

B.M.S. COLLEGE OF ENGINEERING BENGALURU
Autonomous Institute, Affiliated to VTU



Lab Record

Computer Networks – 23CS5PCCON

Submitted in partial fulfillment for the 5th Semester Laboratory

Bachelor of Engineering
in
Computer Science and Engineering

Submitted by:

Dhanush K

(1BM24CS404)

Department of Computer Science and Engineering
B.M.S. College of Engineering
Bull Temple Road, Basavanagudi, Bangalore 560 019
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B.M.S. COLLEGE OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND

ENGINEERING



CERTIFICATE

This is to certify that the Computer Networks (23CS5PCCON) laboratory has been carried out by Dhanush K(1BM24CS404) during the 5th Semester August 2025- December 2025

Signature of the Faculty Incharge:

Rashmi H
Assistant Professor
Department of Computer Science and Engineering
B.M.S. College of Engineering, Bangalore

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4.	Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply.
5.	Configure default route, static route to the Router.
6.	Configure RIP routing Protocol in Routers.
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9.	To construct a WLAN and make the nodes communicate wirelessly.
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11.	To understand the operation of TELNET by accessing the router in server room from a PC in IT office.
12.	To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP).

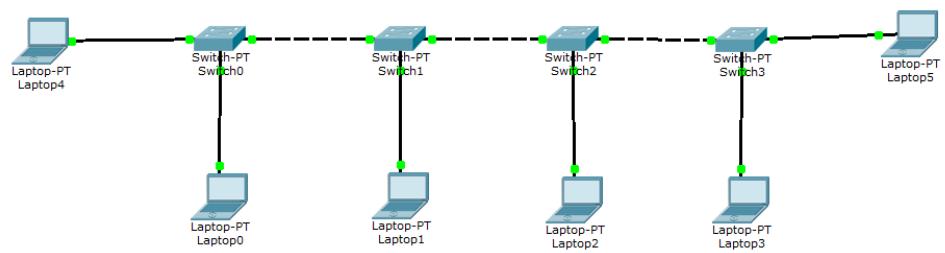
PART – B	
Serial No.	Name of Experiment
1.	Write a program for congestion control using Leaky bucket algorithm.
2.	Using TCP/IP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.
3.	Using UDP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.
4.	Write a program for error detecting code using CRC-CCITT (16-bits).

PART - A

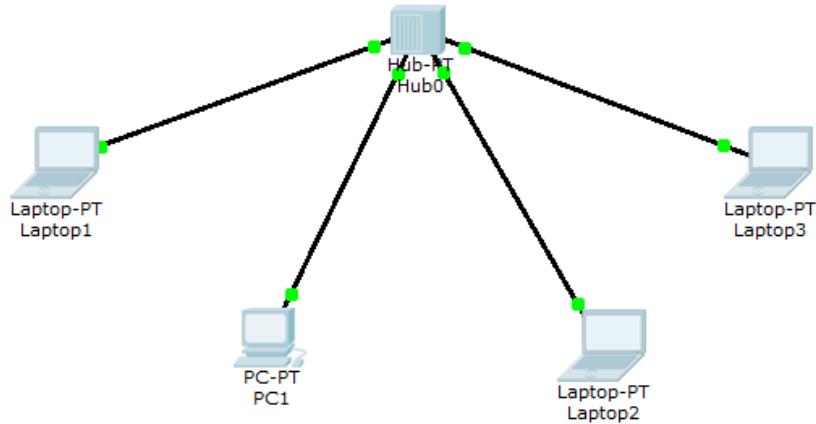
Program 1: Create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping message.

Network diagram:

