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:

G M KUSUMA

(1BM24CS0405)

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 G M Kusuma(1BM24CS405) during the 5th Semester August 2025-December 2025.

Signature of the Faculty Incharge:

Rashmi
Assistant Professor

Department of Computer Science and Engineerin

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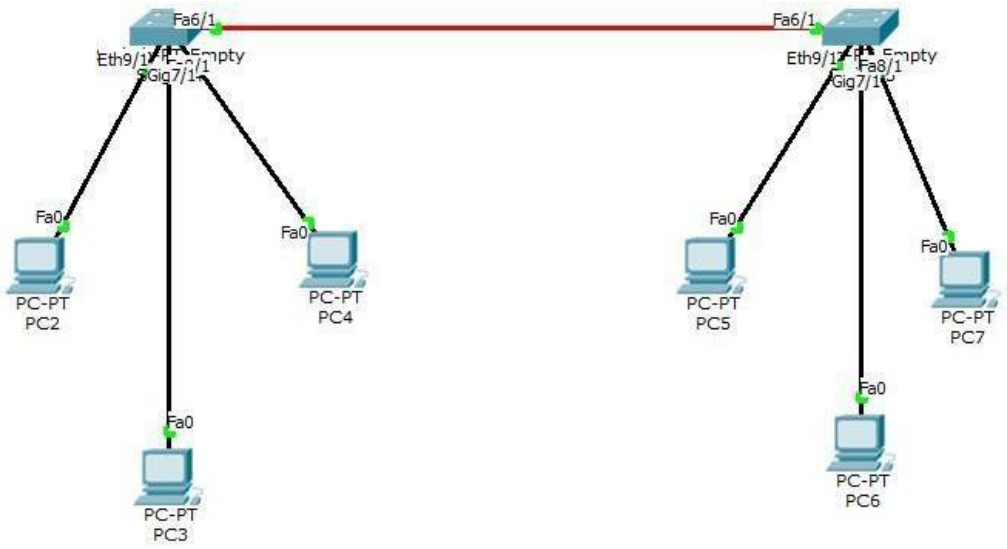
2.	Configure DHCP within a LAN and outside LAN.
3.	Configure Web Server, DNS within a LAN.
4.	Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply.
5.	Configure default route, static route to the Router.
6.	Configure RIP routing Protocol in Routers.
7.	Configure OSPF routing protocol.
8.	To construct a VLAN and make the PC's communicate among a VLAN.
9.	To construct a WLAN and make the nodes communicate wirelessly.
10.	Demonstrate the TTL/ Life of a Packet.
11.	To understand the operation of TELNET by accessing the router in the server room from a PC in the IT office.
12.	To construct a simple LAN and understand the concept and operation of Address Resolution Protocol (ARP).

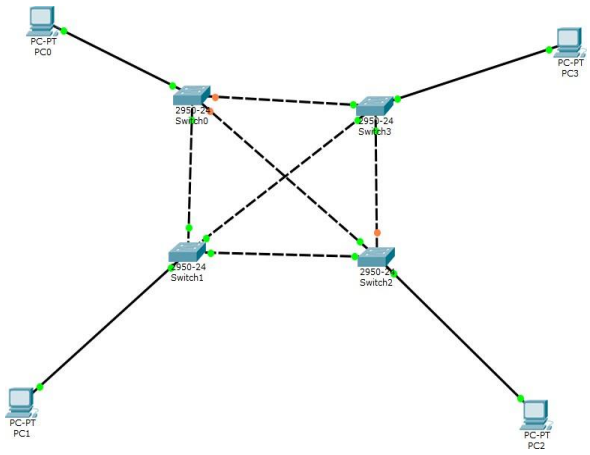
PART – B	
Serial No.	**Name of Experiment**
1.	Write a program for congestion control using Leaky bucket algorithm.
2.	Using TCP/IP sockets, write a client-server program to make the client send the file name and the server to send back the contents of the requested file if present.
3.	Using UDP sockets, write a client-server program to make the client send 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

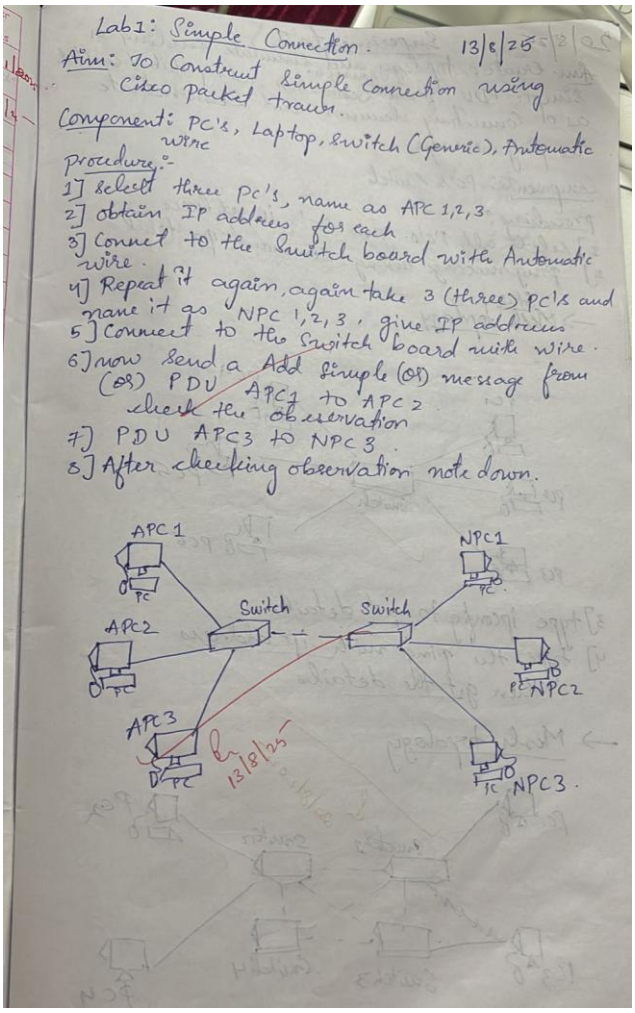
Program 1: Create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping messages.

Network diagram:



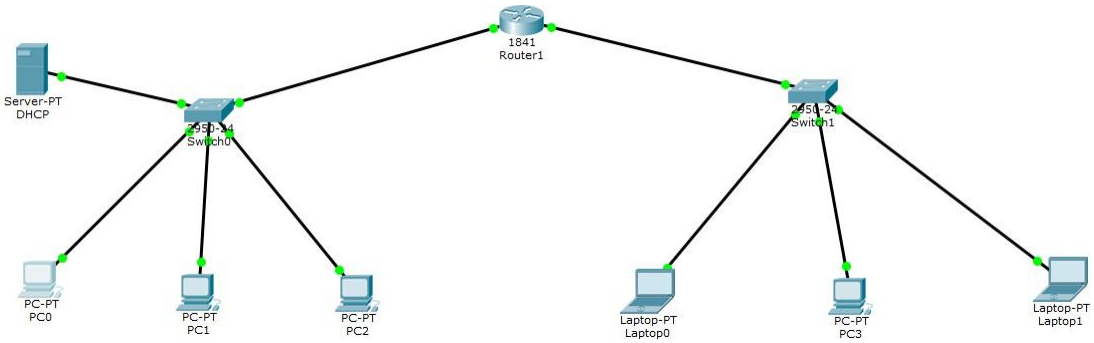


Configuration:

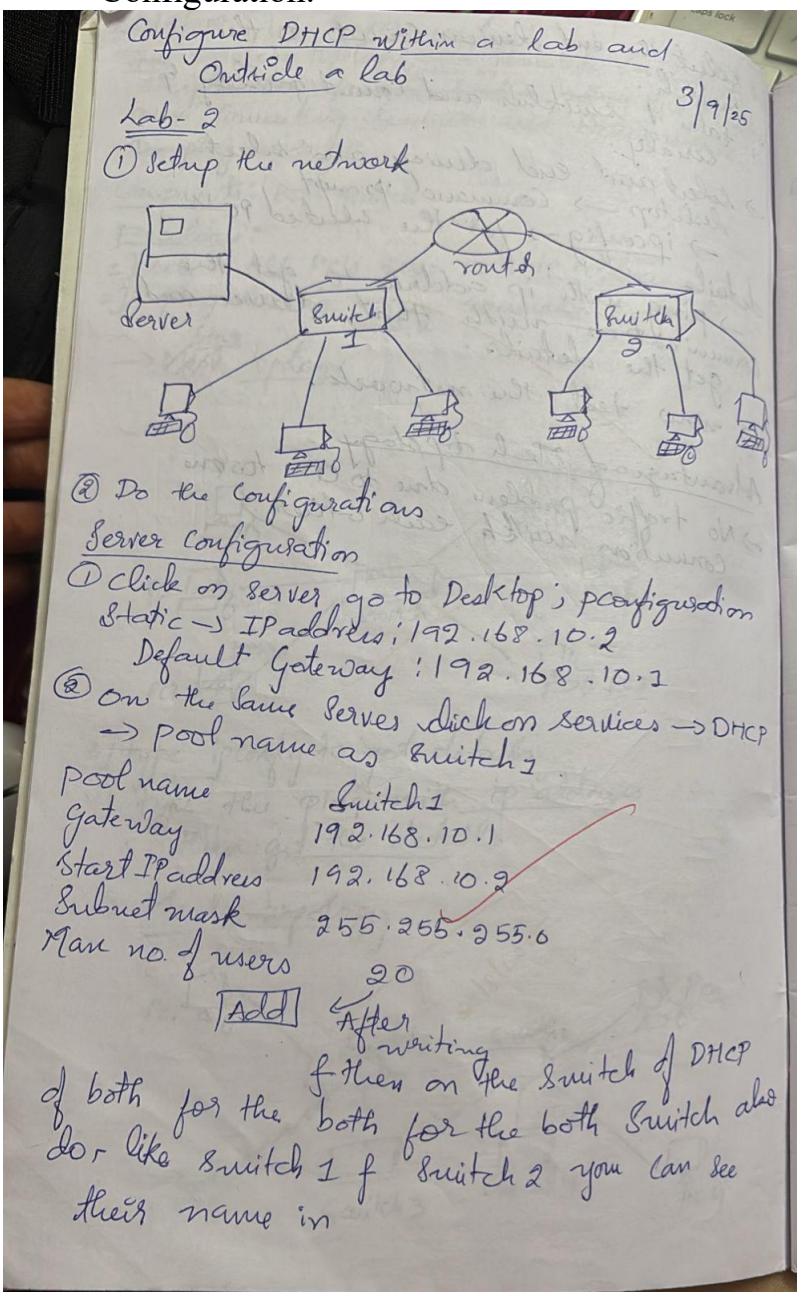


Program 2: Configure DHCP within a LAN and outside LAN.

Network diagram:



Configuration:



Configure DHCP within a lab and Outside a lab.

3/9/25

Lab-2

① Setup the network

② Do the configurations

Server Configuration

① Click on server go to Desktop; pconfiguration
Static → IP address: 192.168.10.2
Default Gateway: 192.168.10.1

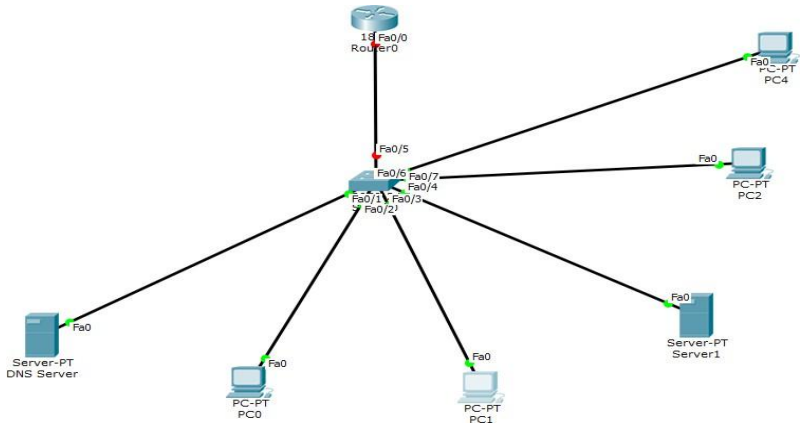
② On the same Server click on services → DHCP
→ pool name as Switch 1

pool name	Switch1
Gateway	192.168.10.1
Start IP address	192.168.10.2
Subnet mask	255.255.255.0
Max no. of users	20

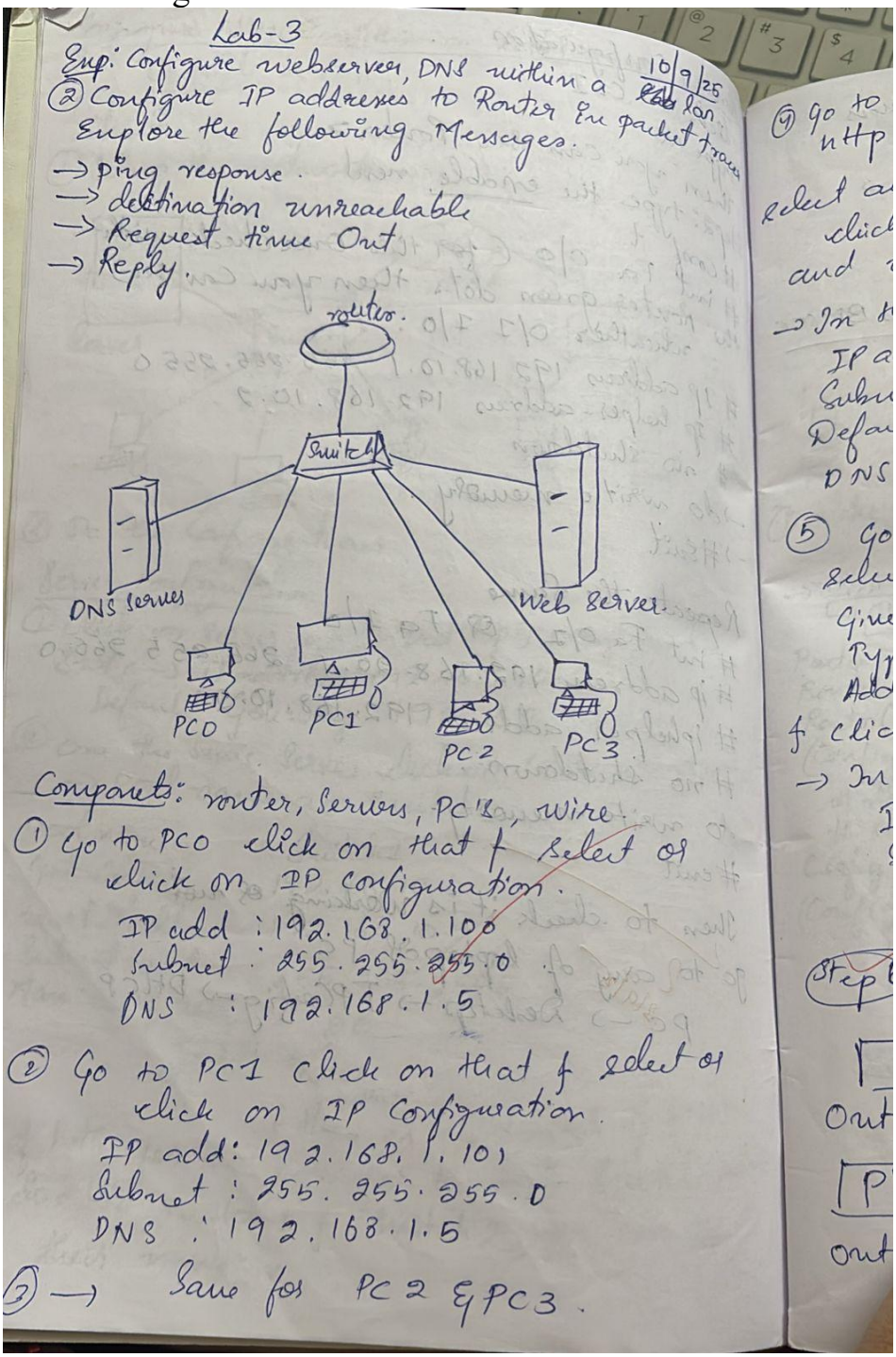
Add ← After writing

then on the Switch of DHCP of both for the both for the both Switch also do, like Switch 1 & Switch 2 you can see their name in

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

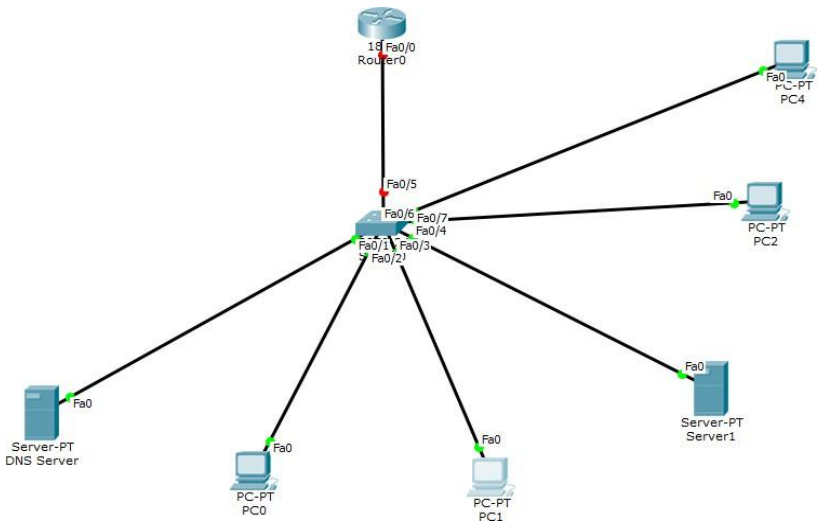


Configuration:

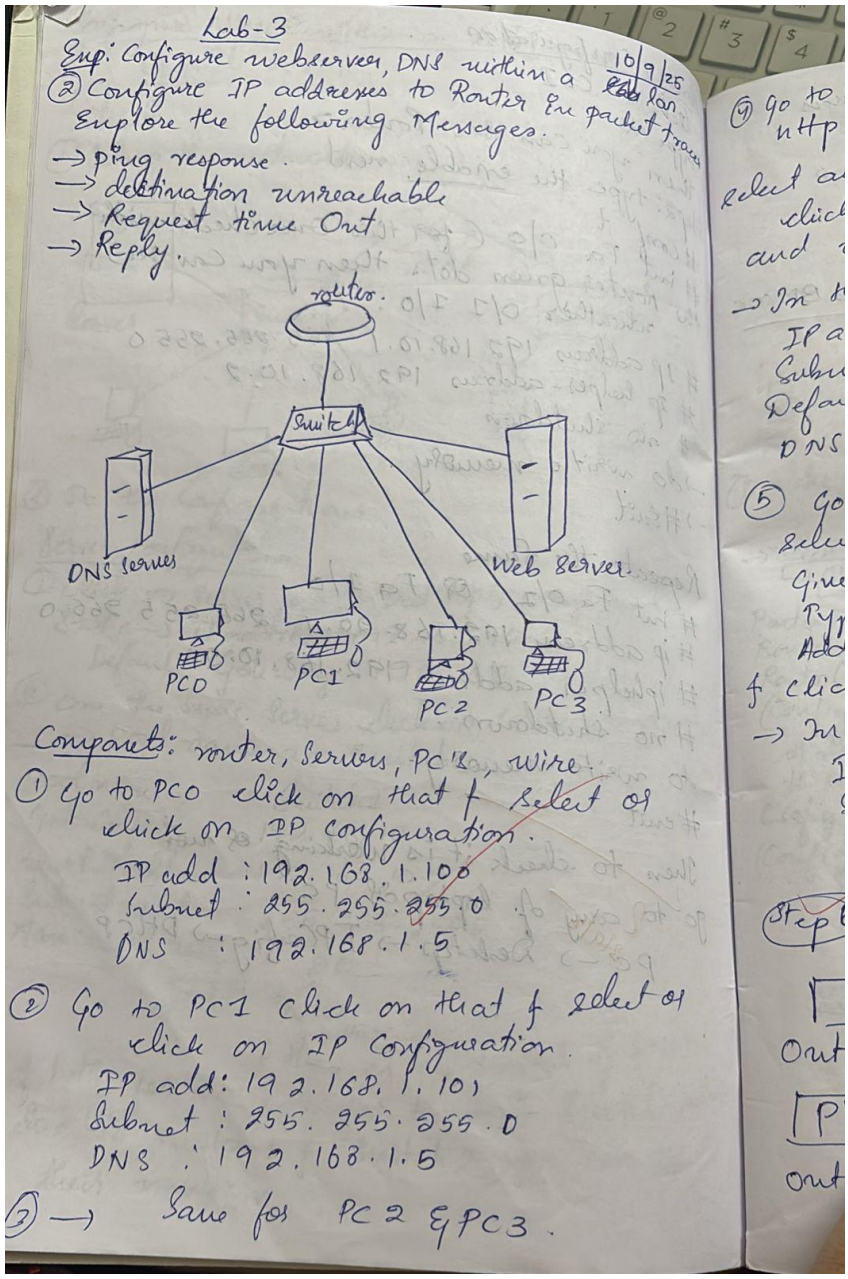


Program 4: Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply.

Network diagram:

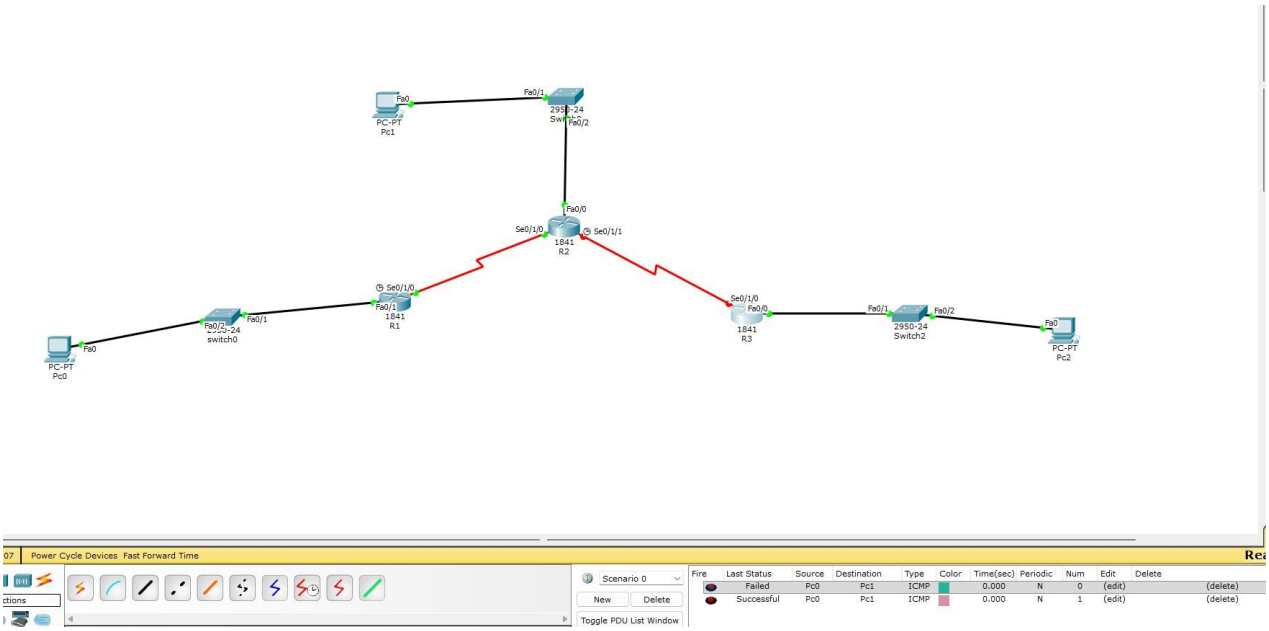


Configuration:



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

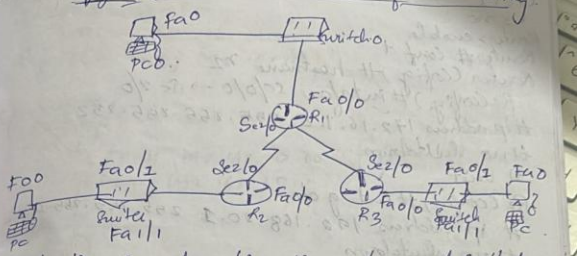
Network diagram:



Configuration:

Lab-4 17/9/25

Configure IPV4 static and default routing.



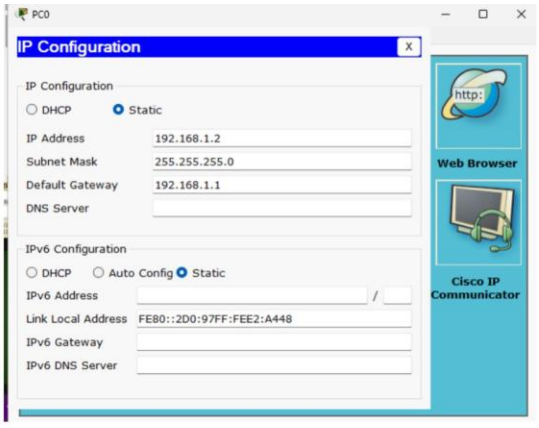
① make the connection btw the routers and switch and with PCs.

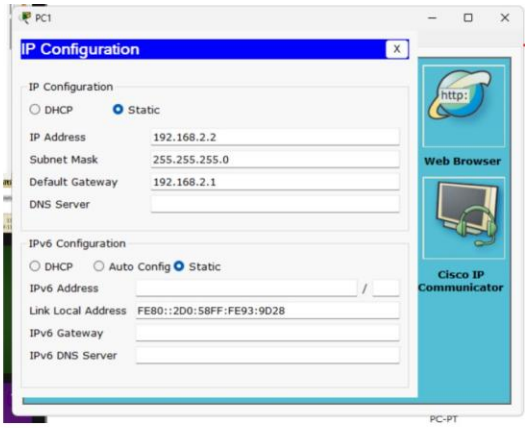
→ click on R1 → (Routers)
  ↳ CLI
    ↳ NO.

