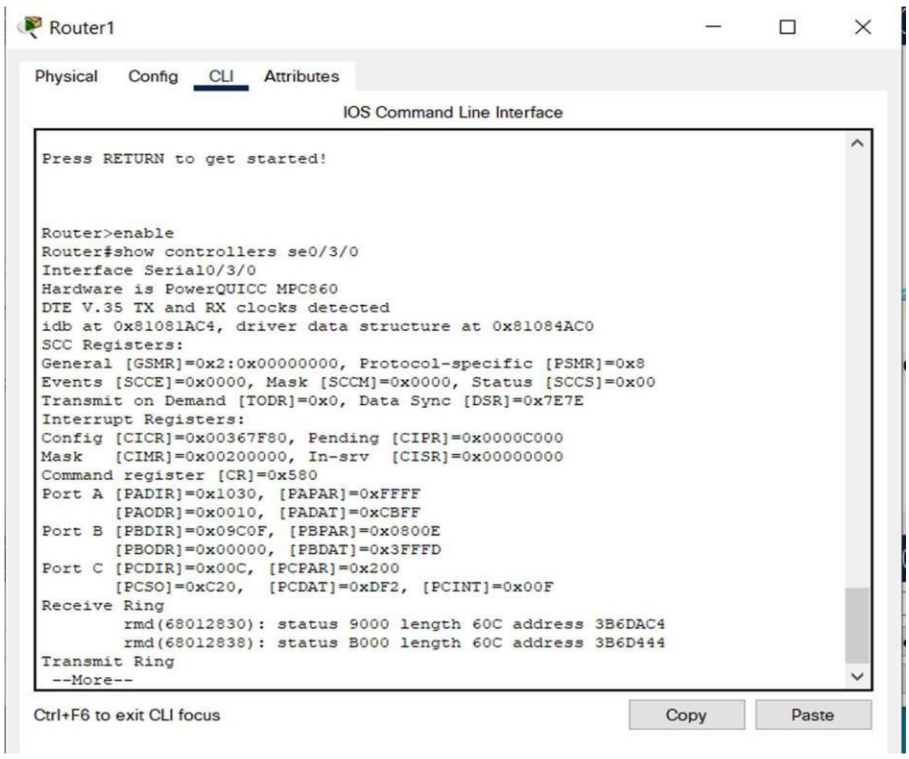
1 . Connect the devices as shown in the below figure.

2 . Initial IP configuration.

Device / Interface	IP Address	Connected with
PC0 / Fa0	10.0.0.2 /8	Router0 / Fa0/0
PC1 / Fa0	20.0.0.2 /8	Router1 / Fa0/0
Router0 / Se0/3/0	192.168.1.2 /30	Router1 / Se0/3/0
Router1 / Se0/3/0	192.168.1.3 /30	Router0 / Se0/3/0

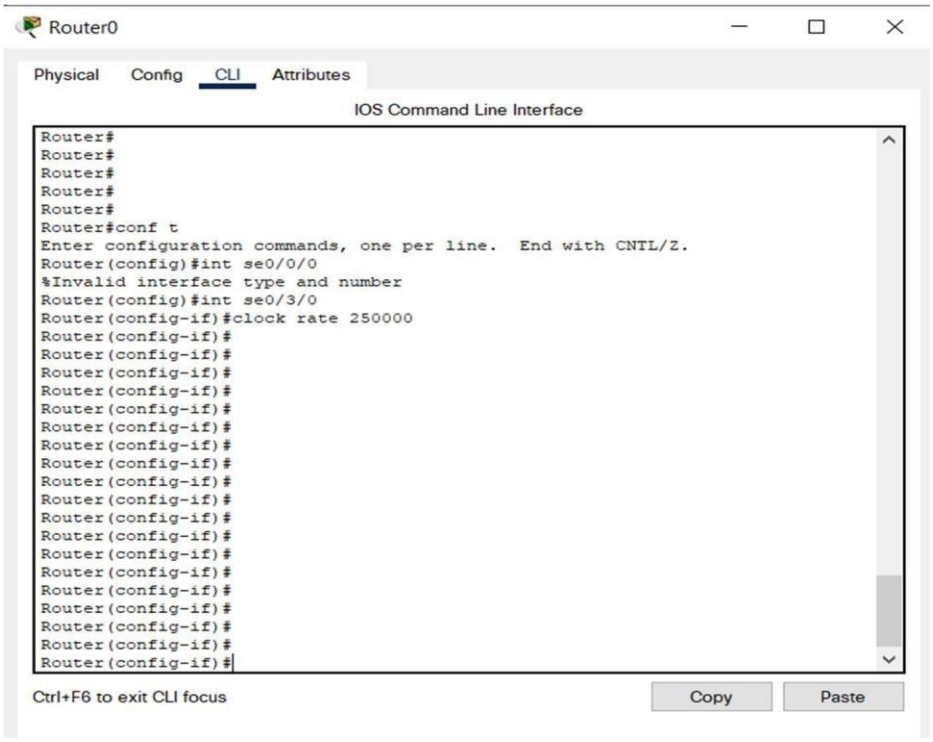
3 . Use the connected laptops to find the DCE and DTE routers


Router0
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router>conf t
^
% Invalid input detected at '^' marker.
Router>enable
Router#show controllers se0/3/0
Interface Serial0/3/0
Hardware is PowerQUICC MPC860
DCE V.35, clock rate 2000000
idb at 0x81081AC4, driver data structure at 0x81084AC0
SCC Registers:
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E
Interrupt Registers:
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000
Mask [CIMR]=0x00200000, In-srv [CISR]=0x00000000
Command register [CR]=0x580
Port A [PADIR]=0x1030, [PAPAR]=0xFFFF
[PAODR]=0x0010, [PADAT]=0xCBFF
Port B [PBDIR]=0x09C0F, [PBPAR]=0x0800E
[PBODR]=0x00000, [PBDAT]=0x3FFFD
Port C [PCDIR]=0x00C, [PCPAR]=0x200
[PCSO]=0xC20, [PCDAT]=0xDF2, [PCINT]=0x00F
Receive Ring
rmd(68012830): status 9000 length 60C address 3B6DAC4
rmd(68012838): status B000 length 60C address 3B6D444
Transmit Ring
--More--
Ctrl+F6 to exit CLI focus
Copy
Paste

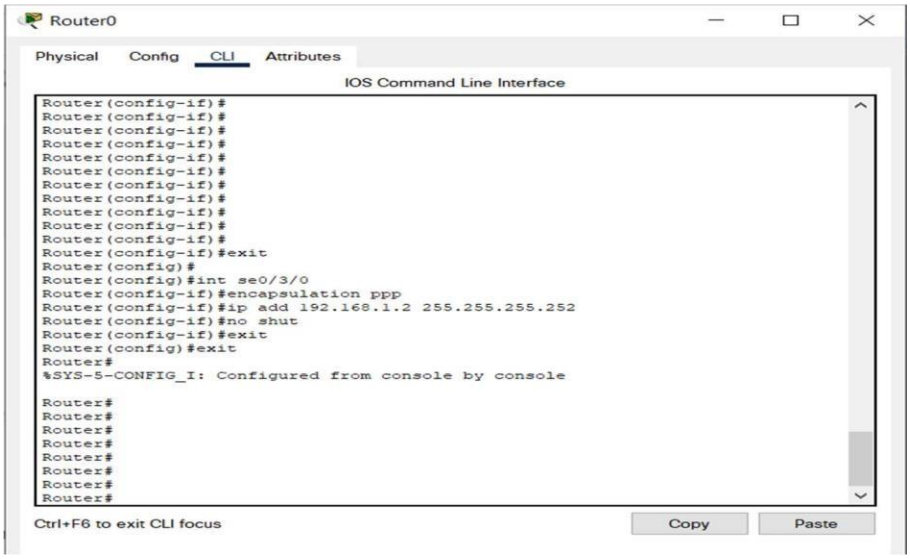

Router1
Physical
Config
CLI
Attributes
IOS Command Line Interface
Press RETURN to get started!
Router>enable
Router#show controllers se0/3/0
Interface Serial0/3/0
Hardware is PowerQUICC MPC860
DTE V.35 TX and RX clocks detected
idb at 0x81081AC4, driver data structure at 0x81084AC0
SCC Registers:
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E
Interrupt Registers:
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000
Mask [CIMR]=0x00200000, In-srv [CISR]=0x00000000
Command register [CR]=0x580
Port A [PADIR]=0x1030, [PAPAR]=0xFFFF
[PAODR]=0x0010, [PADAT]=0xCBFF
Port B [PBDIR]=0x09C0F, [PBPAR]=0x0800E
[PBODR]=0x00000, [PBDAT]=0x3FFFD
Port C [PCDIR]=0x00C, [PCPAR]=0x200
[PCSO]=0xC20, [PCDAT]=0xDF2, [PCINT]=0x00F
Receive Ring
rmd(68012830): status 9000 length 60C address 3B6DAC4
rmd(68012838): status B000 length 60C address 3B6D444
Transmit Ring
--More--
Ctrl+F6 to exit CLI focus
Copy
Paste

4. Configure the routers with the following parameters

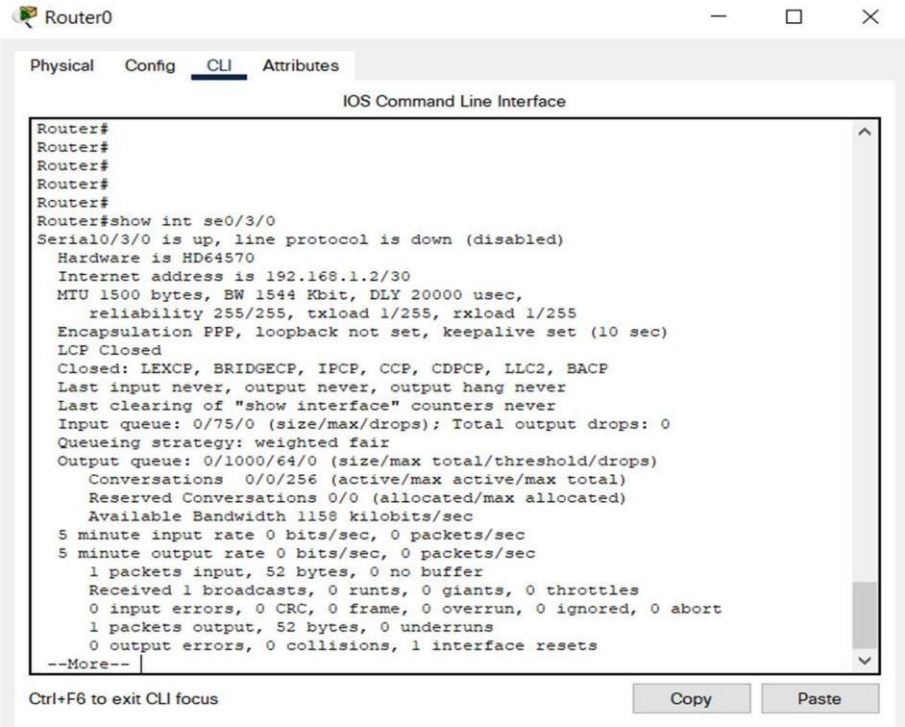
Router0 being the DCE, clock rate has to be configured on Router0 serial 0/3/0 interface.