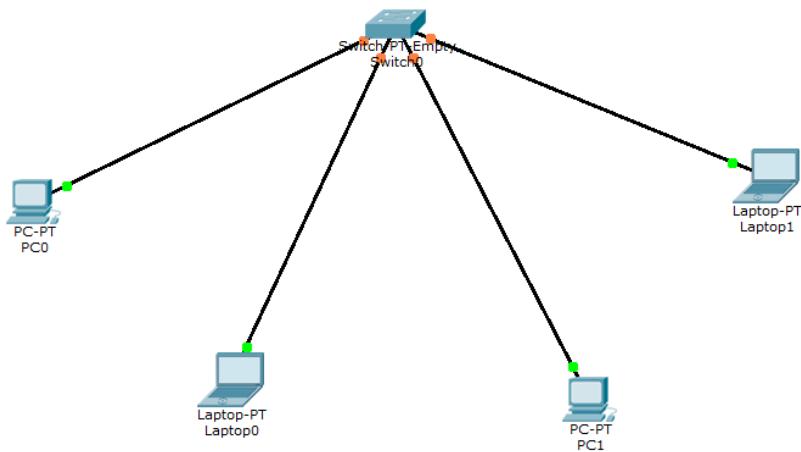
Bus



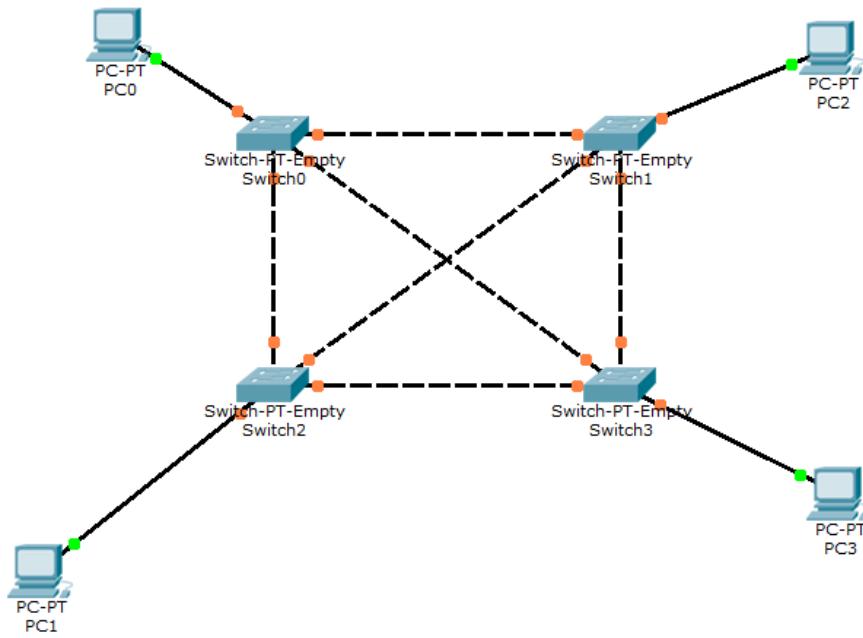
Hub



Switch

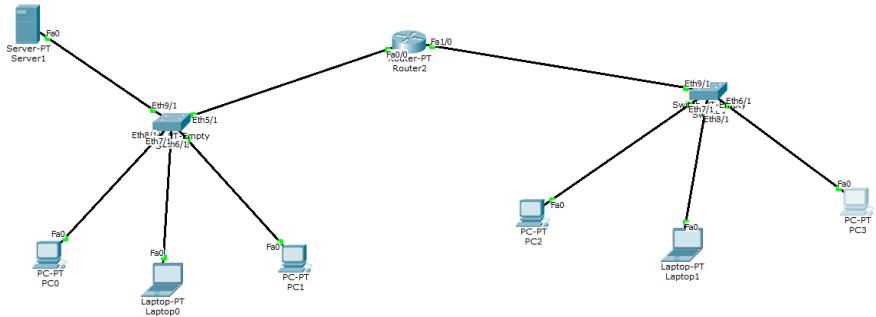


Mesh

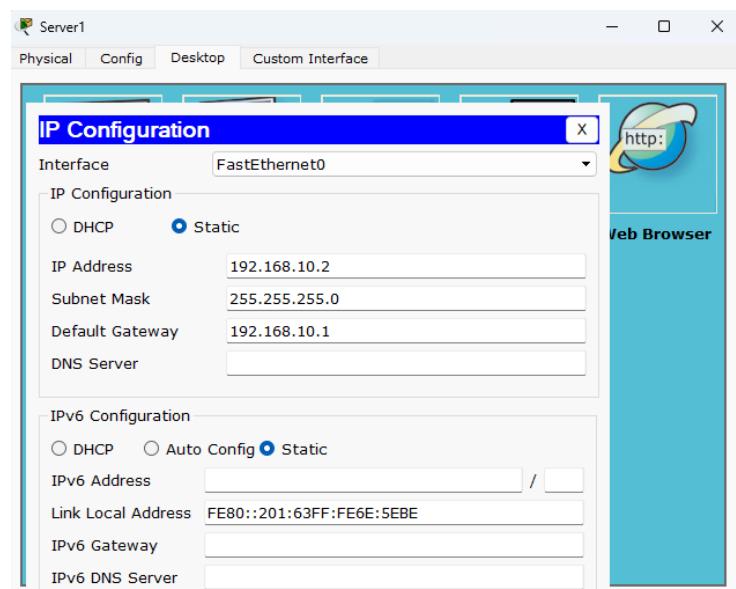
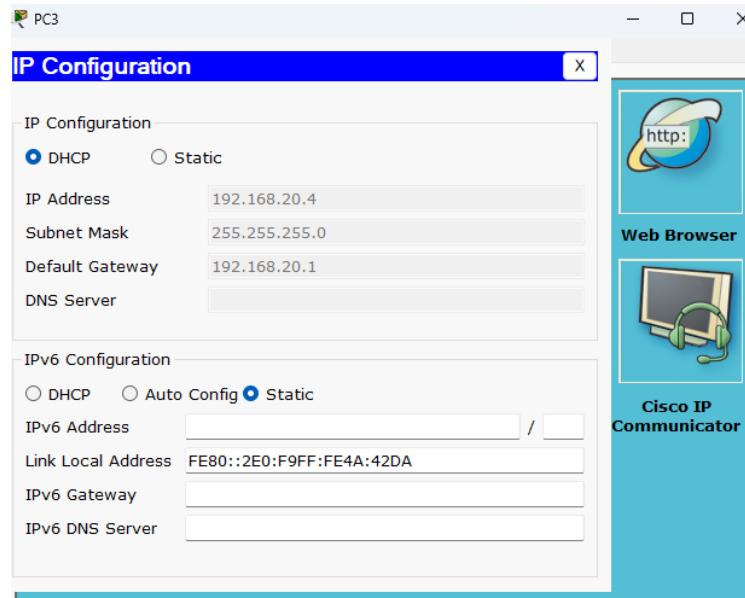


Program 2: Configure DHCP within a LAN and outside LAN.

Network diagram:



Configuration:



```
PT 1001 (PTSC2005) processor (revision 0x200) with 60416K/8120K bytes of memory
.
Processor board ID PT0123 (0123)
PT2005 processor: part number 0, mask 01
Bridging software.
X.25 software, Version 3.0.0.
4 FastEthernet/IEEE 802.3 interface(s)
2 Low-speed serial(sync/async) network interface(s)
32K bytes of non-volatile configuration memory.
63488K bytes of ATA CompactFlash (Read/Write)

    --- System Configuration Dialog ---

Continue with configuration dialog? [yes/no]: no

Press RETURN to get started!

Router>enable
Router>conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int Fa0/0
Router(config-if)#ip address 192.168.10.1 255.255.255.0
Router(config-if)#ip helper-address 192.168.10.2
Router(config-if)#no shutdown

Router(config-if)#
$LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

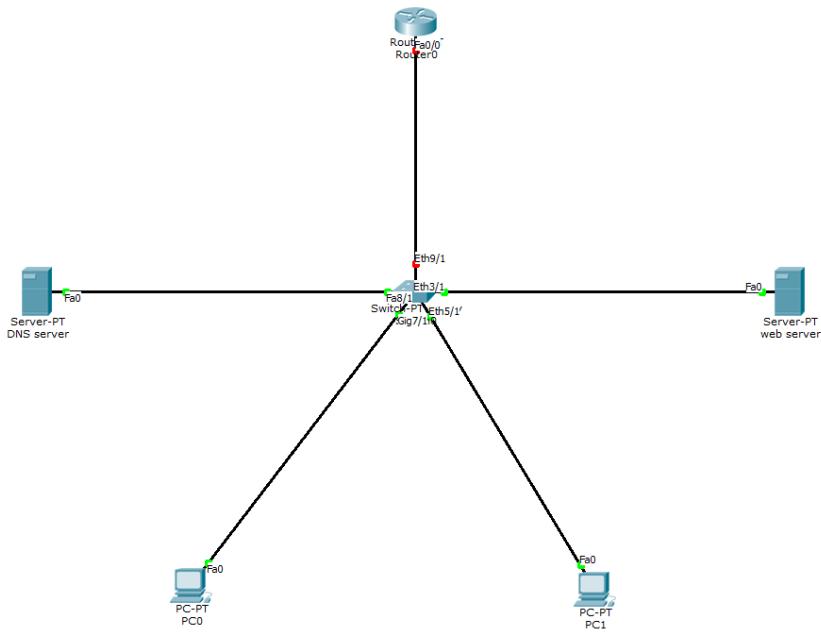
$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to
o up
do write memory
Building configuration...
[OK]
Router(config-if)#exit
Router(config)#int Fa1/0
Router(config-if)#ip address 192.168.20.1 255.255.255.0
Router(config-if)#ip helper-address 192.168.10.2
Router(config-if)#no shutdown

Router(config-if)#
$LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up

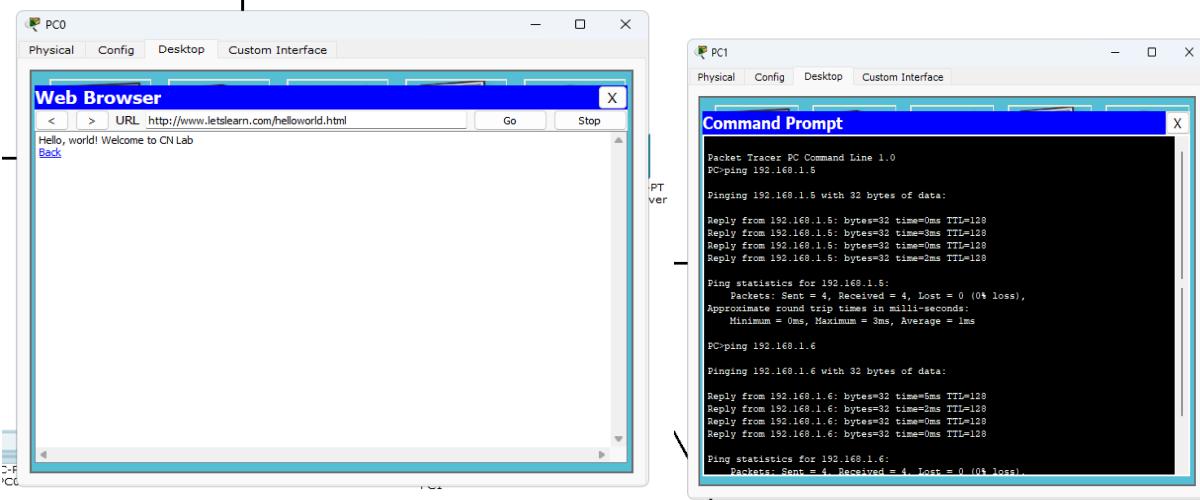
$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to
o up
do write memory
Building configuration...
[OK]
Router(config-if)#exit
Router(config)#exit
Router#
$SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router##IP-4-DUPADDR: Duplicate address 192.168.10.1 on FastEthernet0/0, sourced
by 000A.4166.1664
```

Program 3: Configure Web Server, DNS within a LAN.