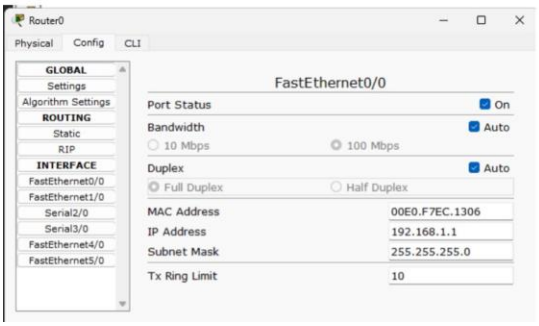
Router > enable
Router > conf t
Router(Config) # interface Serial 0/0/0
Se2/0 → serial no. of router.
(Config-if) # ip address 172.16.1.1 255.255.255.252
 # no shutdown
 # exit
(Config) # interface GigabitEthernet 0/0
(Config-if) # ip address 192.168.10.1 255.255.255.0
 # no shutdown
 exit
 write memory

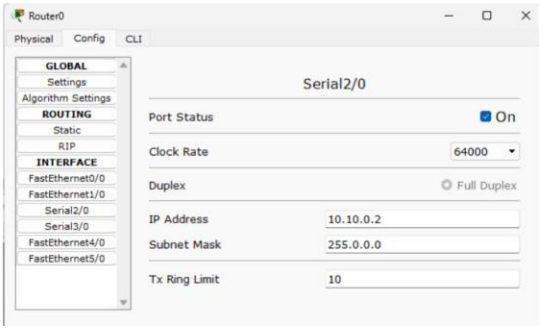
Output: Building configuration Successful.

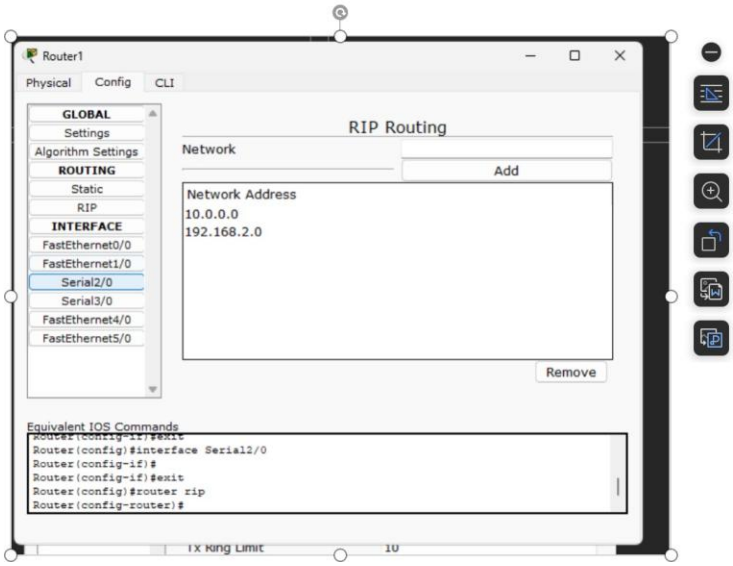
Program 6: Configure RIP routing Protocol in Routers. Network diagram:

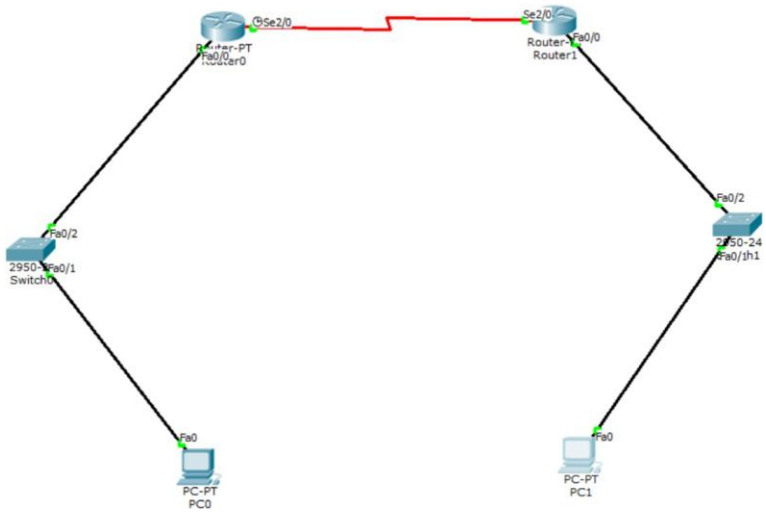






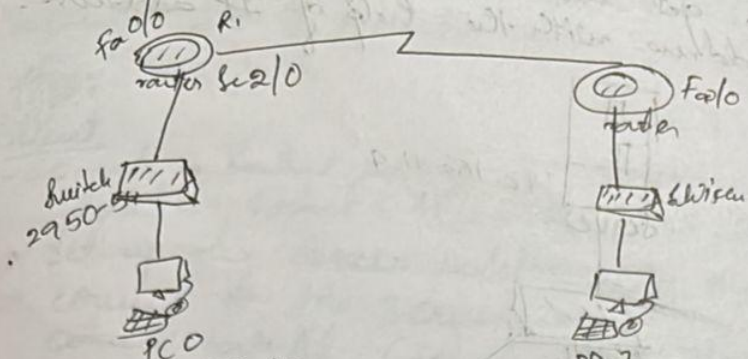



Router1
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
RIP Routing
Network
Add
Network Address
10.0.0.0
192.168.2.0
Remove
Equivalent IOS Commands
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#
Tx Ring Limit
10



Configuration:

Configure RIP routing protocol in routers to transfer packet from node A to B



→ R1: Config: fastethernet 0/0 → turn on
IP add → 192.168.1.1

→ R2: config IPaddress → 192.168.2.1

→ R1: config: Serial 2/0 → turn on
Clock rate: 64000, IP address → 10.10.0.2

→ R2: Config clock rate: 64000, IP → 10.10.0.3

→ R1 → Config → RIP → network 192.168.10 (left bar) (Def)
click on Add.
→ network 10.0.0.0
Click on Add.

Select setting → Save

→ R2 → Config → RIP → Setting → Save

(or) R2 → CLI → exit

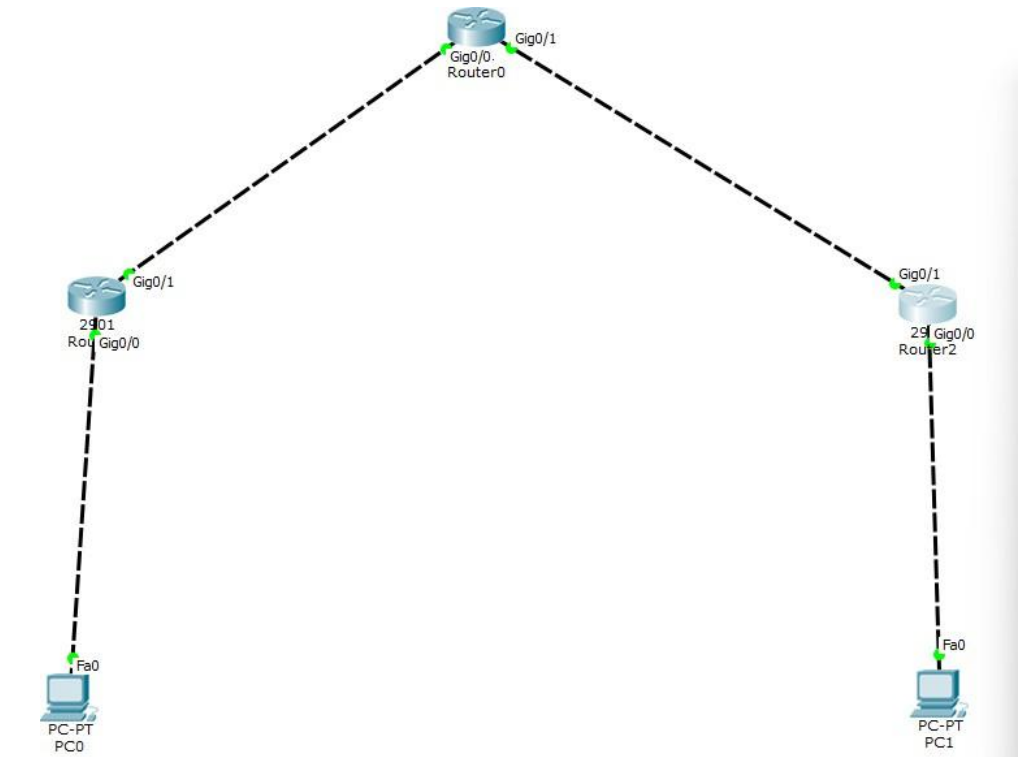
Router(Config)# router rip
Router(Config-router)# network 192.168.2.0
network 10.0.0.0
exit

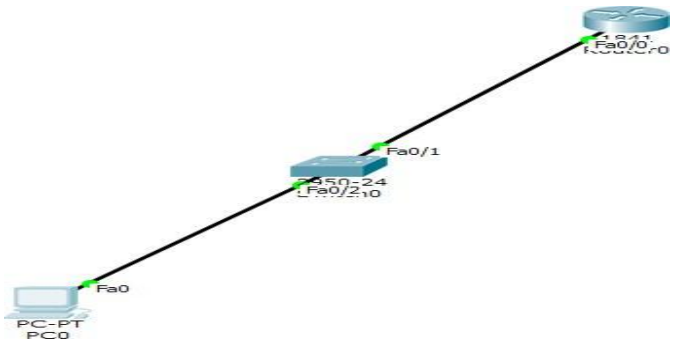
Router(Config) #exit
Router # wr
Building Configuration [OK]