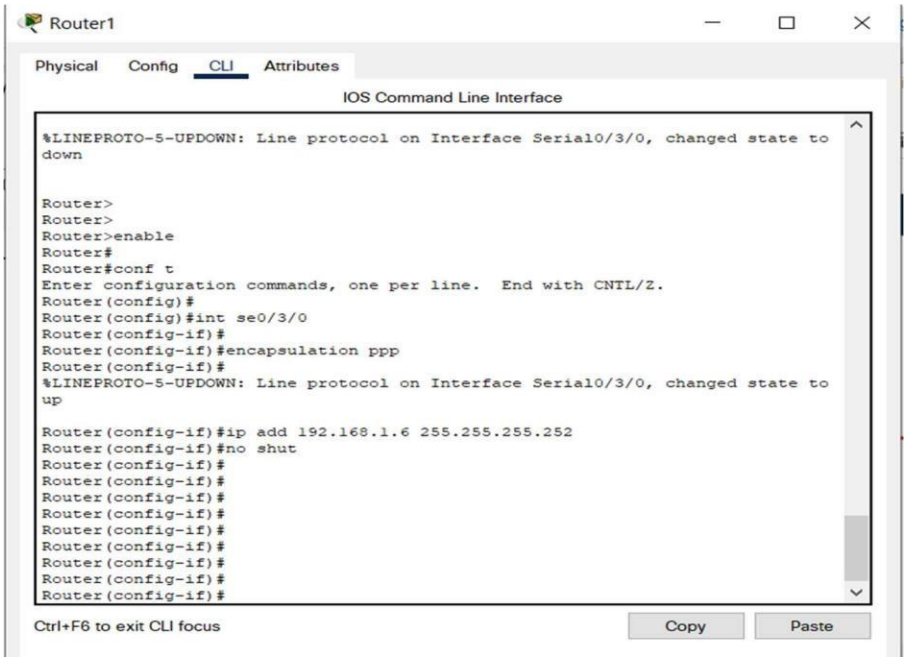
5. Then, configure PPP encapsulation and IP address on Router0 serial 0/3/0 interface. The **encapsulation ppp** configures PPP protocol on the serial interface. Router0 being the DCE side of the serial link, the 192.168.1.3 /30 IP address is configured on Router0 serial 0/3/0 interface. Don't forget to enable the interface with a no shutdown command.



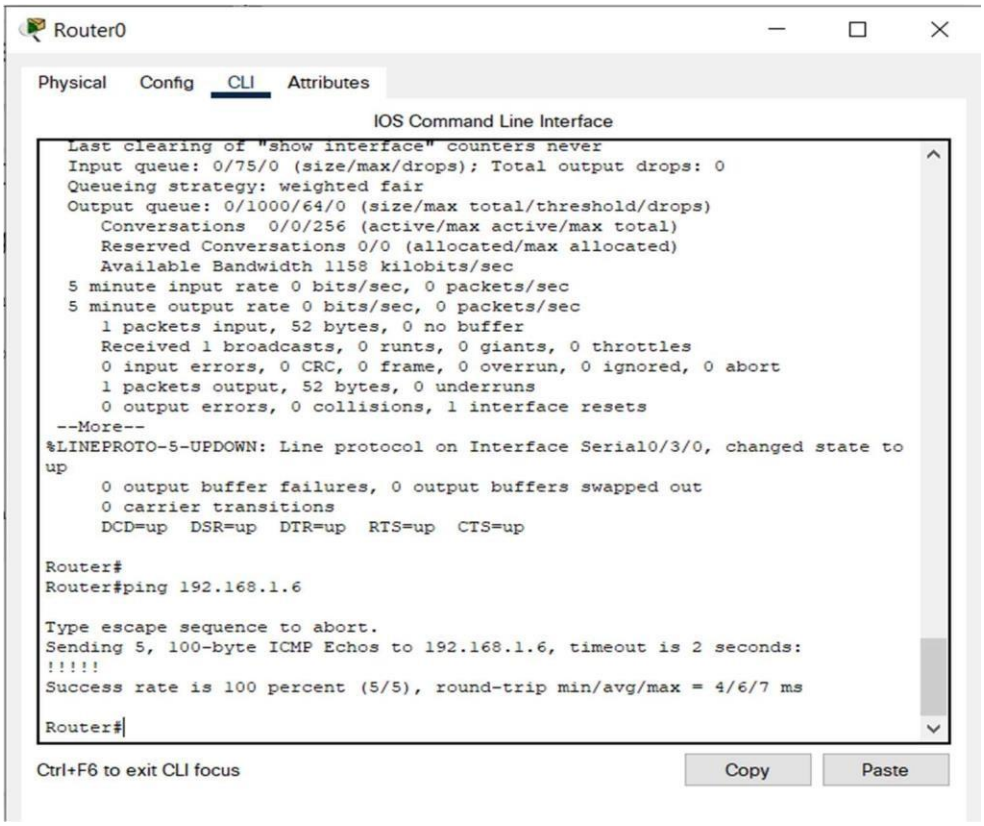
6. The show interfaces serial 0/3/0 confirms that PPP encapsulation is enabled on the interface : Encapsulation PPP, loopback not set, keepalive set (10 sec)



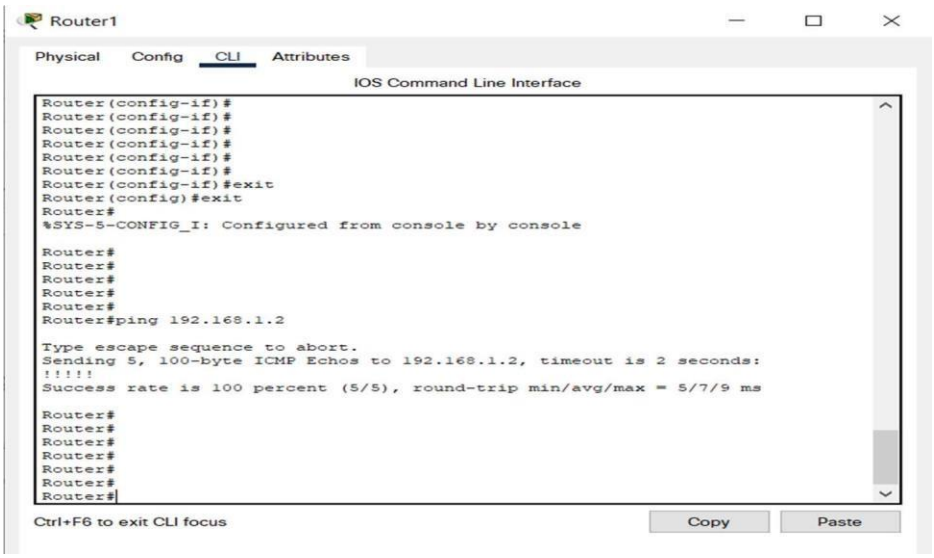
7. Finally, configure PPP encapsulation and IP address on Router1 serial 0/3/0 interface. The link comes up as both routers are correctly configured.



8. NOW CHECK THE CONNECTION BY PINGING EACH OTHER.First we go to Router0 and ping withRouter1:



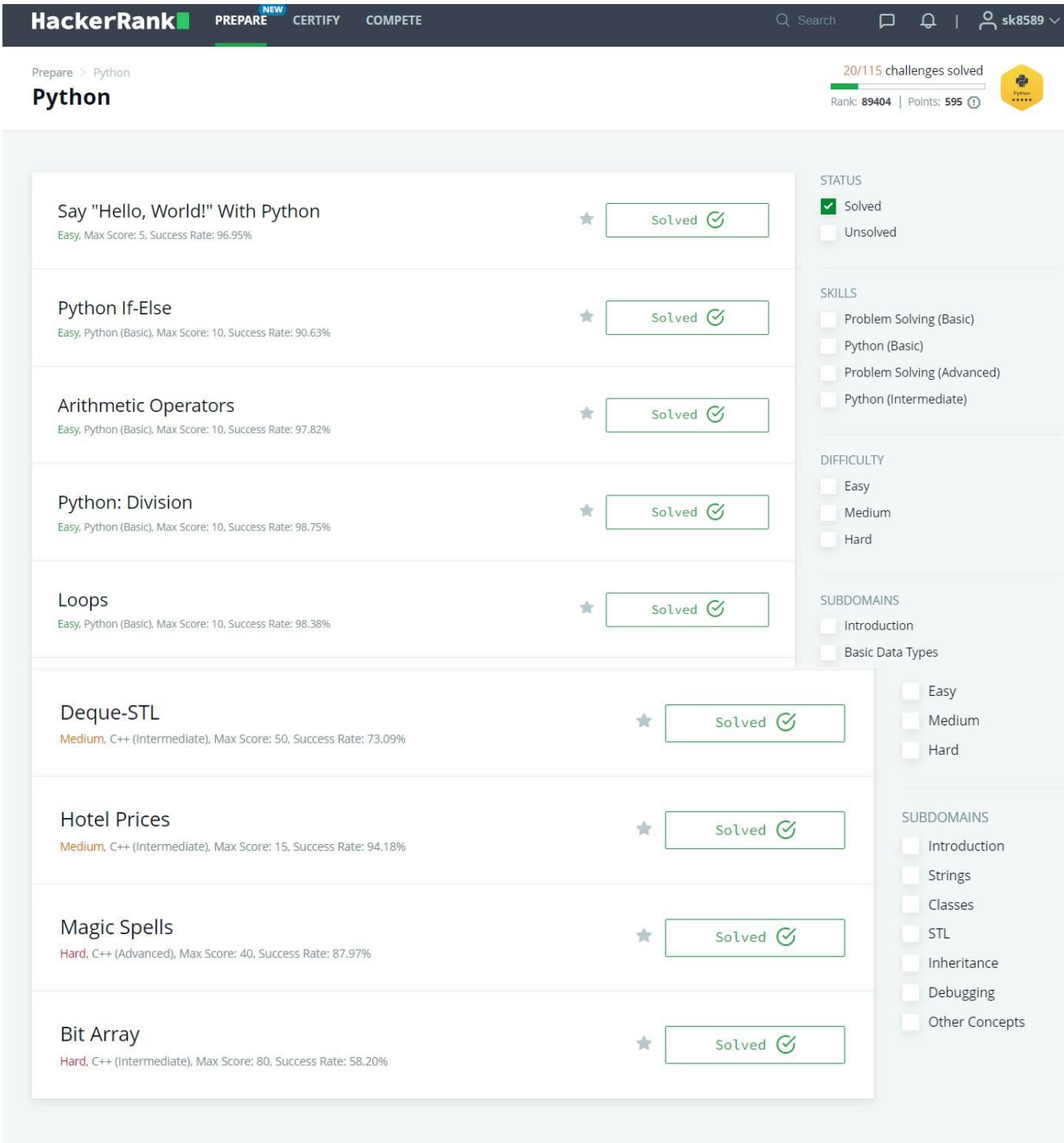
Now we go to Router1 and test the network by pinging the Router0 interface.