Network diagram:

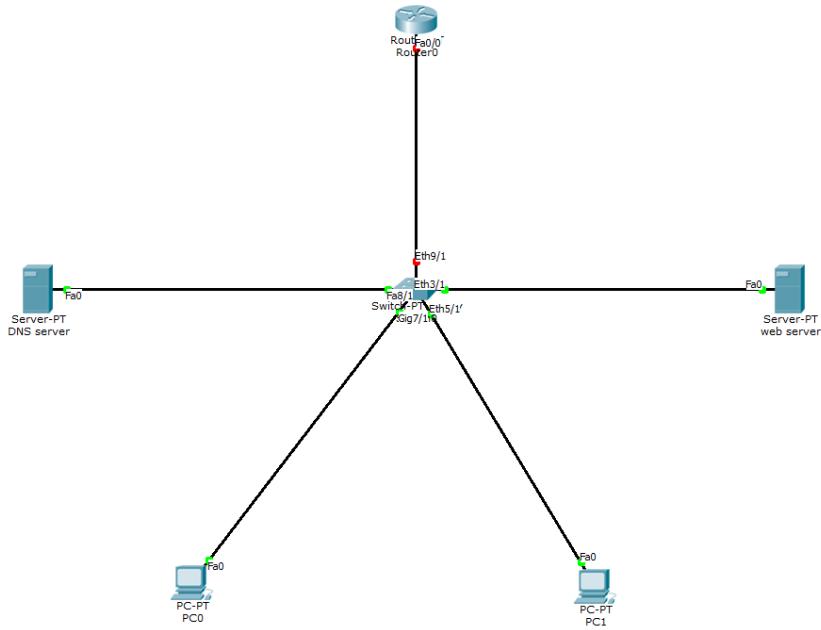


Configuration:



Program 4: Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply.

Network diagram:



Configuration:

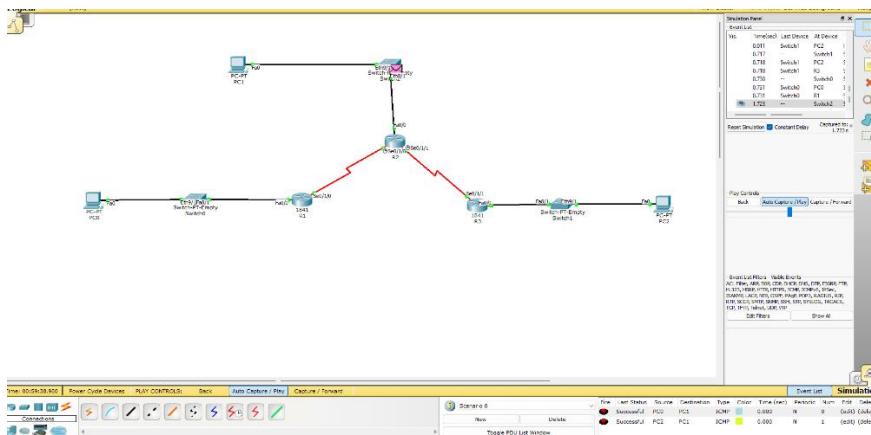
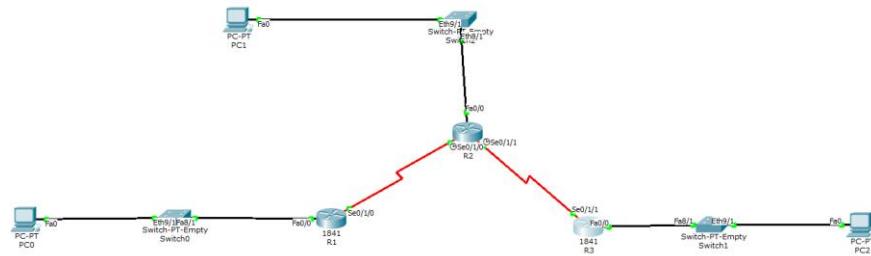
```
PC>ping 192.168.1.101
Pinging 192.168.1.101 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.1.101:
  Packets: Sent = 4, Received = 0, Lost = 4 (100% loss), Ping statistics for 192.168.1.6:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss)
  Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 5ms, Average = 1ms

PC>ping 192.168.1.6
Pinging 192.168.1.6 with 32 bytes of data:
Reply from 192.168.1.6: bytes=32 time=5ms TTL=128
Reply from 192.168.1.6: bytes=32 time=0ms TTL=128
Reply from 192.168.1.6: bytes=32 time=0ms TTL=128
Reply from 192.168.1.6: bytes=32 time=0ms TTL=128
```

Program 5: Configure default route, static route to the Router.

Network diagram:



Configuration:

PC0

IP Configuration

IP Configuration

- DHCP Static

IP Address: 192.168.10.10
Subnet Mask: 255.255.255.0
Default Gateway: 192.168.10.1
DNS Server: []

IPv6 Configuration

- DHCP Auto Config Static

IPv6 Address: [] / []
Link Local Address: FE80::230:F2FF:FE57:D640
IPv6 Gateway: []
IPv6 DNS Server: []

R1

Physical Config CLI

IOS Command Line Interface

```

Router>enable
Router#enable
Building configuration...
[OK]
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - Candidate default, o - per-user static route, o - ODR
      P - Periodic downloaded static route

Gateway of last resort is not set

C 172.16.1.0/24 is directly connected, Serial0/1/0
S 172.16.1.2 [1/0] via 172.16.1.2
C 192.168.10.0/24 is directly connected, FastEthernet0/0
S 192.168.20.0/24 [1/0] via 172.16.1.2
S 192.168.30.0/24 [1/0] via 172.16.1.2
Router#
Router#