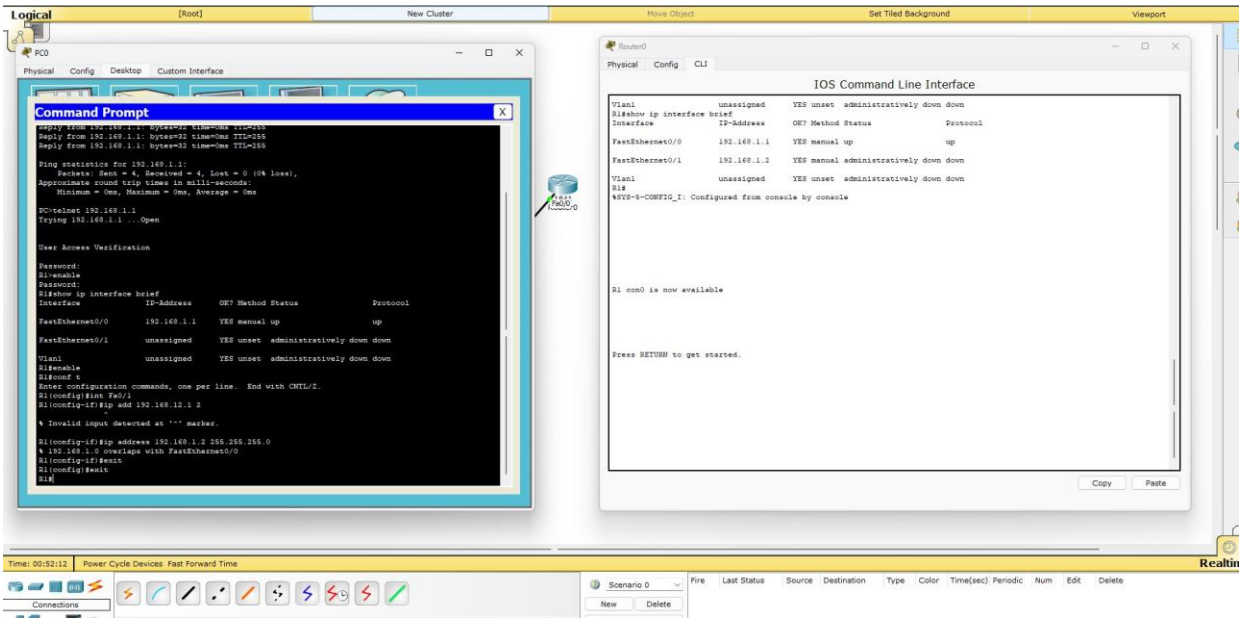
Send msg packet from PC0 to PC1 (status: Successful)

Program 7: Configure OSPF routing protocol.

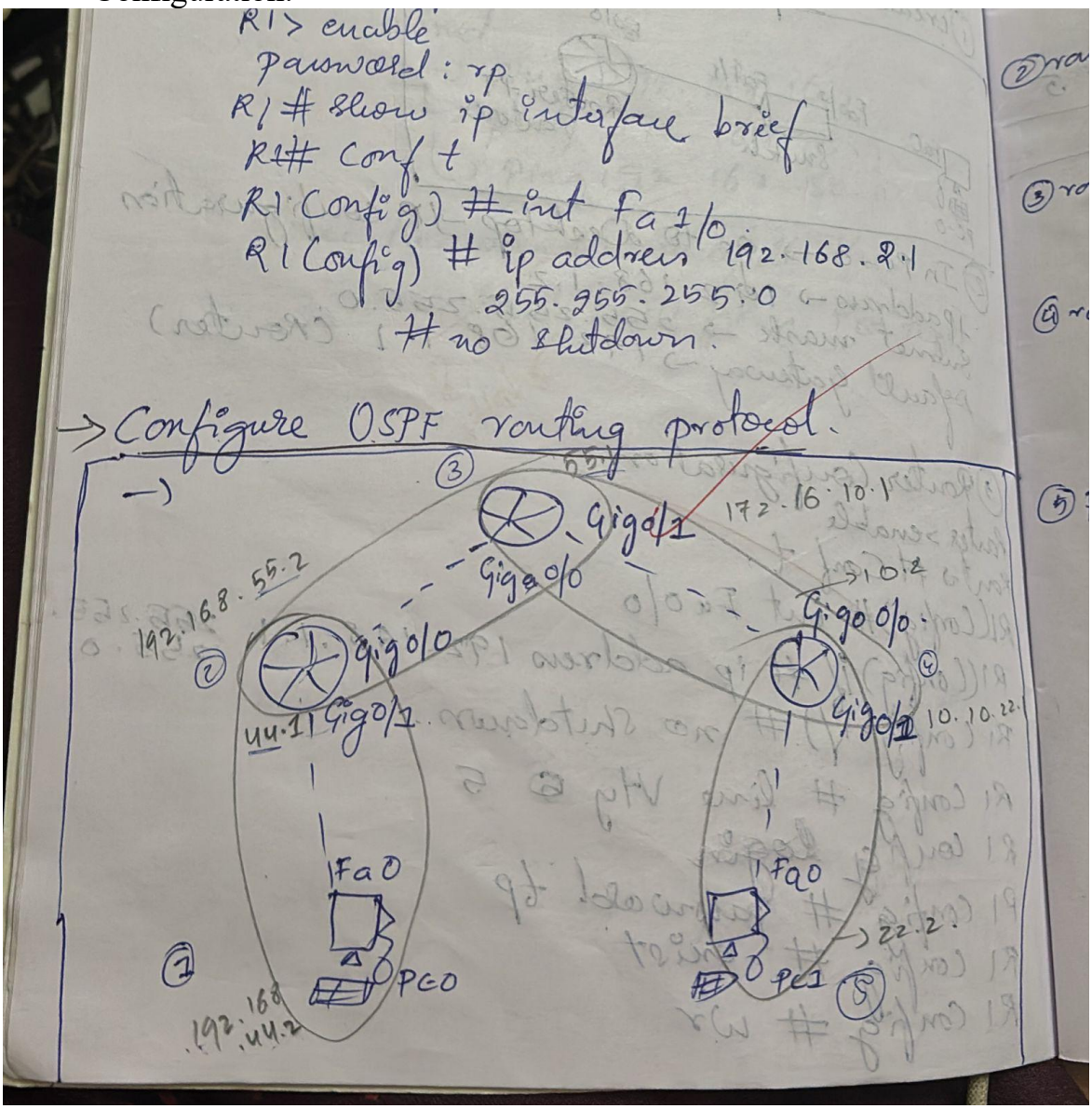
Network diagram:


Gig0/1
Gig0/0
Router0
Gig0/1
Gig0/1
Gig0/0
Router2
Fa0
PC-PT
PC0
Fa0
PC-PT
PC1


Fa0/1
Fa0
PC-PT
PC0

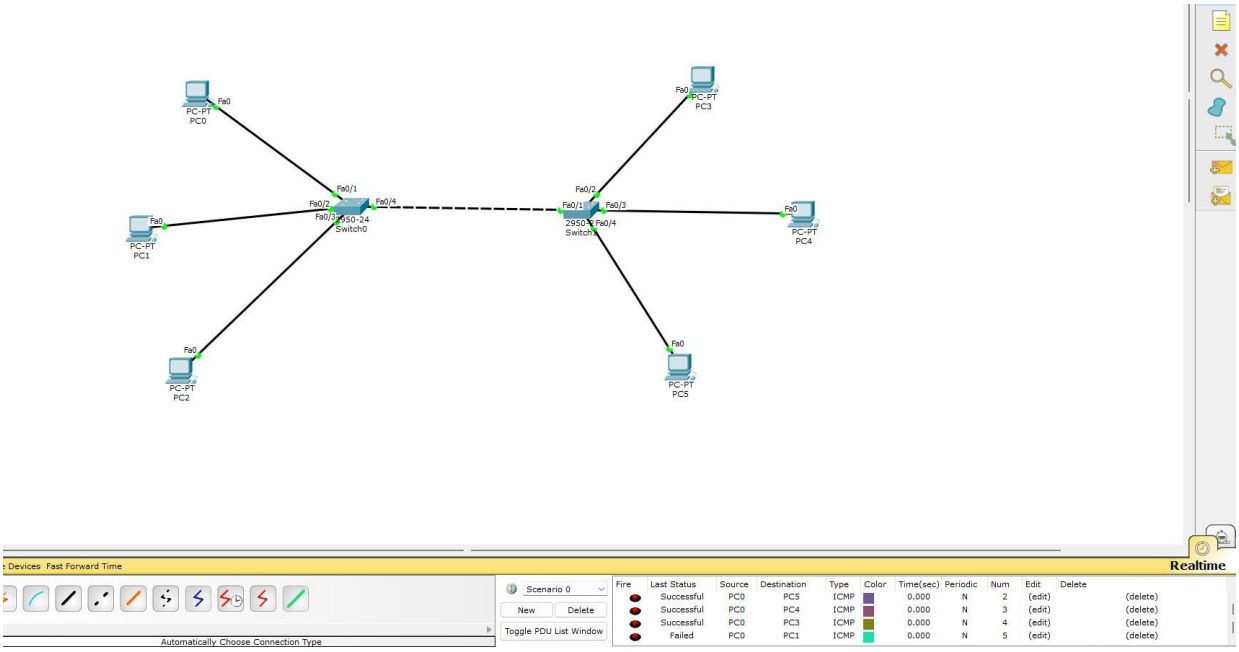


Configuration:



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

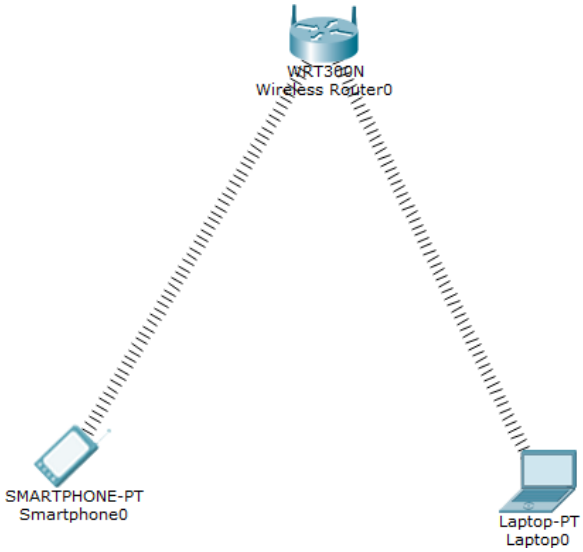
Network diagram:



Configuration:

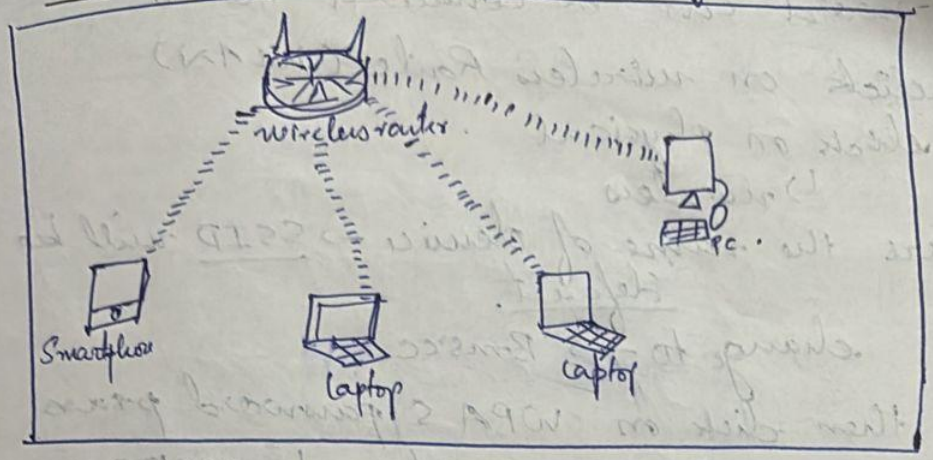
Program 9: To construct a WLAN and make the nodes communicate wirelessly.

Network diagram:



Configuration:

Q) To Construct a WLAN and make the nodes communicate wirelessly



Scenario - 1 :→ Connecting Devices without passing

1→ here the Smartphone will be connected to Router Directly (no need for connectivity)

2→ For the laptop to be connected to WLAN
→ click on laptop
→ Open physical device / Switch off then
→ Remove the physical Adapter connected to it
→ Add the wireless Adapter.

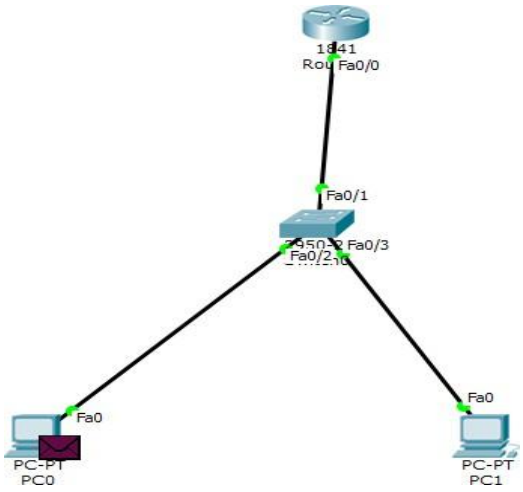
Now the laptop would be Connected to WLAN

3 Same way connecting to PC
→ click on PC
→ open its physical / Switch off then
→ Remove the physical Adapter connected to it
→ then Add the wireless Adapter

Now the PC will be connected to WLAN

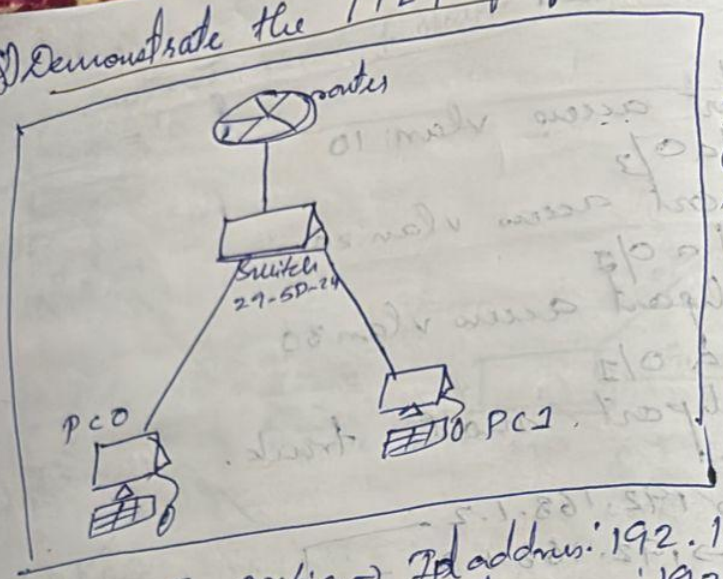
Program 10: Demonstrate the TTL/ Life of a Packet.

Network diagram:



Configuration:

Demonstrate the TTL / life of a packet



Inband 255
Outband 128
Inband 128
Outband 255

PC → 0 → Ip config → Ip address: 192.168.1.2
gateway : 192.168.1.1

PC → 1 → Ip address: 192.168.1.3
gateway : 192.168.1.1

Router → CLI → Interface Fa 0/0
Ip add: 192.168.1.1 [Same as Gateway]

Send packet from PC0 to PC1

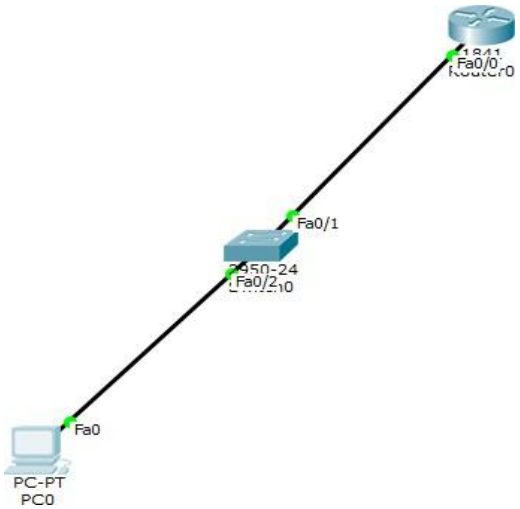
TTL is used to calculate time taken by msg packet to reach Destination after sending packet click on msg packet
[Simulation mode]