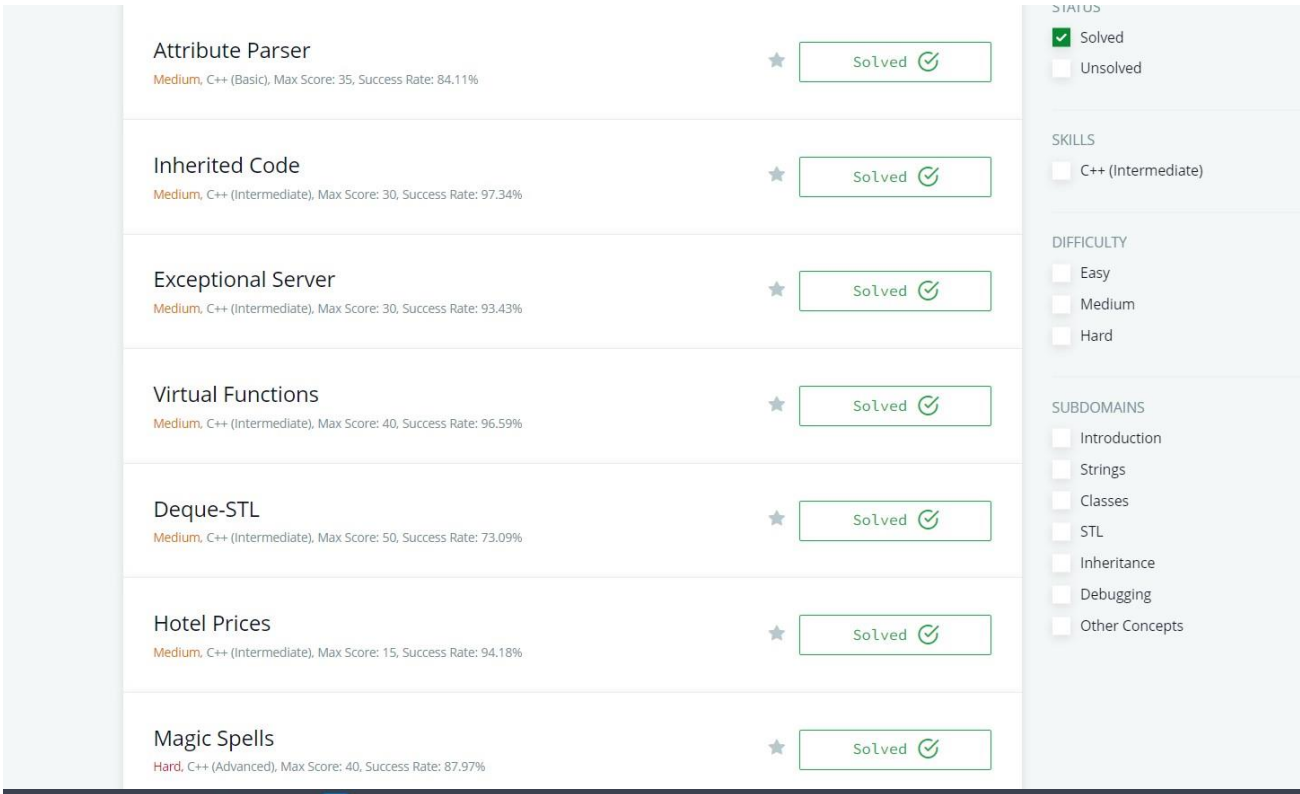


RESULT:

Hence successfully, configured PPP using routers in Cisco Packet Tracer.

HACKERRANK


HackerRank
PREPARE
NEW
CERTIFY
COMPETE
Search
sk8589
Prepare > Python
Python
20/115 challenges solved
Rank: 89404 | Points: 595
Say "Hello, World!" With Python
Easy, Max Score: 5, Success Rate: 96.95%
Solved
Python If-Else
Easy, Python (Basic), Max Score: 10, Success Rate: 90.63%
Solved
Arithmetic Operators
Easy, Python (Basic), Max Score: 10, Success Rate: 97.82%
Solved
Python: Division
Easy, Python (Basic), Max Score: 10, Success Rate: 98.75%
Solved
Loops
Easy, Python (Basic), Max Score: 10, Success Rate: 98.38%
Solved
STATUS
Solved
Unsolved
SKILLS
Problem Solving (Basic)
Python (Basic)
Problem Solving (Advanced)
Python (Intermediate)
DIFFICULTY
Easy
Medium
Hard
SUBDOMAINS
Introduction
Basic Data Types
Deque-STL
Medium, C++ (Intermediate), Max Score: 50, Success Rate: 73.09%
Solved
Hotel Prices
Medium, C++ (Intermediate), Max Score: 15, Success Rate: 94.18%
Solved
Magic Spells
Hard, C++ (Advanced), Max Score: 40, Success Rate: 87.97%
Solved
Bit Array
Hard, C++ (Intermediate), Max Score: 80, Success Rate: 58.20%
Solved
Easy
Medium
Hard
SUBDOMAINS
Introduction
Strings
Classes
STL
Inheritance
Debugging
Other Concepts


Attribute Parser
Medium, C++ (Basic), Max Score: 35, Success Rate: 84.11%
Solved
Inherited Code
Medium, C++ (Intermediate), Max Score: 30, Success Rate: 97.34%
Solved
Exceptional Server
Medium, C++ (Intermediate), Max Score: 30, Success Rate: 93.43%
Solved
Virtual Functions
Medium, C++ (Intermediate), Max Score: 40, Success Rate: 96.59%
Solved
Deque-STL
Medium, C++ (Intermediate), Max Score: 50, Success Rate: 73.09%
Solved
Hotel Prices
Medium, C++ (Intermediate), Max Score: 15, Success Rate: 94.18%
Solved
Magic Spells
Hard, C++ (Advanced), Max Score: 40, Success Rate: 87.97%
Solved
Solved
Unsolved
SKILLS
C++ (Intermediate)
DIFFICULTY
Easy
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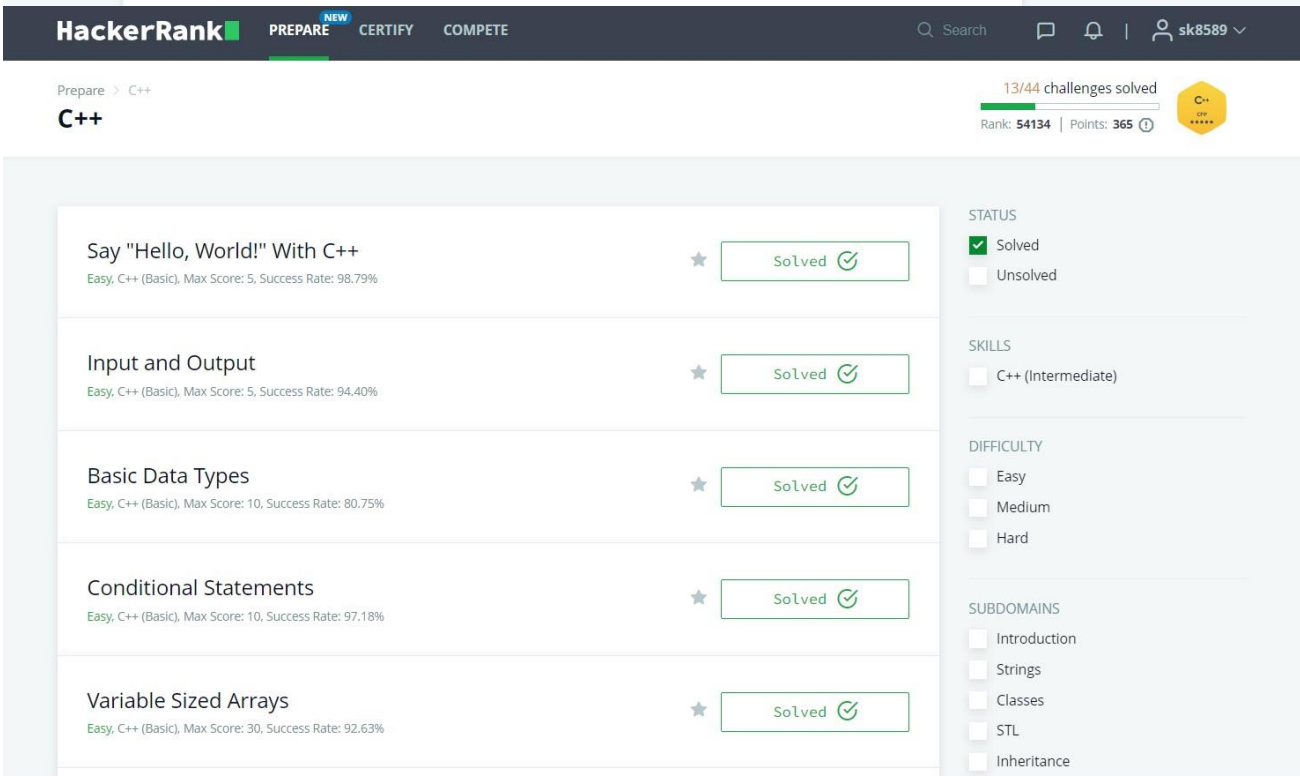
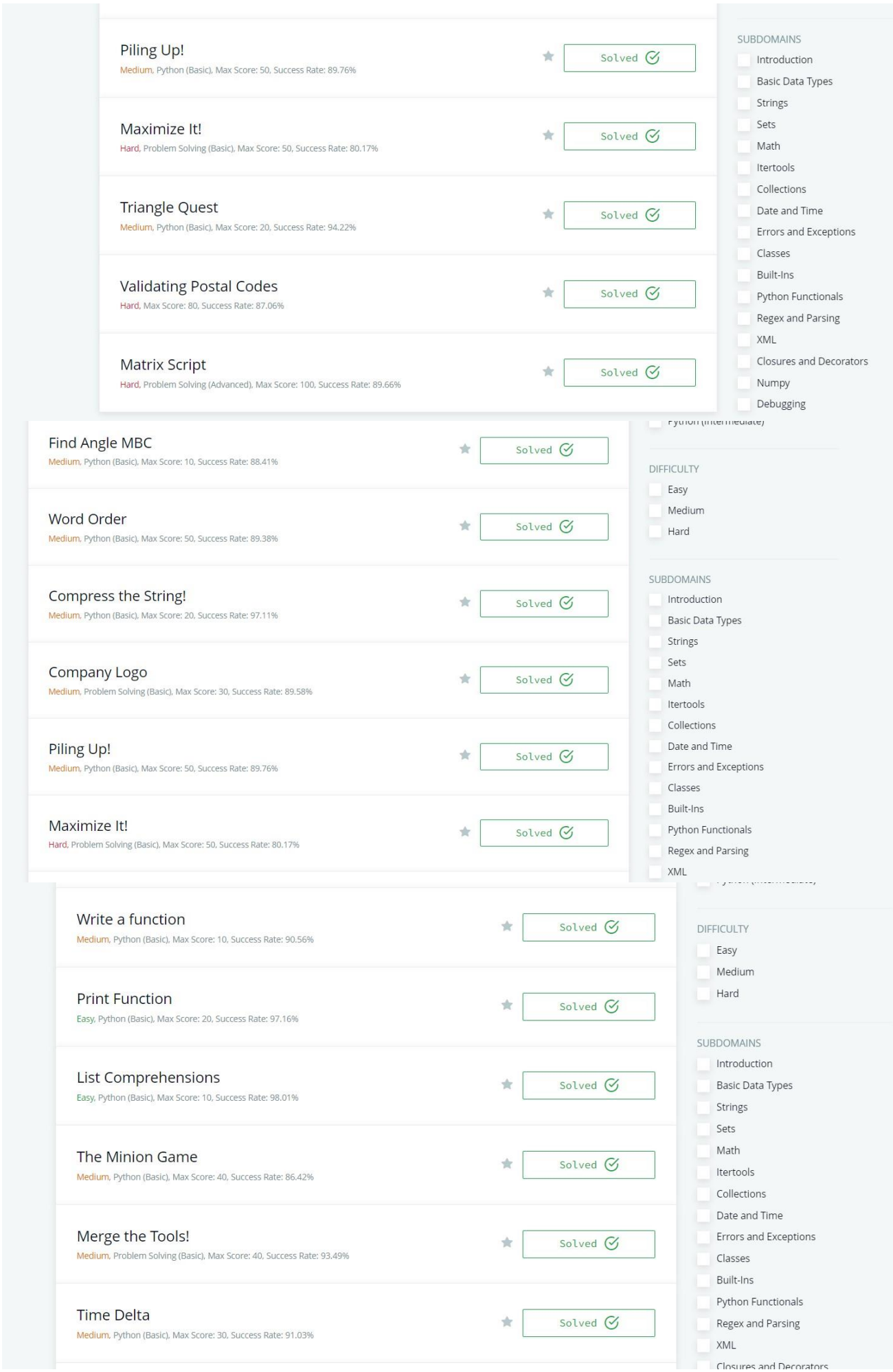