```

Continue with configuration dialog? {yes/no}: no

Press RETURN to get started!

```

Router>enable
Router>conf t
Building configuration commands, one per line. End with CNTL/Z.
Router>(config)#int R2/0
R2(config)#ip address 172.16.1.2 255.255.255.252
R2(config)#no shutdown

R2(config-if)#
$LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
$LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up

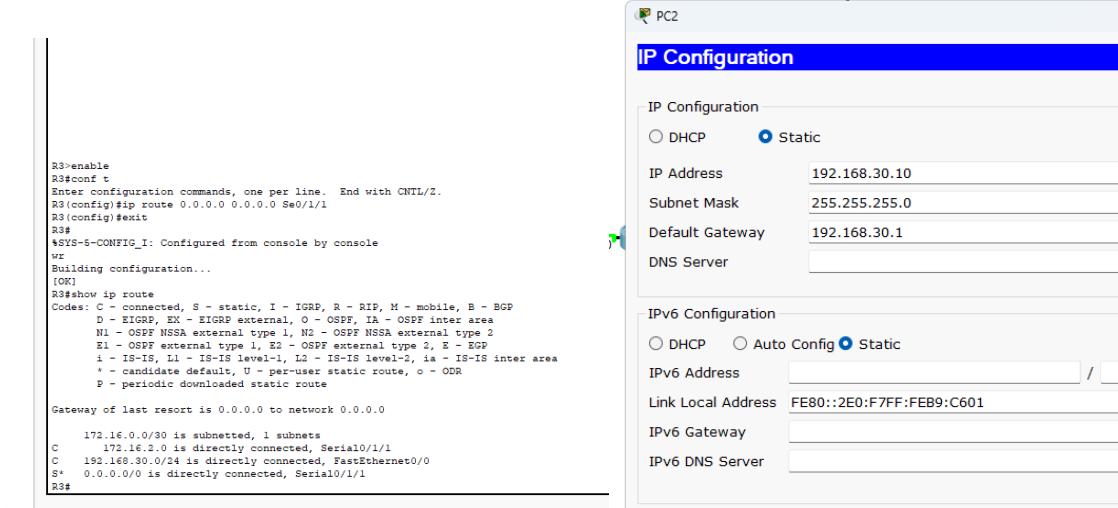
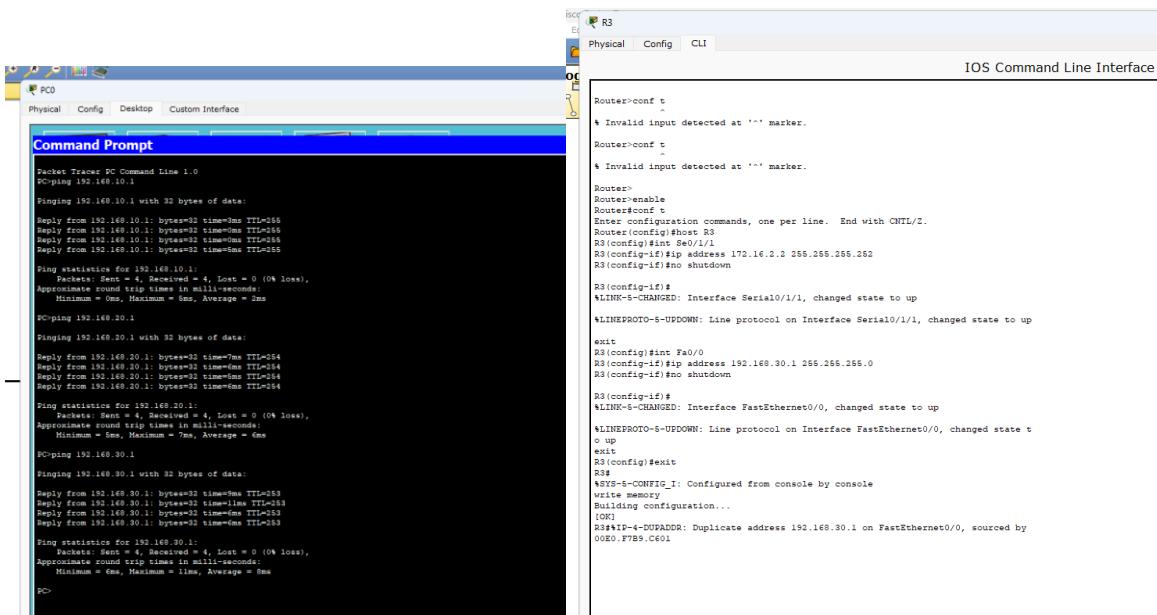
exit
R2(config)#int Fa0/0
R2(config-if)#ip address 192.168.20.1 255.255.255.0
R2(config-if)#no shutdown

R2(config-if)#
$LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

exit
R2(config)#int Se0/1/1
R2(config-if)#ip address 172.16.2.1 255.255.255.252
R2(config-if)#no shutdown

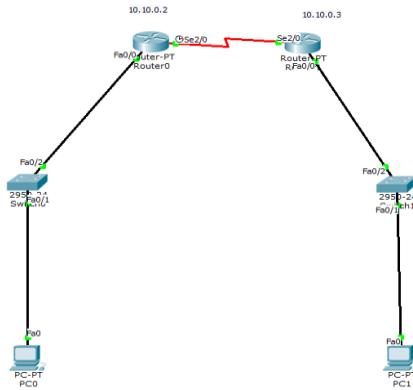
$LINK-5-CHANGED: Interface Serial0/1/1, changed state to down
R2(config-if)#exit
R2(config)#exit
R2#
$SYS-5-CONFIG_I: Configured from console by console
Building configuration...
[OK]
Router#
$LINK-5-CHANGED: Interface Serial0/1/1, changed state to up
$LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up

```

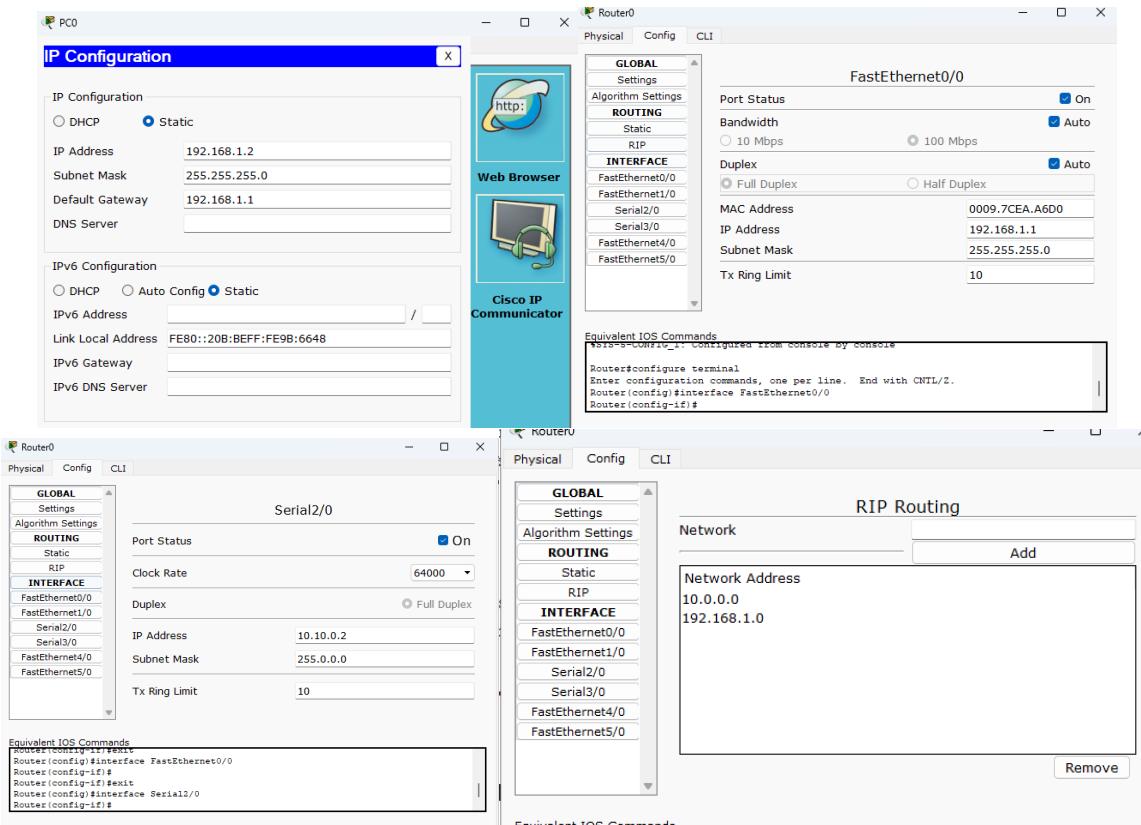


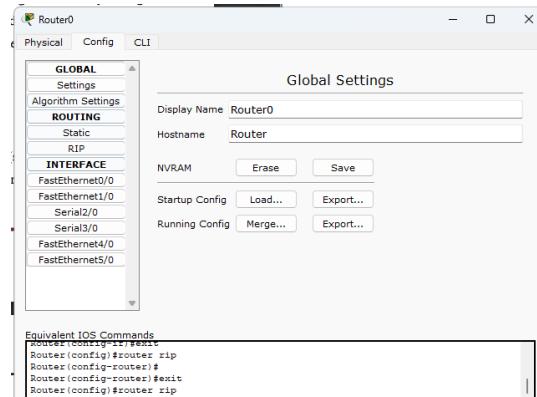
Program 6: Configure RIP routing Protocol in Routers.

Network diagram:



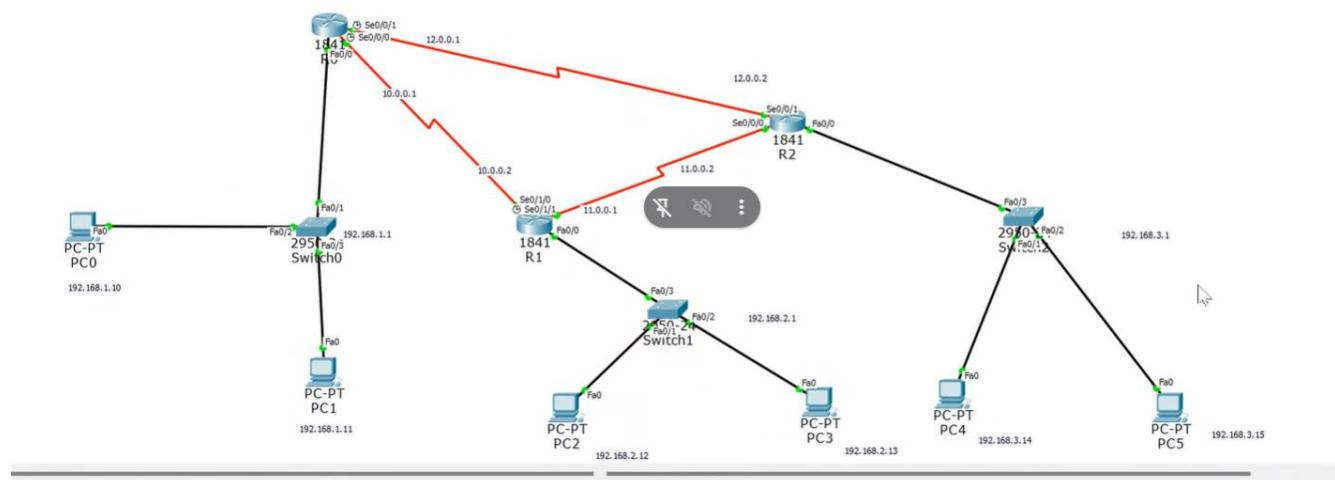
Configuration:





Program 7: Configure OSPF routing protocol.