Add capture play → on clicking ☑ Inband PDU

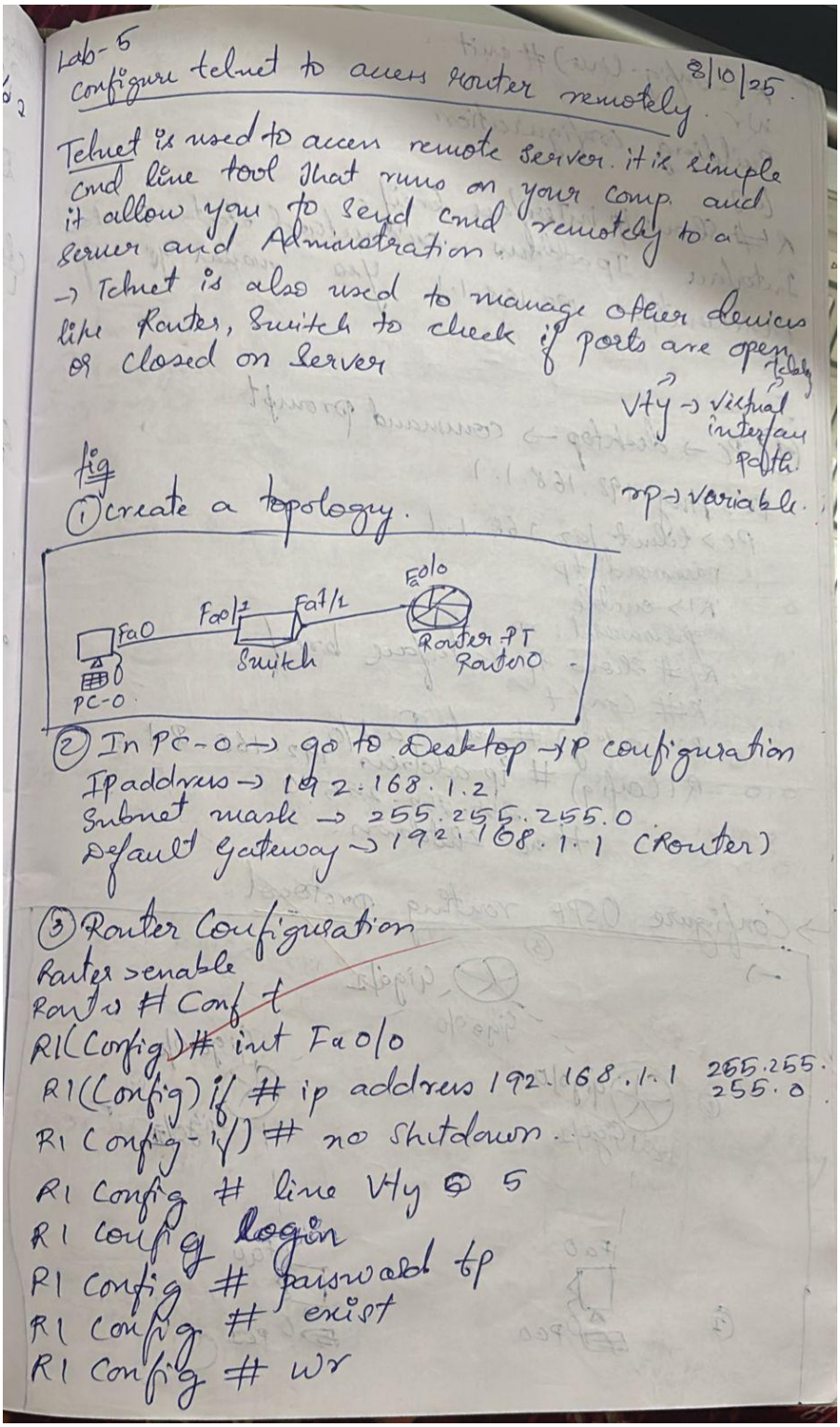
Outbound PDU → To view Data Variable length checksum Seq NO: TTL: 255

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

Network diagram:



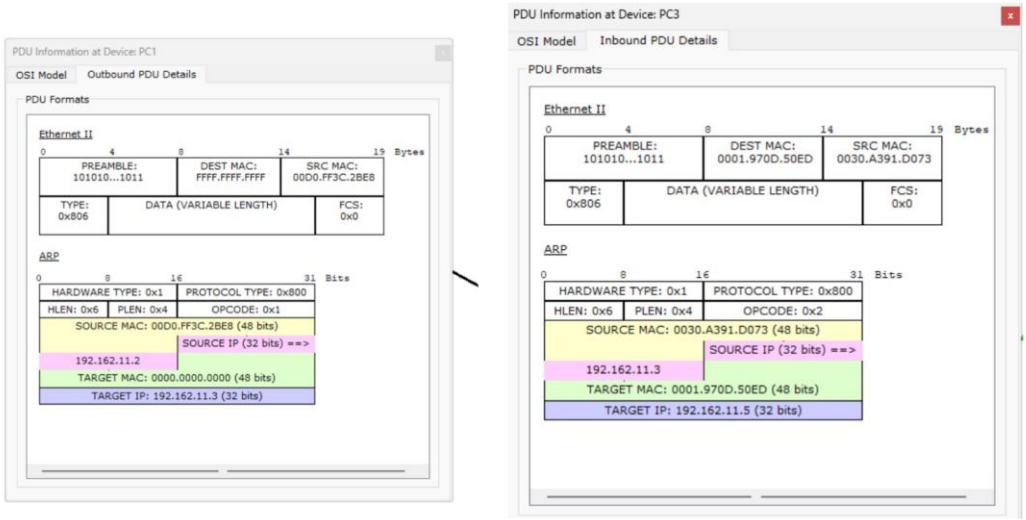
Configuration:



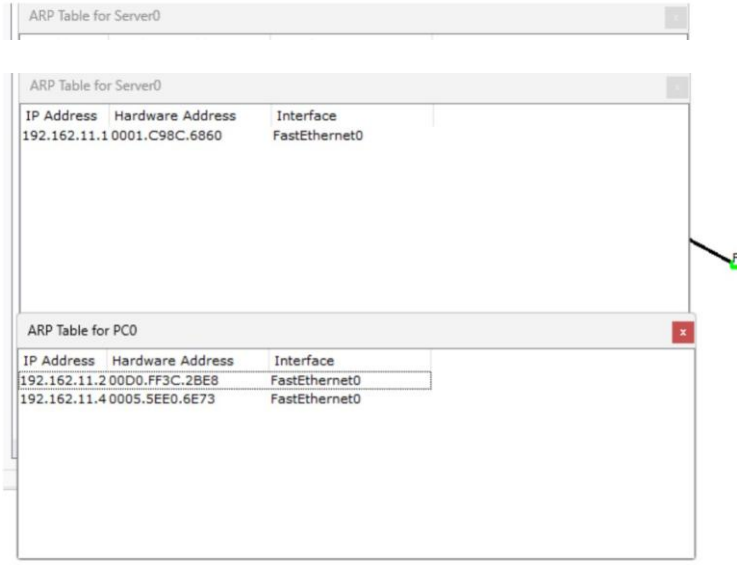
Program 12: To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP).

Network diagram:

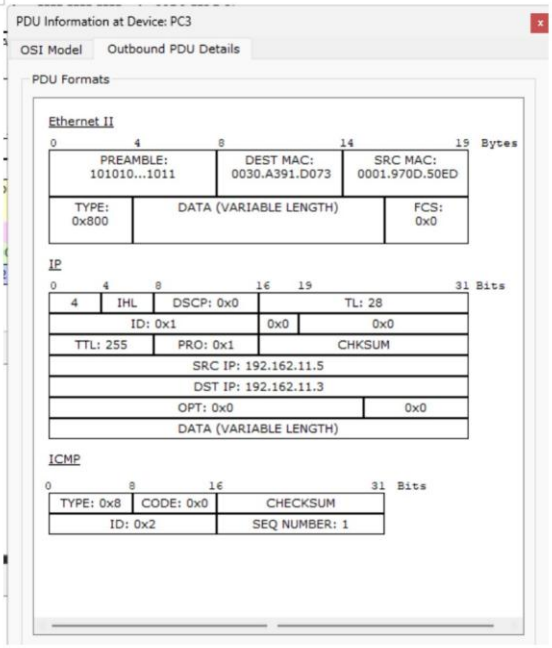
ARP



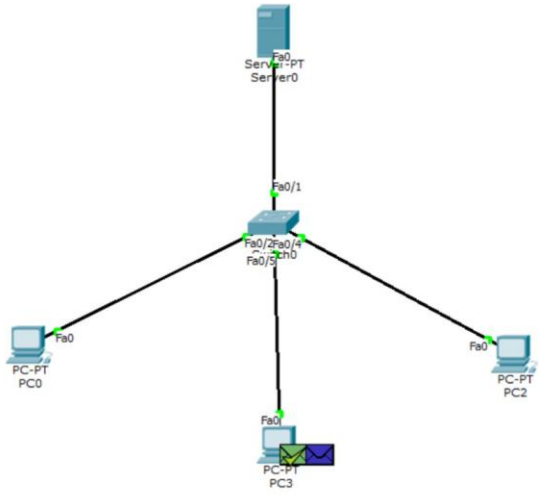
THE MAC ADDRESS before and after encrypting and sending



ARP table of pc0 and server after sending a simple PDU



The address of sent one

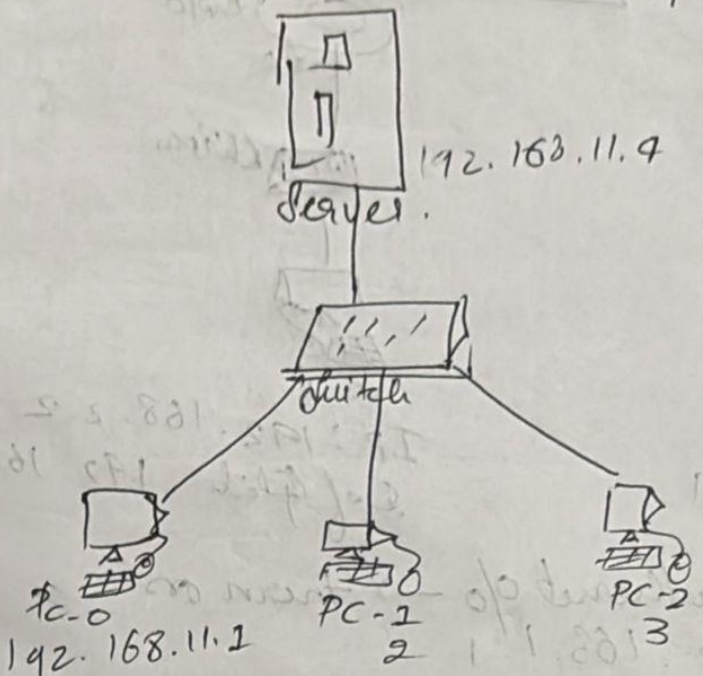


topology

Configuration:

ARP → Address Resolution Protocol

* ARP is used to map an IP address to a mac address
* ARP is used to get data link layer address, mac address with the help of IP address.