HackerRank
PREPARE
NEW
CERTIFY
COMPETE
Search
sk8589
Prepare > C++
C++
13/44 challenges solved
Rank: 54134 | Points: 365
Say "Hello, World!" With C++
Easy, C++ (Basic), Max Score: 5, Success Rate: 98.79%
Solved
Input and Output
Easy, C++ (Basic), Max Score: 5, Success Rate: 94.40%
Solved
Basic Data Types
Easy, C++ (Basic), Max Score: 10, Success Rate: 80.75%
Solved
Conditional Statements
Easy, C++ (Basic), Max Score: 10, Success Rate: 97.18%
Solved
Variable Sized Arrays
Easy, C++ (Basic), Max Score: 30, Success Rate: 92.63%
Solved
STATUS
Solved
Unsolved
SKILLS
C++ (Intermediate)
DIFFICULTY
Easy
Medium
Hard
SUBDOMAINS
Introduction
Strings
Classes
STL
Inheritance


Piling Up!
Medium, Python (Basic), Max Score: 50, Success Rate: 89.76%
Solved
Maximize It!
Hard, Problem Solving (Basic), Max Score: 50, Success Rate: 80.17%
Solved
Triangle Quest
Medium, Python (Basic), Max Score: 20, Success Rate: 94.22%
Solved
Validating Postal Codes
Hard, Max Score: 80, Success Rate: 87.06%
Solved
Matrix Script
Hard, Problem Solving (Advanced), Max Score: 100, Success Rate: 89.66%
Solved
SUBDOMAINS
Introduction
Basic Data Types
Strings
Sets
Math
Itertools
Collections
Date and Time
Errors and Exceptions
Classes
Built-Ins
Python Functionals
Regex and Parsing
XML
Closures and Decorators
Numpy
Debugging
Find Angle MBC
Medium, Python (Basic), Max Score: 10, Success Rate: 88.41%
Solved
Word Order
Medium, Python (Basic), Max Score: 50, Success Rate: 89.38%
Solved
Compress the String!
Medium, Python (Basic), Max Score: 20, Success Rate: 97.11%
Solved
Company Logo
Medium, Problem Solving (Basic), Max Score: 30, Success Rate: 89.58%
Solved
Piling Up!
Medium, Python (Basic), Max Score: 50, Success Rate: 89.76%
Solved
Maximize It!
Hard, Problem Solving (Basic), Max Score: 50, Success Rate: 80.17%
Solved
DIFFICULTY
Easy
Medium
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SUBDOMAINS
Introduction
Basic Data Types
Strings
Sets
Math
Itertools
Collections
Date and Time
Errors and Exceptions
Classes
Built-Ins
Python Functionals
Regex and Parsing
XML
Write a function
Medium, Python (Basic), Max Score: 10, Success Rate: 90.56%
Solved
Print Function
Easy, Python (Basic), Max Score: 20, Success Rate: 97.16%
Solved
List Comprehensions
Easy, Python (Basic), Max Score: 10, Success Rate: 98.01%
Solved
The Minion Game
Medium, Python (Basic), Max Score: 40, Success Rate: 86.42%
Solved
Merge the Tools!
Medium, Problem Solving (Basic), Max Score: 40, Success Rate: 93.49%
Solved
Time Delta
Medium, Python (Basic), Max Score: 30, Success Rate: 91.03%
Solved
DIFFICULTY
Easy
Medium
Hard
SUBDOMAINS
Introduction
Basic Data Types
Strings
Sets
Math
Itertools
Collections
Date and Time
Errors and Exceptions
Classes
Built-Ins
Python Functionals
Regex and Parsing
XML
Closures and Decorators

AWS CERTIFICATION &BADGE


aws
ACADEMY
Cloud Security
Foundations

MINI PROJECT

NETWORK CONFIGURATION FOR A SMALL BUSINESS

A COURSE PROJECT REPORT

By

Anirudh Vishwanath (RA2011031010045)
Sripad Sriram (RA2011031010050)
Sidhant Pragada (RA2011031010058)
Shivam Kumar (RA2011031010066)

Under the guidance of
Dr. S. Thenmalar
In partial fulfilment for the Course
of

18CSC302J - COMPUTER NETWORKS

in Computer Science (Information Technology)

FACULTY OF ENGINEERING AND TECHNOLOGY

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

Kattankulathur, Chengalpattu District

NOVEMBER 2022

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Under Section 3 of UGC Act, 1956)

BONAFIDE CERTIFICATE

Certified that this project report of "**Network Configuration for a Small Business Organization**" is the Bonafide work of **Anirudh Vishwanath, Sripad Sriram, Sidhant Pragada, and Shivam Kumar,** who carried out the project work under my supervision.

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TABLE OF CONTENTS

ABSTRACT

A private, safe, and secure network is detrimental to an organization's success. This is because this single entity can enable the transfer of information and effective communication between all the major stakeholders associated with the business. Hence we must ensure quality provision, like features that include speed, reliability, safety, privacy, etc. This project mainly aims to study the architecture of an the network of such an organization. It examines the barriers to planning, designing and implementing such a network. This study also covers the methods to implement level networks. A basic router configuration is used for covering the Routing technologies which route data between branches. After that there is an inclusion of a Wide Area Network (WAN), along with a Frame-relay to connect multiple locations using a single interface of the router. This is not mandatory, but reduces costs. The concept of Network Address Translation (NAT) is of prime importance as we have an active requirement to translate live Internet Protocol (IP) into local addresses for on ground usage, and vice-versa.

INTRODUCTION

The chosen project aims at building a network configuration suitable for a small business organization. Hence it is important to pay heed to their requirements, after which the design can be improved upon. Priority number one is to have the functional requirements in place. these are requirements that are essential to the business and cannot be compromised upon. The non-functional requirements can then later be added on demand, as these are not essential for the business to run. Their absence may not hinder the company operations drastically.

Implementing a company network scenario is completely dependent on network technologies. Such secured networks are often used in big organizations and other institutions to make secure communication and sharing of their data. We also must have separate networks for departments if each of them is big enough. The main aim is to avoid unauthorized access and maintain data privacy and security with reliable speeds. This is what this project aims to achieve.

LITERATURE SURVEY

It is important to pay heed to the company's requirements, completing which the design can be improved further upon. Priority number one is to have the functional requirements in place. These are requirements that are essential to the business and cannot be compromised upon. The non -functional requirements can then later be added on demand, as these are not essential for the business to run their absence may not hinder the company operations drastically.

- The absolute essential features are listed below:

1) A high-speed reliable secure internet connection is essential as it will ensure there are no gaps in communication between stakeholders, and will ensure that the transaction take place in a smooth manner.
2) Switches/ethernet hubs help by ensuring all round connectivity so that everything is available to everyone on demand

    i. Security is also of prime importance as it takes care of two things:
    ii. a) that there is no breach in the ecosystem and that the company data is safe and secure, and not out in the open
    iii. b) that there is no malware/spyware that will jeopardize the company's future performance by corrupting their data assets
    iv.

3) Communication between the organization and the outside world is facilitated by use of a telephone, or other pathways that give the company a specific name or brand value.

REQUIREMENT ANALYSIS

- In this specific case, the must have features include:

1) A secure internet connection -

   The connection with the ISP (internet service provider) should be secure, meaning there shouldn't be any unprecedented breaks in between. this could be detrimental to the business transactions.

2) A router with high-speed connectivity capabilities –

   Such a device is essential as it prevents lag and data discrepancy due to time mishaps.

3) A modem –

   To provide stable and reliable internet connectivity

4) Firewall capabilities -

   This is one of the most important features, as its absence will pose a threat to the company by opening up its confidential data reserves to the public, and hence paving way for a breach

5) Multiple Switches -

   This option allows computers to link to each other over an internal network.

6) A Phone Line-

   This component can be used for communication with potential customers or other stakeholders

7) Security Software-

   To prevent attacks and breaches through malware.

About the application:

Cisco Packet Tracer (V8.0.0)

Cisco Packet Tracer as the name suggests, is a tool built by Cisco. This tool provides anetwork simulation to practice simple and complex networks.

The main purpose of Cisco Packet Tracer is to help students learn the principles of networking with hands-on experience as well as develop Cisco technology specific skills. Since the protocols are implemented in software only method, this tool cannot replace the hardware Routers or Switches. Interestingly, this tool does not only include Cisco productsbut also many more networking devices.

Fig 1.0

Fig 1.0 shows the Logo for the application

A workspace inside the application looks like this:

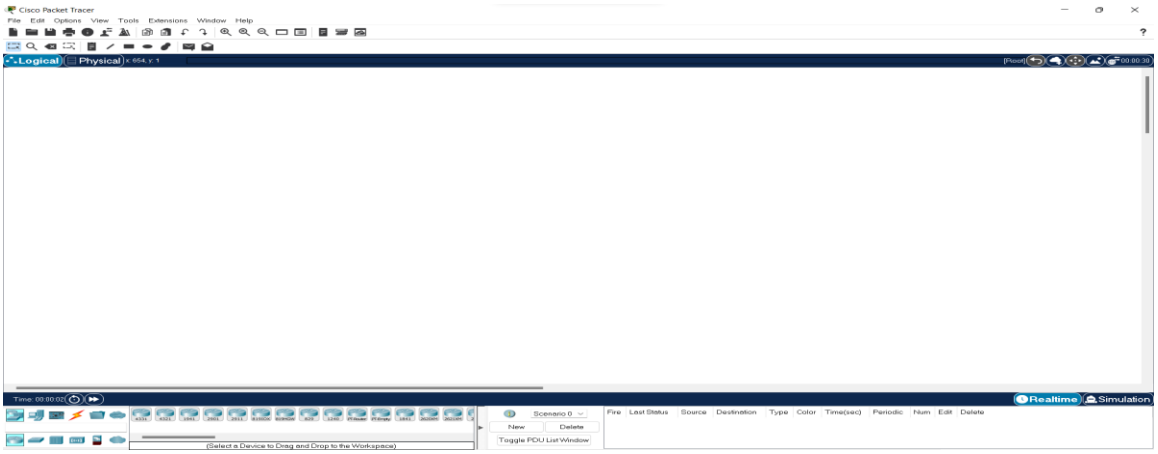


Fig 1.1

Fig 1.1 shows a blank workspace inside the application

Components Involved:

1) **ROUTERS:**

A router is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet.Data sent through the internet, such as a web page or email, is in the form of data packets. A packet is typically forwarded from one router to another router through the networks that constitute an internetwork (e.g., the Internet) until it reaches its destination node.

A common tool for modern network computing, routers connect employees to networks, both local and the Internet, where just about every essential business activity takes place. Without routers, we wouldn't be able to use the Internet to collaborate, communicate, or gather information and learn.

Fig 1.2

Fig 1.2 Shows a standard Router

2) SWITCHES:

A network switch (also called switching hub, bridging hub, and, by the IEEE,MAC bridge) is networking hardware that connects devices on a computer network by using packet switching to receives and forward data to the destination device. A network switch is a multiport network bridge that uses MAC addresses to forward data at the data link layer (layer 2) of the OSI model often see them used in home networks or wherever a few more ports are needed, such as at your desk, in a lab, or in a conference room.

Fig 1.3

Fig 1.3 Shows a standard switch

3) HOST COMPUTER:

A network host is a computer or another device connected to a computer network. A host may work as a server offering information resources, services, and applications to users or other hosts on the network. Hosts are assigned at least one network address.

Hosts typically do not include intermediary network devices like switches and routers, which are instead often categorized as nodes. A node is also a broader term that includes anything connected to a network, while a host requires an IP address. In other words, all hosts are nodes, but network nodes are not hosts unless they require an IP address to function.