Network diagram:



Configuration:

```

* Incomplete command.
Router(config)#exit
Router#
*SYS-5-CONFIG_I: Configured from console by console
enable
Router(config) t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 192.168.1.0 0.0.0.255 area0
^
* Invalid input detected at `^` marker.

Router(config-router)#network 192.168.1.1 0.0.0.255 area0
^
* Invalid input detected at `^` marker.

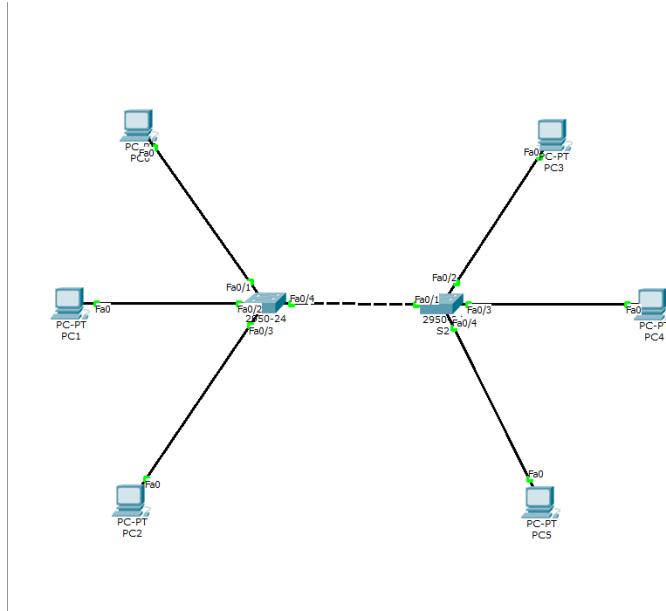
Router(config-router)#exit
Router(config)#exit
Router#
*SYS-5-CONFIG_I: Configured from console by console
enable
Router(config) t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf1
^
* Invalid input detected at `^` marker.

Router(config)#router ospf 1
Router(config-router)#

```

Program 8: To construct a VLAN and make the PC's communicate among a VLAN.

Network diagram:

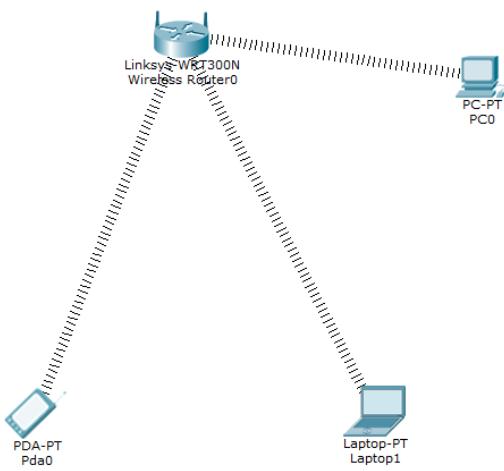


Configuration:

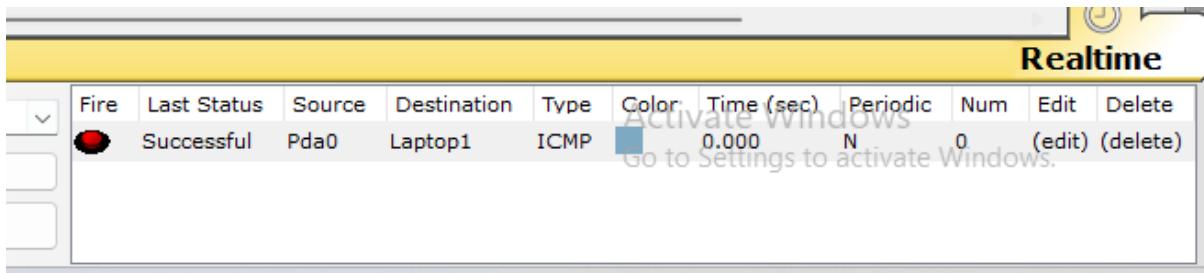
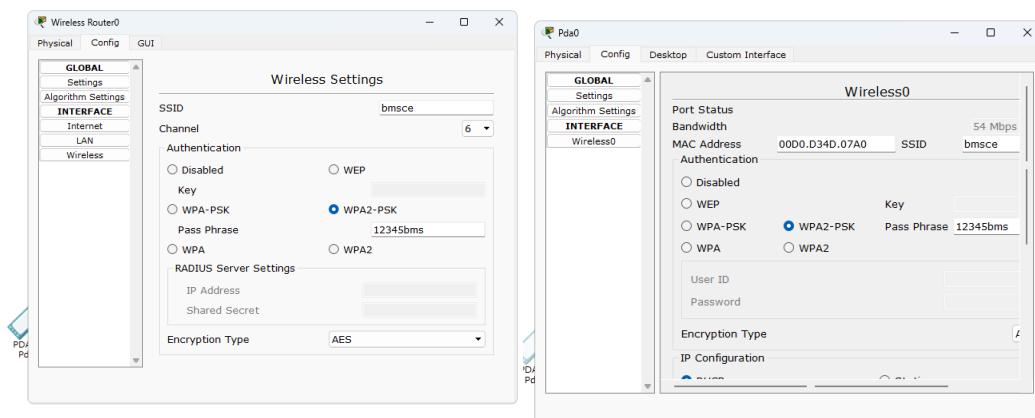
Switch Configuration (CLI)	IOS Command Line Interface (CLI)	Switch Status Table																						
<pre> Switch> Switch>enable Switch>conf t Enter configuration commands, one per line. End with CNTL/Z. Switch(config)#int fa0/1 Switch(config-if)#switchport access vlan 10 # Access VLAN does not exist. Creating vlan 10 Switch(config-if)#int fa0/2 Switch(config-if)#switchport access vlan 20 # Access VLAN does not exist. Creating vlan 20 Switch(config-if)#int fa0/3 Switch(config-if)#switchport access vlan 30 # Access VLAN does not exist. Creating vlan 30 Switch(config-if)#int fa0/4 Switch(config-if)#switchport mode trunk Switch(config-if)# \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state t o down \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state t o up </pre>	<pre> Physical Config CLI IOS Command Line Interface \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state t o up \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state t o down \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state t o up Switch>enable Switch>conf t Enter configuration commands, one per line. End with CNTL/Z. Switch(config)#int fa0/1 Switch(config-if)#switchport access vlan 10 # Access VLAN does not exist. Creating vlan 10 Switch(config-if)#int fa0/3 Switch(config-if)#switchport access vlan 20 # Access VLAN does not exist. Creating vlan 20 Switch(config-if)#int fa0/4 Switch(config-if)#switchport access vlan 30 # Access VLAN does not exist. Creating vlan 30 Switch(config-if)#int fa0/1 Switch(config-if)#switchport mode trunk Switch(config-if)# </pre>	<table border="1"> <thead> <tr> <th>Fire</th> <th>Last Status</th> <th>Source</th> <th>Destination</th> <th>Type</th> <th>Color</th> <th>Time (sec)</th> <th>Periodic</th> <th>Num</th> <th>Edit</th> <th>Delete</th> </tr> </thead> <tbody> <tr> <td>●</td> <td>Failed</td> <td>PC0</td> <td>PC4</td> <td>ICMP</td> <td></td> <td>2.028</td> <td>N</td> <td>0</td> <td>(edit)</td> <td>(delete)</td> </tr> </tbody> </table>	Fire	Last Status	Source	Destination	Type	Color	Time (sec)	Periodic	Num	Edit	Delete	●	Failed	PC0	PC4	ICMP		2.028	N	0	(edit)	(delete)
Fire	Last Status	Source	Destination	Type	Color	Time (sec)	Periodic	Num	Edit	Delete														
●	Failed	PC0	PC4	ICMP		2.028	N	0	(edit)	(delete)														

Program 9: To construct a WLAN and make the nodes communicate wirelessly.