Fig 1.4

Fig 1.4 shows a regular computer

4) Telephones:

A **telephone** is a telecommunications device that permits two or more users to conduct a conversation when they are too far apart to be easily heard directly. A telephone converts sound, typically and most efficiently the human voice, into electronic signals that are transmitted via cables and other communication channels to another telephone which reproduces the sound to the receiving user.

Fig 1.5

Fig 1.5 Shows a Telephone

5) Modems

A modulator-demodulator or modem is a computer hardware device that converts data from a digital format into a format suitable for an analog transmission medium such as telephone or radio. A modem transmits data by modulating one or more carrier wave signals to encode digital information, while the receiver demodulates the signal to recreate the original digital information. The goal is to produce a signal that can be transmitted easily and decoded reliably. Modems can be used with almost any means of transmitting analog signals, from light-emitting diodes to radio. It is the most fundamental device for transmitting internet throughout compact spaces such as offices or homes.

Fig 1.6

Fig 1.6 shows a standard modem

ARCHITECTURE:

Overview of the entire local system:

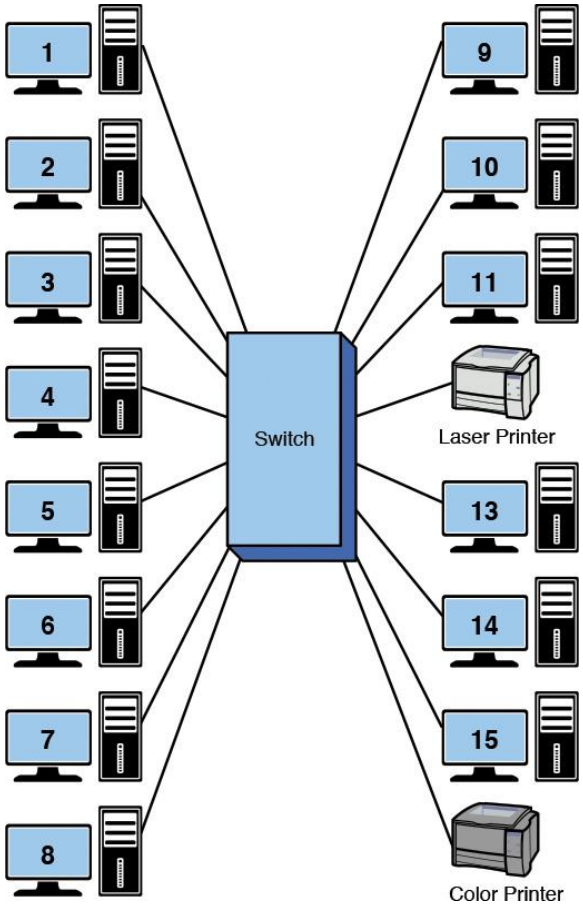


Fig 1.7

Fig 1.7 shows a general switch – device configuration

This is an overview of a basic internet system

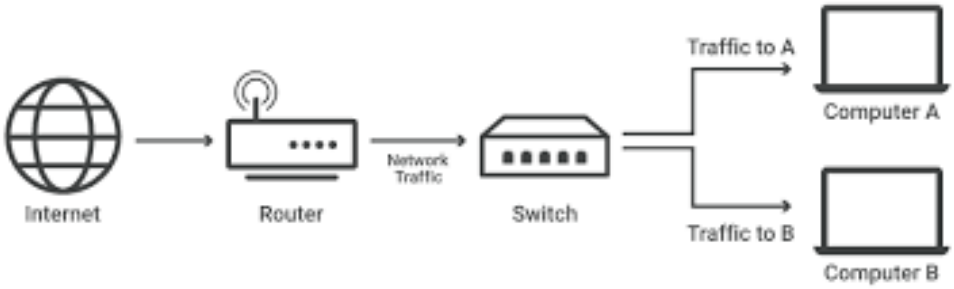


Fig 1.8

Fig 1.8 Shows a general system as a whole

NETWORK DESIGN:

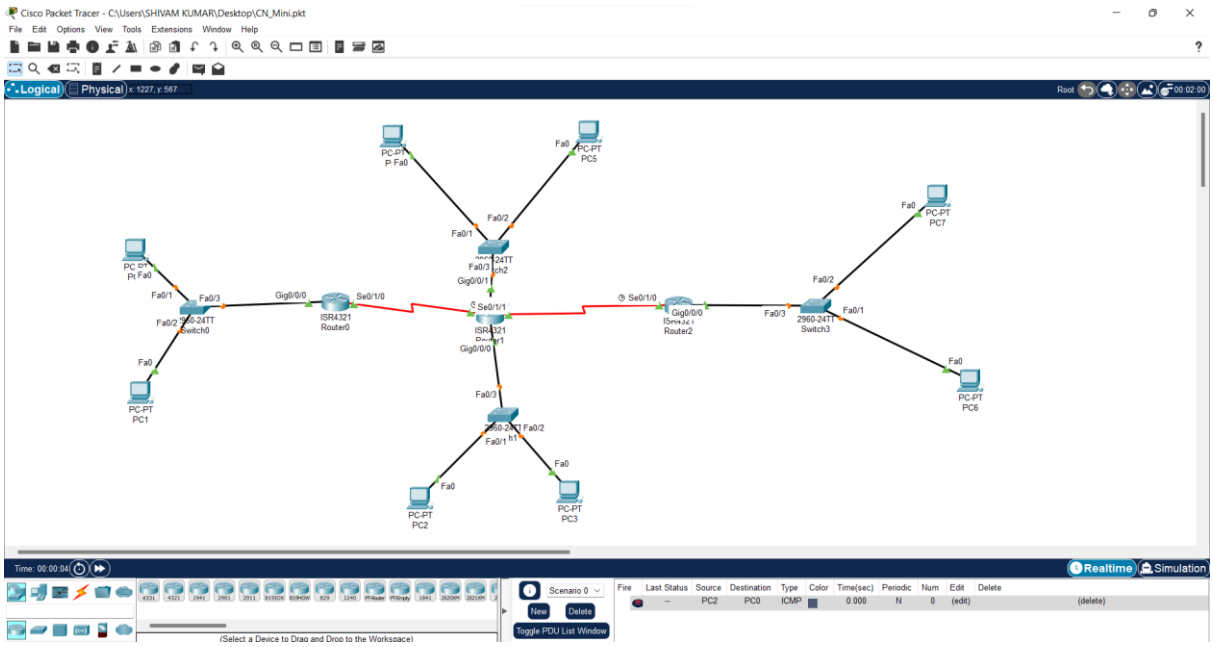
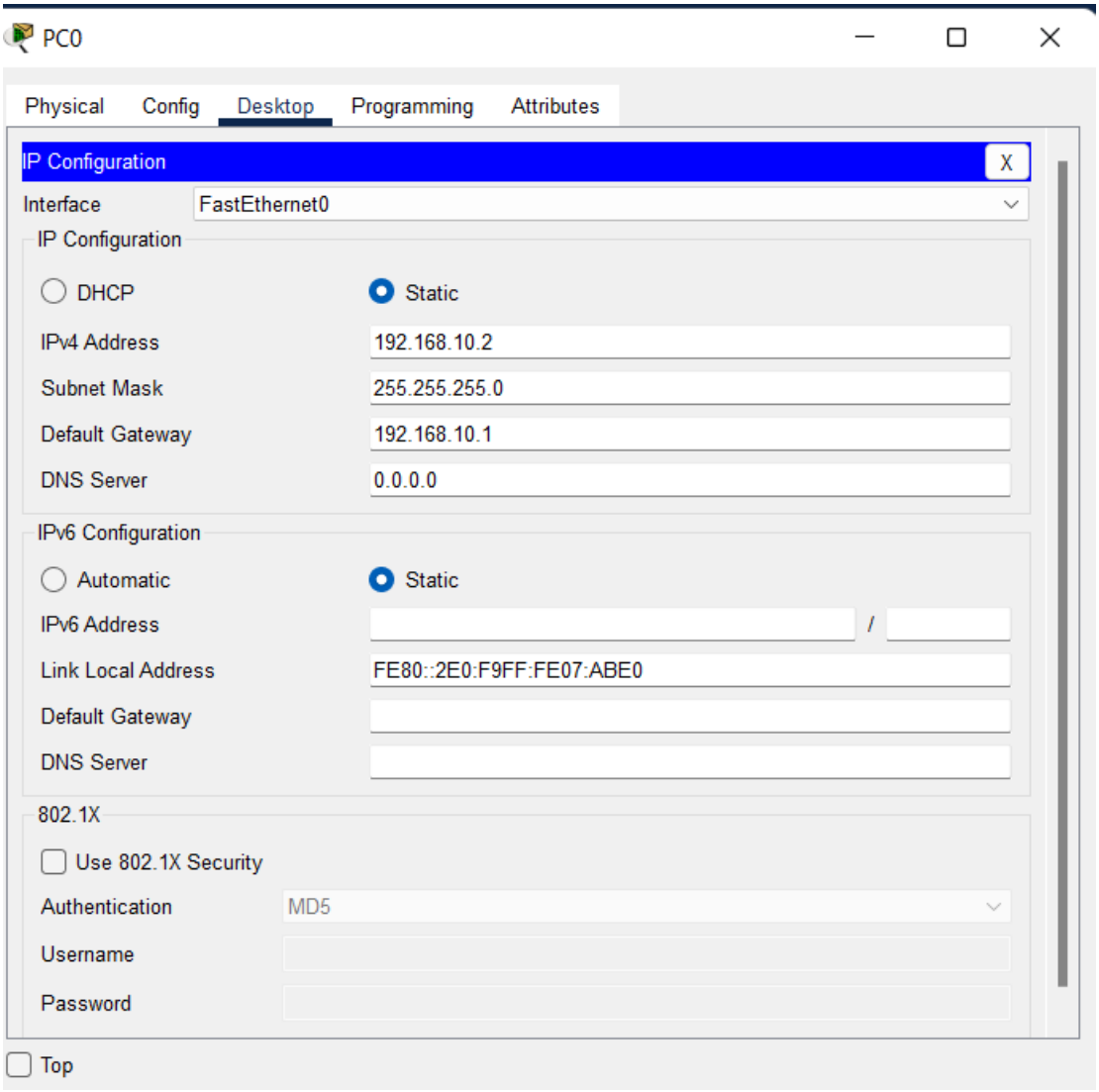