Network diagram:

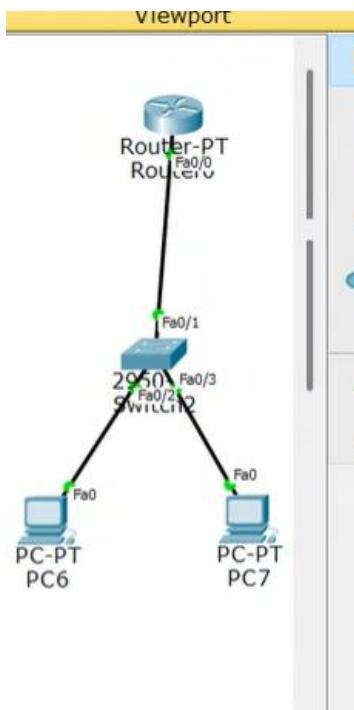


Configuration:

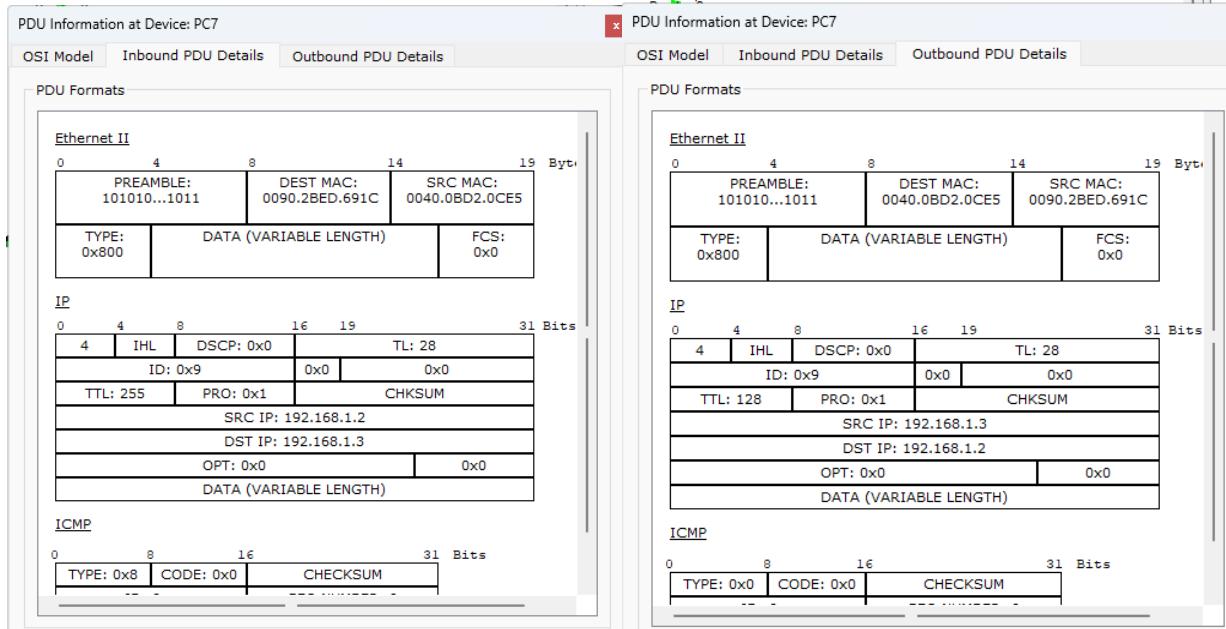


Program 10: Demonstrate the TTL/ Life of a Packet.

Network diagram:

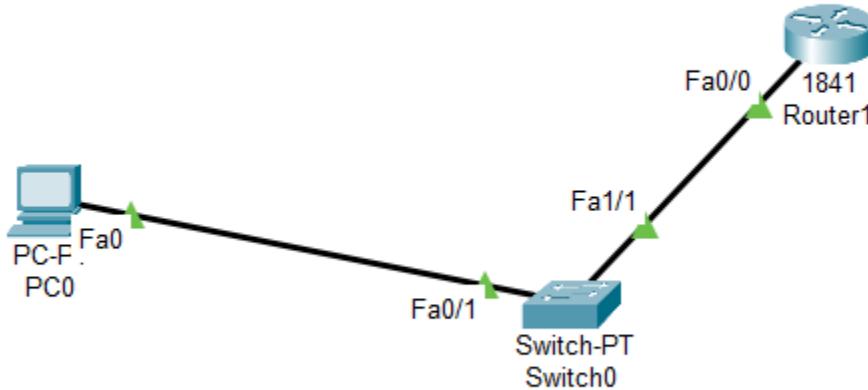


Configuration:



Program 11: To understand the operation of TELNET by accessing the router in server room from a PC in IT office.

Network diagram:



Configuration:

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#enable secret rp
Router(config)#int Fa 0/0
Router(config-if)#int address 192.168.1.1 255.255.255.0
^
% Invalid input detected at '^' marker.

Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#
Router(config-if)#line vty
^
% Invalid input detected at '^' marker.

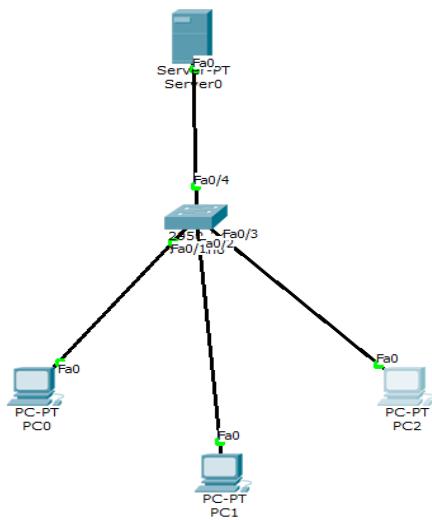
Router(config-if)#line vty
^
% Invalid input detected at '^' marker.

Router(config-if)#line vty
^
% Invalid input detected at '^' marker.

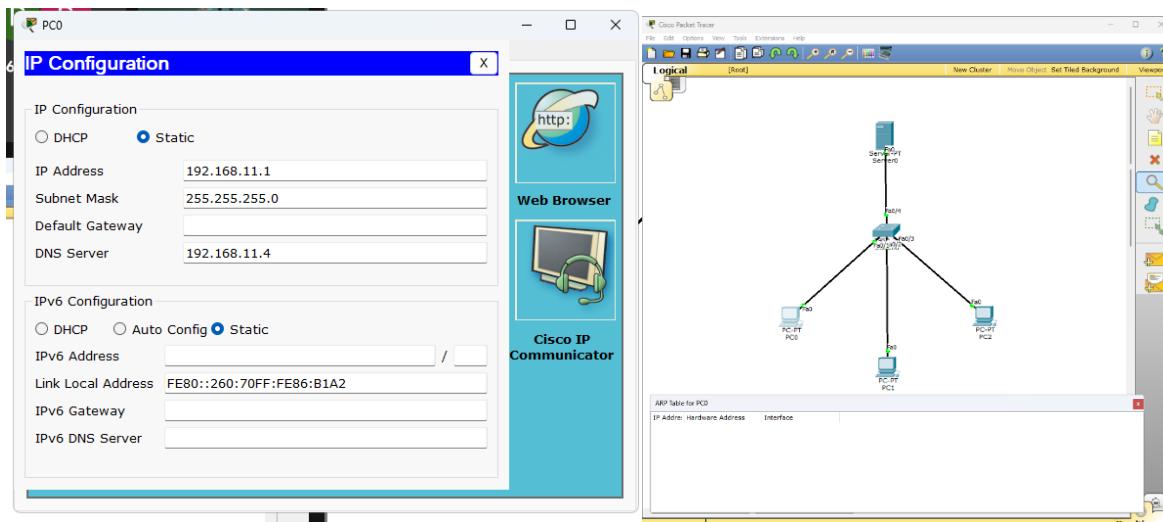
Router(config-if)#exit
Router(config)#line vty
% Incomplete command.
Router(config)#login
% Incomplete command.
Router(config)#enable secret rp
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
enable
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#enable secret rp
```

Program 12: To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP).

Network diagram:



Configuration:



PC0

Physical Config Desktop Custom Interface

Command Prompt

```

Packet Tracer PC Command Line 1.0
PC>ARP -A
  Internet Address      Physical Address      Type
  192.168.11.4          0001.962C.ED36      dynamic

PC>PING 192.168.11.4
Pinging 192.168.11.4 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.11.4:
  Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>

```

PDU Information at Device: PC1

OSI Model Outbound PDU Details

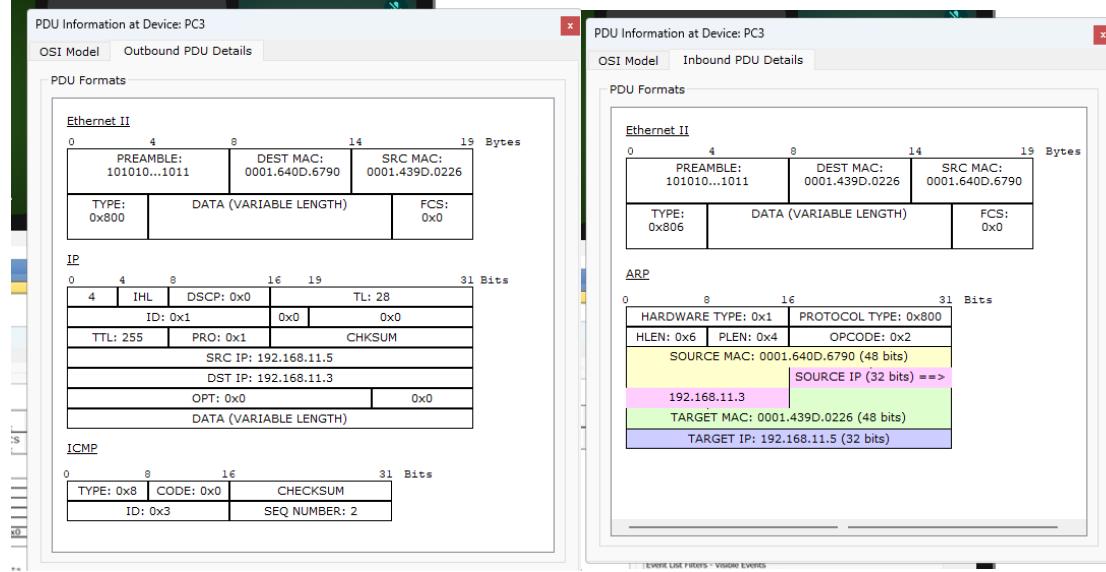
PDU Formats

Ethernet II

0	4	8	14	19	Bytes
PREAMBLE: 101010...1011				DEST MAC: FFFF.FFFF.FFFF	SRC MAC: 0001.962C.ED36
TYPE: 0x806				DATA (VARIABLE LENGTH)	
				FCS: 0x0	

ARP

0	8	16	31	Bits
HARDWARE TYPE: 0x1 PROTOCOL TYPE: 0x800				
HLEN: 0x6	PLEN: 0x4	OPCODE: 0x1		
SOURCE MAC: 0001.962C.ED36 (48 bits)				
192.168.11.2 SOURCE IP (32 bits) ==>				
TARGET MAC: 0000.0000.0000 (48 bits)				
TARGET IP: 192.168.11.3 (32 bits)				



PART - B

Program 1: Write a program for congestion control using Leaky bucket algorithm.

Code: #include<stdio.h>

```
int min(int x, int y) {
    return (x < y) ? x : y;
}

int main() {
    int drop = 0, mini, nsec, cap, count = 0, i, inp[25], process;
    printf("Enter the bucket size: ");
    scanf("%d", &cap);
    printf("Enter the processing rate: ");
    scanf("%d", &process);
    printf("Enter the number of seconds you want to simulate: ");
    scanf("%d", &nsec);
    for (i = 0; i < nsec; i++) {
        printf("Enter the size of the packet entering at %d sec: ", i + 1);
        scanf("%d", &inp[i]);
    }
    printf("\n Second | Packet Received | Packet Sent | Packet Left | Dropped \n");
    printf("-----\n");
    for (i = 0; i < nsec; i++) {
        count += inp[i];
        if (count > cap) {
            drop = count - cap;
            count = cap;
        }
        printf("%6d | %15d | ", i + 1, inp[i]);
        mini = min(count, process);
        printf(" %11d | ", mini);

        count -= mini;
        printf(" %11d | %7d\n", count, drop);

        drop = 0;
    }
    while (count != 0) {
        i++;
        if (count > cap) {
            drop = count - cap;
            count = cap;
        }
        printf("%6d | %15d | ", i, 0);
        mini = min(count, process);
        printf(" %11d | ", mini);

        count -= mini;
        printf(" %11d | %7d\n", count, drop);
    }
}
```

```
    }
    return 0;
}
```

OUTPUT:

```
Enter the bucket size: 5
Enter the processing rate: 2
Enter the number of seconds you want to simulate: 3
Enter the size of the packet entering at 1 sec: 3
Enter the size of the packet entering at 2 sec: 4
Enter the size of the packet entering at 3 sec: 3
Enter the size of the packet entering at 4 sec: 4
Enter the size of the packet entering at 5 sec: 3

Second | Packet Received | Packet Sent | Packet Left | Dropped
-----|-----|-----|-----|-----
1 | 5 | 2 | 3 | 0
2 | 4 | 2 | 3 | 2
3 | 3 | 2 | 3 | 1
4 | 0 | 2 | 1 | 0
5 | 0 | 1 | 0 | 0

Process returned 0 (0x0) execution time : 21.548 s
Press any key to continue.
```

Program 2: Using TCP/IP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.

Code:

Server:

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

int main(int argc, char *argv[])
{
    int sockfd, newsockfd, portno, n;
    char buffer[256], line[2000], filedatal[20000];
    struct sockaddr_in serv, cli;
    socklen_t len;
```

```
FILE *fp;
if (argc < 2) {
    printf("Error: No port number provided.\nUsage: ./server <port>\n");
    exit(1);
}
sockfd = socket(AF_INET, SOCK_STREAM, 0);
if (sockfd < 0) {
    perror("Socket creation failed");
    exit(1);
}
memset(&serv, 0, sizeof(serv));
portno = atoi(argv[1]);
serv.sin_family = AF_INET;
serv.sin_addr.s_addr = INADDR_ANY;
serv.sin_port = htons(portno);
if (bind(sockfd, (struct sockaddr *)&serv, sizeof(serv)) < 0) {
    perror("Bind failed");
    exit(1);
}
listen(sockfd, 5);
printf("Server: Waiting for connection...\n");
len = sizeof(cli);
newsockfd = accept(sockfd, (struct sockaddr *)&cli, &len);
if (newsockfd < 0) {
    perror("Accept failed");
    exit(1);
}
```

```
memset(buffer, 0, sizeof(buffer));
n = read(newsockfd, buffer, sizeof(buffer) - 1);
if (n < 0) {
    perror("Error reading file name");
    exit(1);
}
printf("Server received file request: %s\n", buffer);
fp = fopen(buffer, "r");
if (fp == NULL) {
    printf("Server: File not found.\n");
    write(newsockfd, "File not found", 15);
    close(newsockfd);
    close(sockfd);
    return 0;
}
printf("Server: File found. Reading...\n");
memset(filedata, 0, sizeof(filedata));
while (fgets(line, sizeof(line), fp) != NULL) {
    strcat(filedata, line);
}
fclose(fp);
n = write(newsockfd, filedata, strlen(filedata));
if (n < 0)
    perror("Error writing to socket");
printf("Transfer complete.\n");
```

```
        close(newsockfd);
        close(sockfd);
        return 0;
    }
```