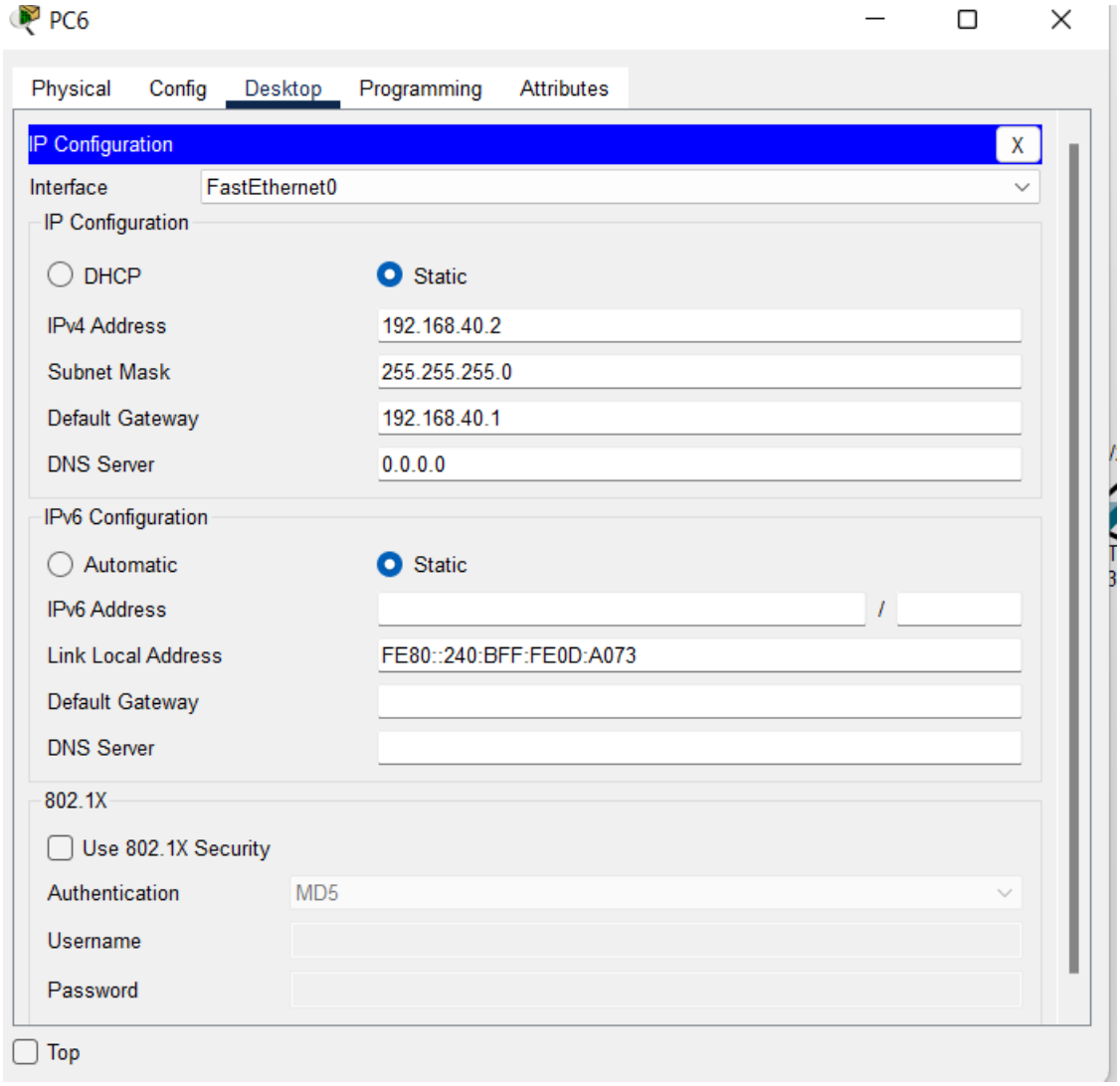
Fig 1.9

This figure (Fig 1.9) shows the system that we have built to service our requirements

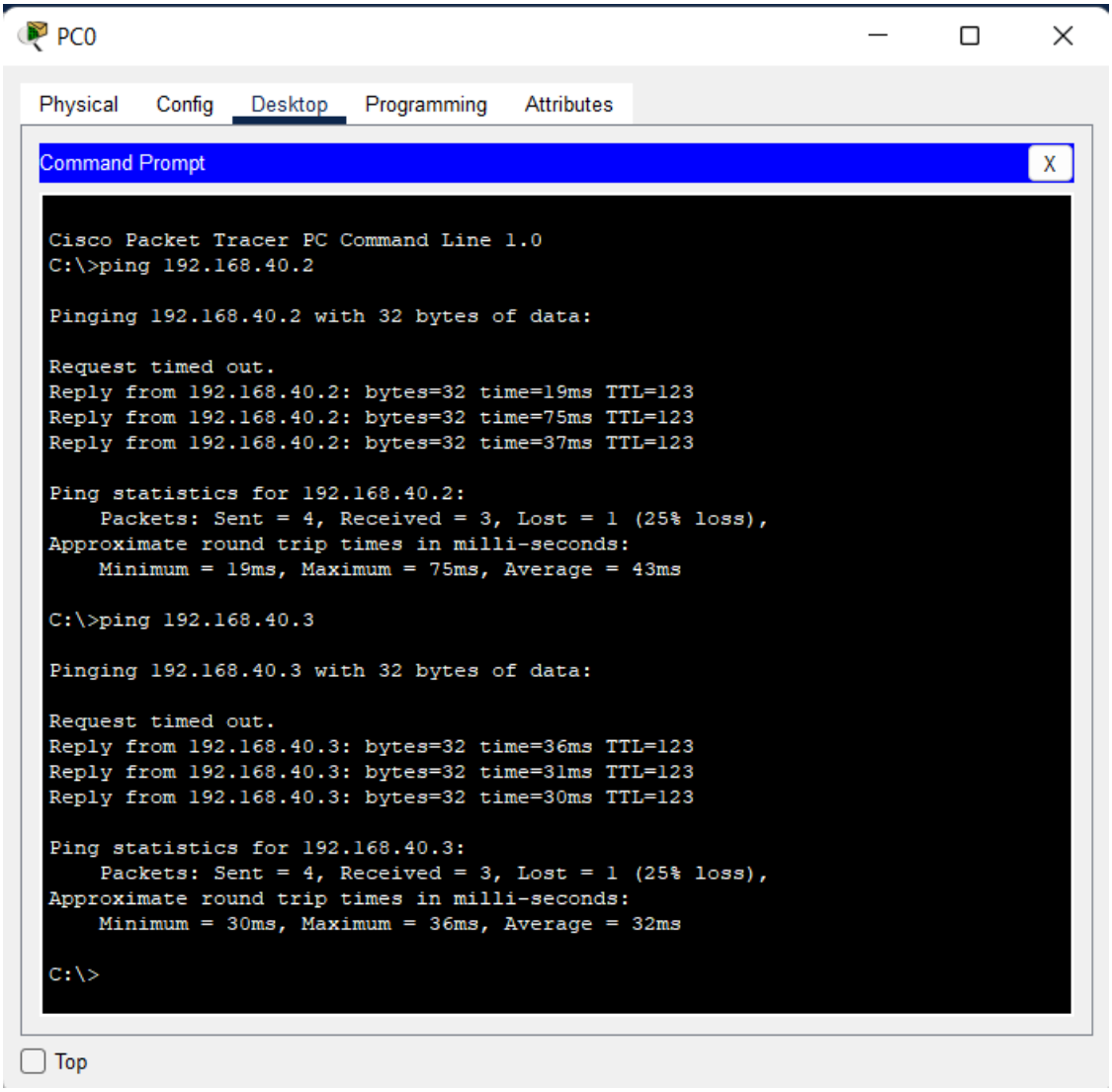
IMPLEMENTATION

IP CONFIGURATION:




PC6
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.40.2
Subnet Mask
255.255.255.0
Default Gateway
192.168.40.1
DNS Server
0.0.0.0
IPv6 Configuration
Automatic
Static
IPv6 Address
/
Link Local Address
FE80::240:BFF:FE0D:A073
Default Gateway
DNS Server
802.1X
Use 802.1X Security
Authentication
MD5
Username
Password
Top

Ping the PC's:

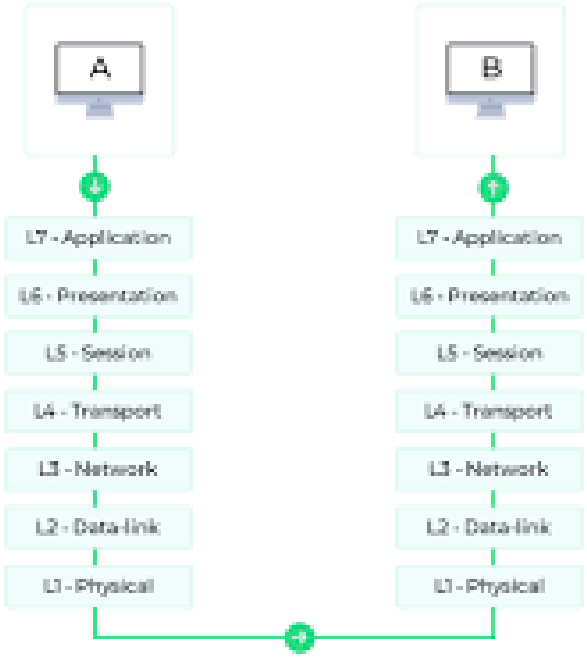

PC0
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.40.2
Pinging 192.168.40.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.40.2: bytes=32 time=19ms TTL=123
Reply from 192.168.40.2: bytes=32 time=75ms TTL=123
Reply from 192.168.40.2: bytes=32 time=37ms TTL=123
Ping statistics for 192.168.40.2:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 19ms, Maximum = 75ms, Average = 43ms
C:\>ping 192.168.40.3
Pinging 192.168.40.3 with 32 bytes of data:
Request timed out.
Reply from 192.168.40.3: bytes=32 time=36ms TTL=123
Reply from 192.168.40.3: bytes=32 time=31ms TTL=123
Reply from 192.168.40.3: bytes=32 time=30ms TTL=123
Ping statistics for 192.168.40.3:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 30ms, Maximum = 36ms, Average = 32ms
C:\>
Top

Protocols Used:

There are various protocols available for us to use while developing such a system. We can choose a protocol based upon our requirements or main goals. Some of these protocols are:

Transmission Control Protocol (TCP)
File Transfer Protocol (FTP)
Internet Protocol (IP)
User Datagram Protocol (UDP)
Post office Protocol (POP)

Let us say that for this organization, the generation and send out of invoices is of utmost importance. This is because this might be a trading or equity broking company who will have to optimally give the transaction details to their clients, on whose behalf they might be working. In this case, since we are using the system to transfer file type content between the stakeholders, we might want to use file transfer protocol or FTP.



FTP Mainly facilitates communication between a client and a server. FTP servers are the solutions used to facilitate file transfers across the internet. If you send files using FTP, files are either uploaded or downloaded to the FTP server. When you're uploading files, the files are transferred from a personal computer to the server. When you're downloaded files, the files are transferred from the server to your personal computer. TCP/IP (Transmission Control Protocol/InternetProtocol), or the language the internet uses to execute commands, is used to transfer files via FTP.

FTP servers can be considered the midpoint between the sender and the recipient of afile. For FTP servers to work, you need the server address. Here's an example of whatthis address may look like "ftp.examplecompany.net". Sometimes, the server address will be given as a numeric address, like "12.345.678.90".

Depending on the type of FTP server you use and the level of security that is needed, you may have to input a username and password. Some FTP servers allow for anonymous connection, which does not require you to enter a name or password to gainaccess.

A network host is a computer or other device connected to a computer network. A host may work as a server offering information resources, services, and applications to users or other hosts on the network. Hosts are assigned at least one network address.

Hosts typically do not include intermediary network devices like switches and routers, which are instead often categorized as nodes. A node is also a broader term that includes anything connected to a network, while a host requires an IP address. In other words, all hosts are nodes, but network nodes are not hosts unless they require an IP address to function.