Client:

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

int main(int argc, char *argv[])
{
    int sockfd, portno, n;
    char filename[256], filedata[20000];
    struct sockaddr_in serv;
    if (argc < 2) {
        printf("Error: No port number provided.\nUsage: ./client <port>\n");
        exit(1);
    }
    sockfd = socket(AF_INET, SOCK_STREAM, 0);
    if (sockfd < 0) {
        perror("Socket creation failed");
        exit(1);
    }
    memset(&serv, 0, sizeof(serv));
```

```
portno = atoi(argv[1]);
serv.sin_family = AF_INET;
serv.sin_port = htons(portno);
serv.sin_addr.s_addr = INADDR_ANY; // connecting to same machine
if (connect(sockfd, (struct sockaddr *)&serv, sizeof(serv)) < 0) {
    perror("Server not responding");
    exit(1);
}
printf("Enter file path: ");
scanf("%s", filename);
n = write(sockfd, filename, strlen(filename));
if (n < 0)
    perror("Error writing filename");
memset(filedata, 0, sizeof(filedata));
n = read(sockfd, filedata, sizeof(filedata) - 1);
if (n < 0)
    perror("Error reading data from server");
printf("\n--- File Content ---\n%s\n", filedata);
close(sockfd);
return 0;
}
```

Output:

```
$ cc socketserver.c
$ ./a.out 1025
server:
waiting for connection
server received:/home/aps/cse.txt
```

server:/home/aps/cse.txt found

opening and reading..

reading..

..reading complete

transfer complete

\$ cc socketclient.c

\$./a.out 1025

Enter the file with complete path

/home/aps/cse.txt

Reading..

..

client: display content of /home/aps/cse.txt

..

Welcome to the CSE department.....

2)

\$ cc fserver.c

\$./a.out

error:no port no

usage:

/server port no

\$ cc fclient.c

\$./a.out

Err:no port no.

usage:

./client portno

ex:./client 7777

Program 3: Using UDP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.

Code:

Server:

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

int main(int argc, char *argv[])
{
    int sockfd, portno, n;
    char buffer[1024];
    struct sockaddr_in servaddr, cliaddr;
    socklen_t len;

    if (argc < 2) {
        printf("Usage: ./server <port>\n");
        exit(1);
    }

    portno = atoi(argv[1]);
```

```
sockfd = socket(AF_INET, SOCK_DGRAM, 0);
if (sockfd < 0) {
    perror("Socket creation failed");
    exit(1);
}

memset(&servaddr, 0, sizeof(servaddr));
memset(&cliaddr, 0, sizeof(cliaddr));

servaddr.sin_family = AF_INET;
servaddr.sin_addr.s_addr = INADDR_ANY;
servaddr.sin_port = htons(portno);

if (bind(sockfd, (struct sockaddr *)&servaddr, sizeof(servaddr)) < 0) {
    perror("Bind failed");
    exit(1);
}

printf("UDP Server: Waiting for data...\n");

len = sizeof(cliaddr);
memset(buffer, 0, sizeof(buffer));

n = recvfrom(sockfd, buffer, sizeof(buffer)-1, 0,
             (struct sockaddr *)&cliaddr, &len);
if (n < 0) {
    perror("Receive failed");
```

```
    exit(1);

}

printf("Received from client: %s\n", buffer);

// Echo back the same data
n = sendto(sockfd, buffer, strlen(buffer), 0,
            (struct sockaddr *)&cliaddr, len);
if (n < 0)
    perror("Send failed");

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

Client:

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

int main(int argc, char *argv[])
{
    int sockfd, portno, n;
    char buffer[1024];
```

```
struct sockaddr_in servaddr;
socklen_t len;

if (argc < 2) {
    printf("Usage: ./client <port>\n");
    exit(1);
}

portno = atoi(argv[1]);

sockfd = socket(AF_INET, SOCK_DGRAM, 0);
if (sockfd < 0) {
    perror("Socket creation failed");
    exit(1);
}

memset(&servaddr, 0, sizeof(servaddr));

servaddr.sin_family = AF_INET;
servaddr.sin_port = htons(portno);
servaddr.sin_addr.s_addr = INADDR_ANY; // local machine

printf("Enter message to send: ");
scanf("%[^\\n]", buffer);

len = sizeof(servaddr);
```

```
n = sendto(sockfd, buffer, strlen(buffer), 0,
            (struct sockaddr *)&servaddr, len);
if (n < 0) {
    perror("Send failed");
    exit(1);
}

memset(buffer, 0, sizeof(buffer));

n = recvfrom(sockfd, buffer, sizeof(buffer)-1, 0,
             (struct sockaddr *)&servaddr, &len);
if (n < 0) {
    perror("Receive failed");
    exit(1);
}

printf("Server replied: %s\n", buffer);
close(sockfd);
return 0;
}
```

Output:

1)

UDP Server: Waiting for data...

Received from client: Hello UDP Server!

2)

Enter message to send: Hello UDP Server!

Server replied: Hello UDP Server!

Program 4: Write a program for error detecting code using CRC-CCITT (16-bits).

```
Code: #include <stdio.h>
#include <string.h>
#include <stdlib.h>

int main() {
    char rem[50], a[50], s[50], c, msj[50], gen[30];
    int i, genlen, t, j, flag = 0, k, n;

    printf("Enter the generator polynomial: ");
    fgets(gen, sizeof(gen), stdin);
    gen[strcspn(gen, "\n")] = '\0';
    printf("Generator polynomial is CRC: %s\n", gen);

    genlen = strlen(gen);
    k = genlen - 1;

    printf("Enter the message: ");
    n = 0;
    while ((c = getchar()) != '\n') {
        msj[n] = c;
        n++;
    }
    msj[n] = '\0';

    for (i = 0; i < n; i++) {
        a[i] = msj[i];
    }
    for (i = 0; i < k; i++) {
        a[n + i] = '0';
    }
    a[n + k] = '\0';

    printf("\nMessage polynomial appended with zeros:\n");
    puts(a);

    for (i = 0; i < n; i++) {
        if (a[i] == '1') {
            t = i;
            for (j = 0; j <= k; j++) {
                a[t] = (a[t] == gen[j]) ? '0' : '1';
                t++;
            }
        }
    }

    for (i = 0; i < k; i++) {
        rem[i] = a[n + i];
    }
```

```

rem[k] = '\0';

printf("The checksum appended:\n");
puts(rem);
printf("\nThe message with checksum appended:\n");
for (i = 0; i < n; i++) {
    a[i] = msj[i];
}
for (i = 0; i < k; i++) {
    a[n + i] = rem[i];
}
a[n + k] = '\0';
puts(a);

n = 0;
printf("Enter the received message: ");
while ((c = getchar()) != '\n') {
    s[n] = c;
    n++;
}
s[n] = '\0';
for (i = 0; i < n; i++) {
    if (s[i] == '1') {
        t = i;
        for (j = 0; j <= k; j++, t++) {
            s[t] = (s[t] == gen[j]) ? '0' : '1';
        }
    }
}

for (i = 0; i < k; i++) {
    rem[i] = s[n + i];
}
rem[k] = '\0';
for (i = 0; i < k; i++) {
    if (rem[i] == '1') {
        flag = 1;
    }
}

if (flag == 0) {
    printf("Received polynomial is error-free.\n");
} else {
    printf("Received polynomial has an error.\n");
}

return 0;
}

```

OUTPUT:

```
Enter the generator polynomial: 10011
Generator polynomial is CRC: 10011
Enter the message: 1101011011

Message polynomial appended with zeros:
11010110110000
The checksum appended:
1110

The message with checksum appended:
11010110111110
Enter the received message: 11010110111110
Received polynomial is error-free.

Process returned 0 (0x0)  execution time : 20.417 s
Press any key to continue.
|
```