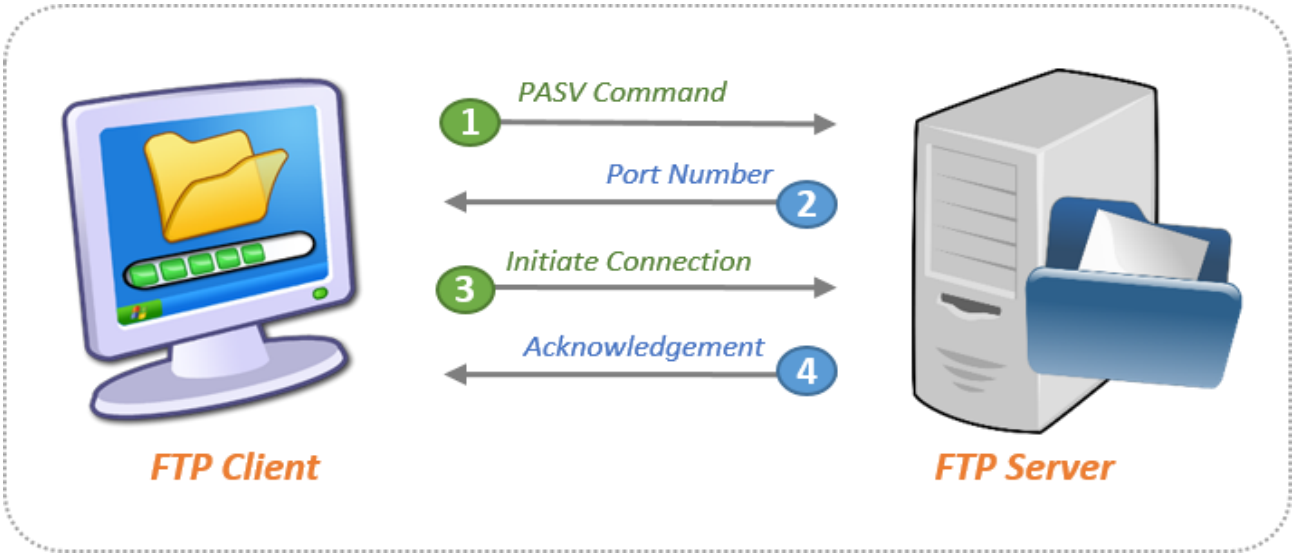


Fig 1.10

Fig 1.10 Shows a general handshake between a client and a server

File transfer protocol is a way to connect two computers to one another in the safestpossible way to help transfer files between two or more points. To put it simply, it's the means by which files are securely shared between parties.

File Transfer Protocol (FTP) is the standard mechanism provided by TCP/IP for copying a file from one host to another.

Although transferring files from one system to another seems simple and straightforward.

Before transferring, some problems must be dealt with first, such as:two

systems may use different file name conventions.

Two systems may have different ways to represent text and data.Two systems

may have different directory structures.

All of these problems have been solved by FTP in a very simple and elegantapproach.

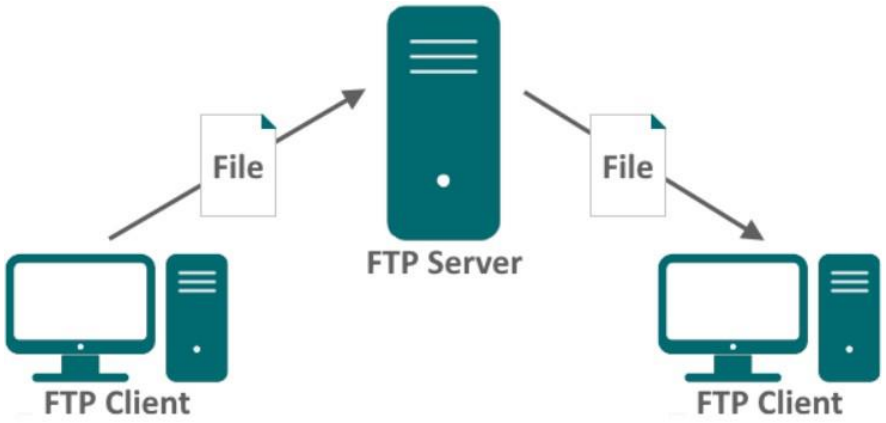
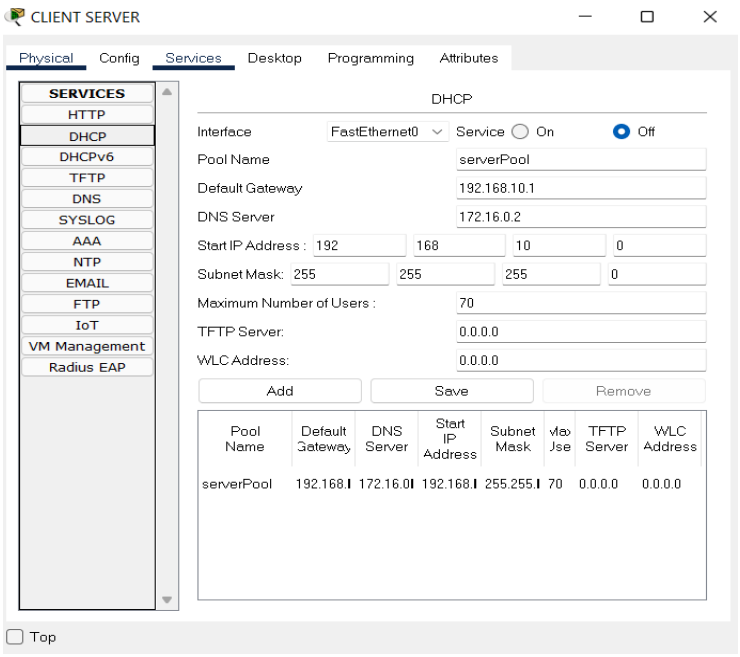


Fig 1.11

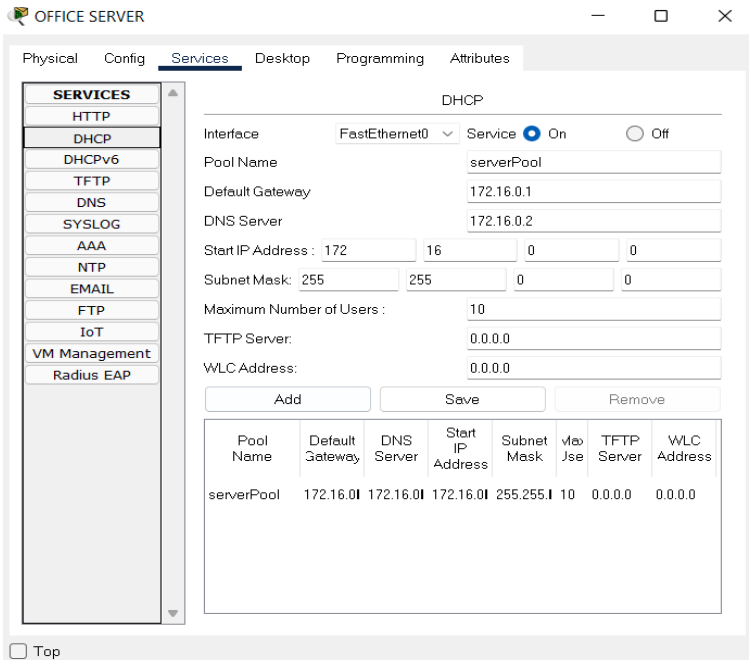
Fig 1.11 Shows a general FTP Client Server Model

Client Side Configuration:

`

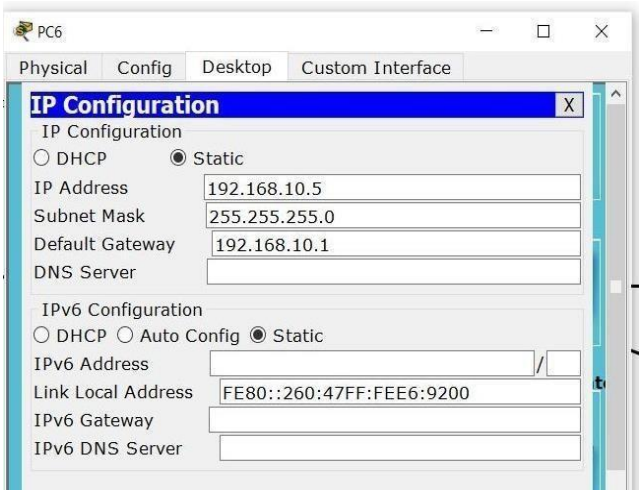


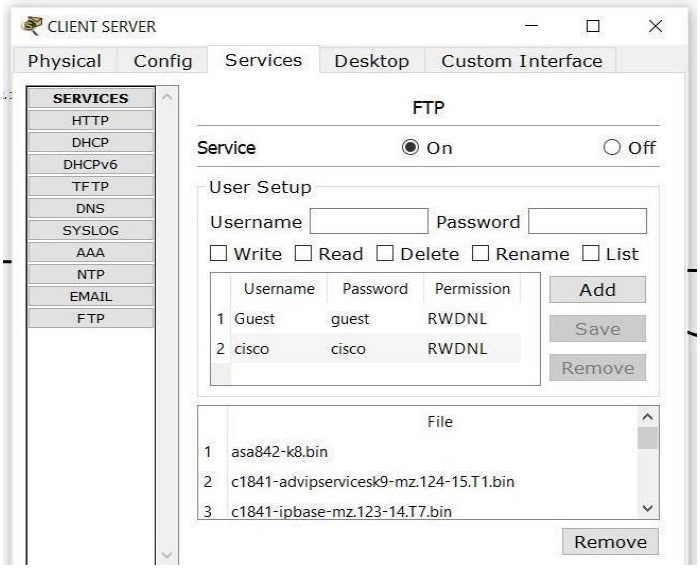
Server Side Configuration:



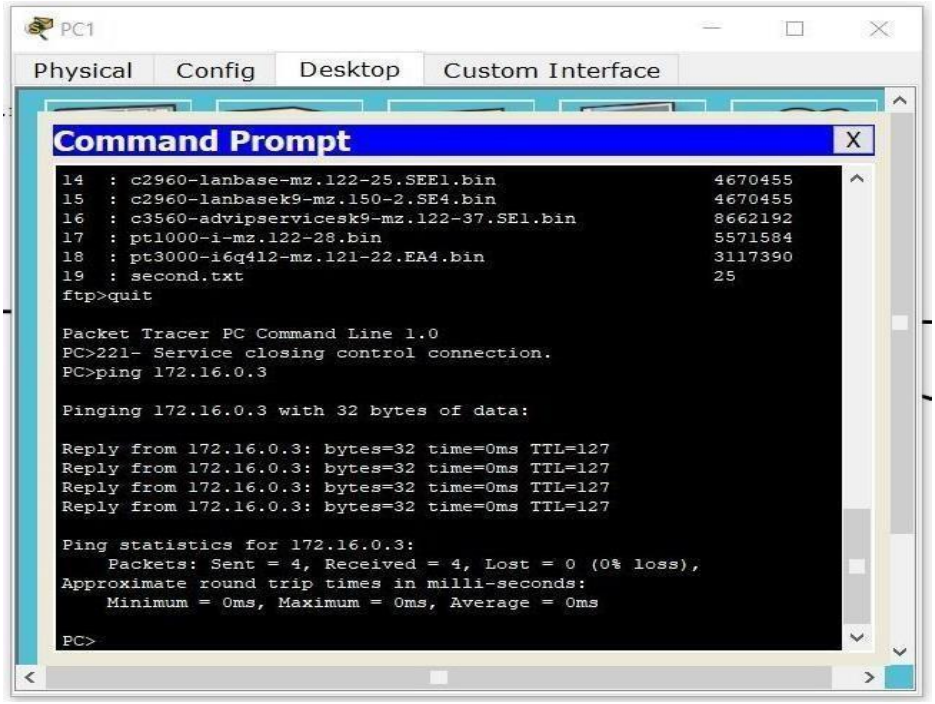
IMPLEMENTATION

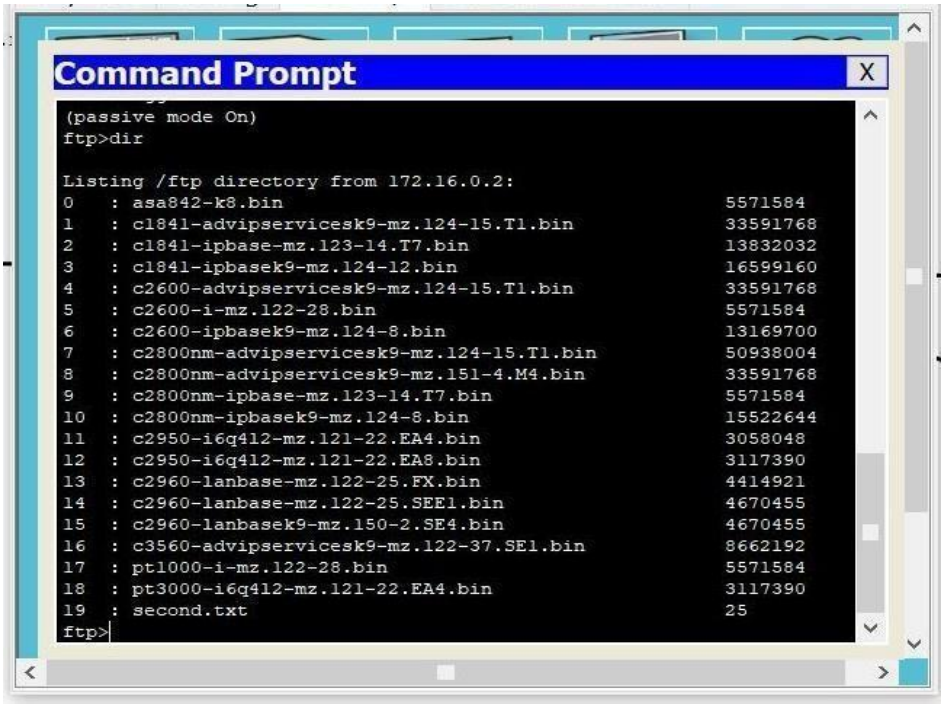
IP CONFIGURATION:





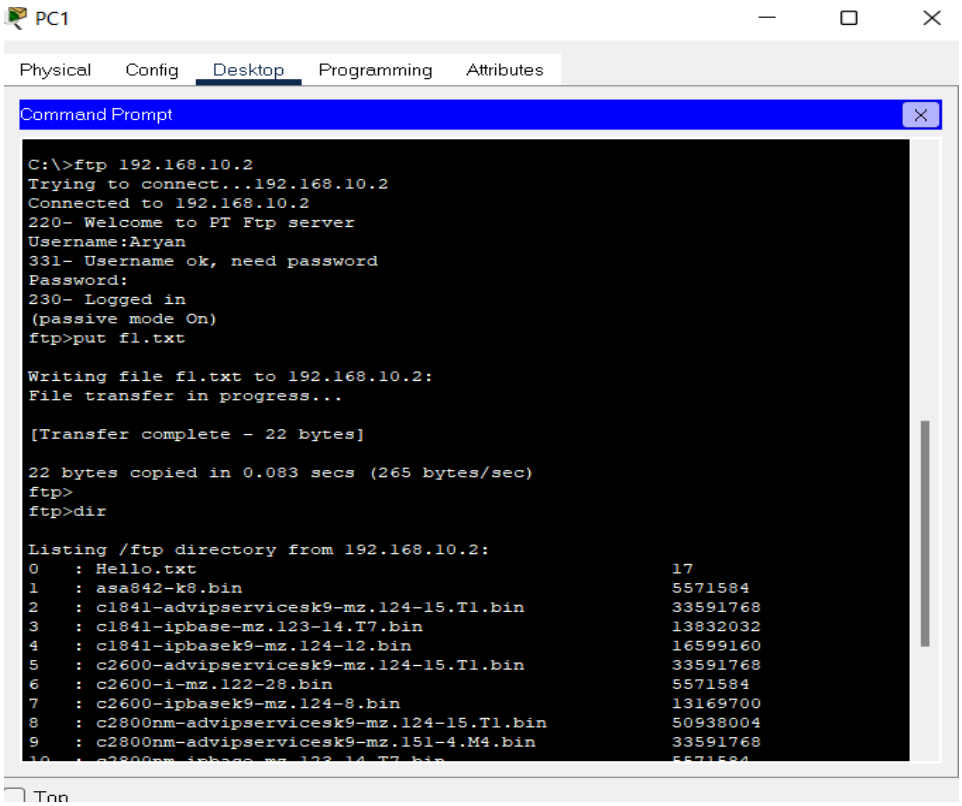
Pinging the servers -



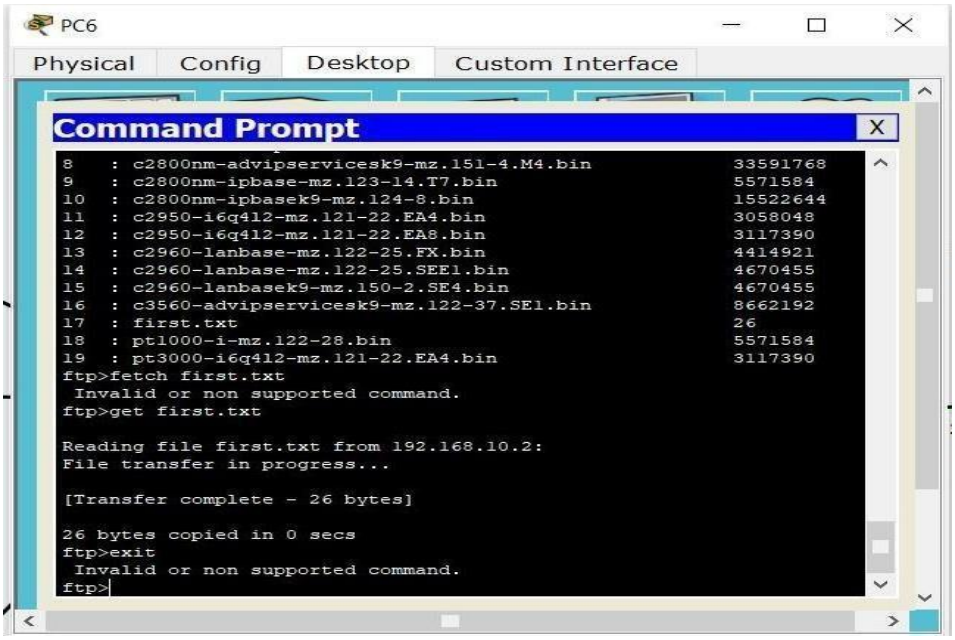


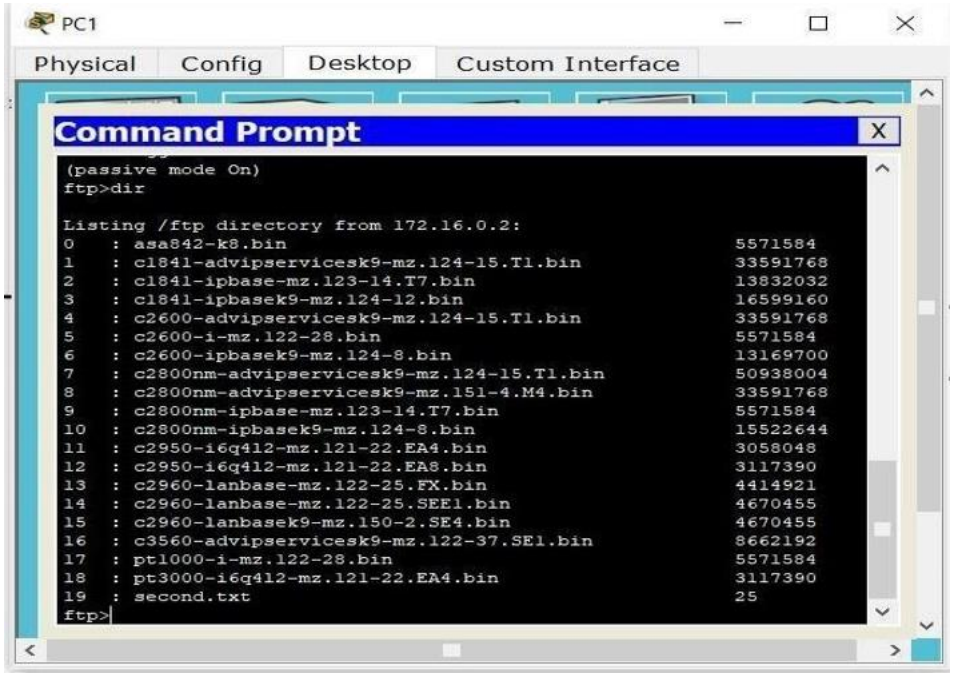
Transferring a file to the server:

Entering login details and sending a '.txt; file to the client server:



Server Side Get Request -

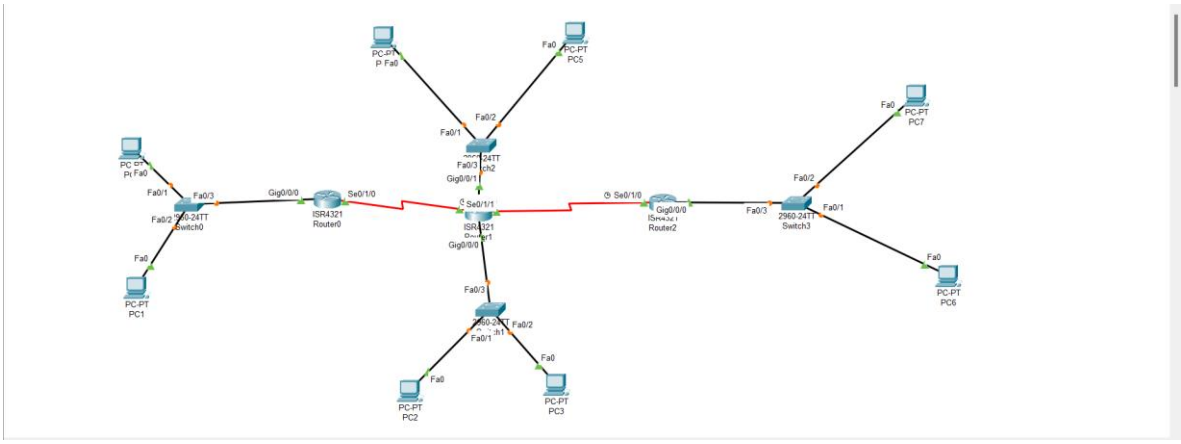




EXPERIMENT RESULTS & ANALYSIS:

Result:

The rough network sketch looks as follows:



Pinging a computer with data looks as follows:

```
C:\>ping 172.16.1.100

Pinging 172.16.1.100 with 32 bytes of data:

Reply from 172.16.1.100: bytes=32 time<1ms TTL=127
Reply from 172.16.1.100: bytes=32 time<1ms TTL=127
Reply from 172.16.1.100: bytes=32 time<1ms TTL=127
Reply from 172.16.1.100: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.1.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

CONCLUSION

A network was designed and implemented for a small business company/ organization. The primary goal of this project was to enable communication of data and information between all the stakeholders involved, while giving emphasis on provisional amenities like internet speeds, secure connections, data privacy, prevention of attacks and security breaches, availability of telephone lines, etc. By doing so, we can ensure that the business prospers due to the presence of a reliable system as a whole, to help them with their operations.

REFERENCES

https://en.wikipedia.org/wiki/Computer_networks

https://www.geeksforgeeks.org/basics-computer-networking/

https://cyberdotin.wordpress.com/2018/05/05/how-do-you-configure-ftpserver-in-packet-tracer/

www.community.cisco.com www.packettracernetwork.com

https://www.cisco.com/c/en/us/solutions/small-business/resource-center/networking/how-to-set-up-a-network.html

https://www.netacad.com/courses/packet-tracer

https://www.cisco.com/c/en_in/index.html

https://www.cisco.com/c/en_in/solutions/small-business/networking.html

https://www.networkworld.com/

https://www.studytonight.com/computer-networks/ftp-protocol

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