Default gateway : 192.168.11.4

→ Simulation : After sending 1 PDU delete source then resend other PDU then click on that to see mac address.

→ check the status after simulation.

→ click on search and after clicking on the PC click on ARP table then the table is visible.

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:\n");
    scanf("%d", &cap);
    printf("Enter the processing rate:\n");
    scanf("%d", &process);
    printf("Enter the number of seconds you want to simulate:\n");
    scanf("%d", &nsec);
    for (i = 0; i < nsec; i++)
    {
        printf("Enter the size of the packet entering at %d sec:\n", 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++)
{
        printf("Enter the size of the packet entering at %d sec:\n", 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(" %12d | %7d\n", count, drop);

        drop = 0;
    }
    // Process remaining packets after all seconds
    for (; count != 0; i++)
    {
  if (count > cap)
        {
```

```
            drop = count - cap;
            count = cap;
        }

        printf("%6d | %15d |", i + 1, 0);

        mini = min(count, process);
        printf(" %11d |", mini);

        count -= mini;
        printf(" %12d | %7d\n", count, drop);
    }

    return 0;
}
```

Output:

Lab 7 :- Leaky Bucket Algorithm for Congestion control

→ Congestion occurs when the no. of packets sent into the network exceeds the network's capacity to process and transmit them.

→ To prevent congestion and ensure smooth flow of packets, C & C are used.

① Open Loop control :- prevents congestion before it happens by good system design

② Closed Loop Control :- Detects and reacts to congestion dynamically using feedback from the network.

The Leaky Bucket algorithm is an Open loop congestion control and traffic shaping mechanism used to control the rate at which data packets are transmitted onto the network.

Parameters :- Bucket Capacity (cap) : max no. of packets that can be stored

Incoming Rate : Rate at which packet arrive

O/p Rate : Rate at which packets are transmitted.

Dropped packets : packets discarded when bucket is full.

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

Code:

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

int main(int argc, char *argv[])
{
   int sockfd, portno, n;
   struct sockaddr_in serv;
   struct hostent *server;
   char buffer[256];
   char c[20000];

   if (argc < 3) {
      printf("Error: insufficient arguments.\n");
      printf("Usage: %s <hostname> <port>\nExample: %s 127.0.0.1 7777\n",
argv[0], argv[0]);
      exit(1);
   }

   portno = atoi(argv[2]);

   // Create socket
```

```
sockfd = socket(AF_INET, SOCK_STREAM, 0);
if (sockfd < 0) {
    perror("Error opening socket");
    exit(1);
}

// Get server by name/IP
server = gethostbyname(argv[1]);
if (server == NULL) {
    fprintf(stderr, "Error: no such host.\n");
    exit(1);
}

// Zero out the structure
bzero((char *)&serv, sizeof(serv));
serv.sin_family = AF_INET;
bcopy((char *)server->h_addr, (char *)&serv.sin_addr.s_addr, server->h_length);
serv.sin_port = htons(portno);

// Connect to server
if (connect(sockfd, (struct sockaddr *)&serv, sizeof(serv)) < 0) {
    perror("Error connecting");
    exit(1);
}

printf("Enter the file path (complete path): ");
scanf("%s", buffer);
```

```
    // Send filename to server
    n = write(sockfd, buffer, strlen(buffer));
    if (n < 0) {
        perror("Error writing to socket");
        exit(1);
    }

    bzero(c, sizeof(c));
    printf("Reading file contents from server...\n");

    // Read file contents
    n = read(sockfd, c, sizeof(c) - 1);
    if (n < 0) {
        perror("Error reading from socket");
        exit(1);
    }

    printf("\nClient: Display content of %s\n----------------------------------\n",
buffer);
    fputs(c, stdout);
    printf("\n---------------------------------------\n");

    close(sockfd);
    return 0;
}
#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, len, n;
   char buffer[256], c[2000], cc[20000];
   struct sockaddr_in serv, cli;
   FILE *fd;

   if (argc < 2) {
      printf("Error: no port number provided.\n");
      printf("Usage: %s <port>\nExample: %s 7777\n", argv[0], argv[0]);
      exit(1);
   }

   // Create socket
   sockfd = socket(AF_INET, SOCK_STREAM, 0);
   if (sockfd < 0) {
      perror("Error opening socket");
      exit(1);
   }
```

```
// Initialize server address structure
bzero((char *)&serv, sizeof(serv));
portno = atoi(argv[1]);
serv.sin_family = AF_INET;
serv.sin_addr.s_addr = INADDR_ANY;
serv.sin_port = htons(portno);

// Bind socket
if (bind(sockfd, (struct sockaddr *)&serv, sizeof(serv)) < 0) {
    perror("Error on binding");
    close(sockfd);
    exit(1);
}

// Listen for incoming connections
listen(sockfd, 5);
len = sizeof(cli);
printf("Server: waiting for connection on port %d...\n", portno);

// Accept a client
newsockfd = accept(sockfd, (struct sockaddr *)&cli, (socklen_t *)&len);
if (newsockfd < 0) {
    perror("Error on accept");
    close(sockfd);
    exit(1);
}
```

```
// Read filename from client
bzero(buffer, 255);
n = read(newsockfd, buffer, 255);
if (n < 0) {
    perror("Error reading from socket");
    close(newsockfd);
    close(sockfd);
    exit(1);
}

printf("Server received filename: %s\n", buffer);

// Try to open the file
fd = fopen(buffer, "r");
if (fd != NULL) {
    printf("Server: file '%s' found, reading and sending...\n", buffer);
    bzero(cc, sizeof(cc));
    while (fgets(c, sizeof(c), fd) != NULL) {
        strcat(cc, c);
    }
    fclose(fd);

    // Send file content to client
    n = write(newsockfd, cc, strlen(cc));
    if (n < 0)
        perror("Error writing to socket");
    else
```

```
            printf("File transfer complete.\n");
        } else {
            printf("Server: file not found.\n");
            n = write(newsockfd, "Error: file not found.\n", 24);
            if (n < 0)
                perror("Error writing to socket");
        }

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

Output:

Lab-10

Q. for client server communication using TCP/IP socket to make client send the name of the file and server to send back the contents of the requested file if present.

Algo:-

Client
→ Create a socket using
  Sockfd = socket(AF_INET, SOCK_STREAM, 0);
→ Set up the server address (IP and port)
→ connect to the server using
  connect(sockfd, (struct sockaddr *)&server, sizeof(server));
→ Read the filename from the user
→ Send the filename to the server using
  write(sockfd, buffer, strlen(buffer));
→ Read the file contents from the server using
  read(socket, buffer, sizeof(buffer));
→ close the socket using
  close(sockfd);

Server
→ Create a socket using
→ Bind the socket to a port using bind()
→ Listen for incoming client connection
→ Accept a connection using newsockfd.
→ Read the filename sent by the client using
  recv(---)
→ Try to open the requested file.
→ If the file exists
  → Read.
→ else, send file not found.
→ close connection
→ close the main socket.

12/11/2025

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

Code:

```
#include <stdio.h>

#include <stdlib.h>

#include <string.h>

#include <unistd.h>

#include <arpa/inet.h>
```

```
#define PORT 8080
#define MAXLINE 1024

int main() {
    int sockfd;
    char buffer[MAXLINE];
    struct sockaddr_in servaddr, cliaddr;
    socklen_t len;
    ssize_t n;

    // Create UDP socket
    if ((sockfd = socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
        perror("socket creation failed");
        exit(EXIT_FAILURE);
    }

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

    // Server info
    servaddr.sin_family = AF_INET;
    servaddr.sin_addr.s_addr = INADDR_ANY;
    servaddr.sin_port = htons(PORT);

    // Bind socket to the port
    if (bind(sockfd, (const struct sockaddr *)&servaddr, sizeof(servaddr)) < 0) {
        perror("bind failed");
```

```
        close(sockfd);
        exit(EXIT_FAILURE);
    }

    printf("UDP Server is running on port %d...\n", PORT);

    len = sizeof(cliaddr);

    // Receive filename from client
    n = recvfrom(sockfd, (char *)buffer, MAXLINE, 0, (struct sockaddr *)&cliaddr,
&len);
    buffer[n] = '\0';
    printf("Client requested file: %s\n", buffer);

    FILE *fp = fopen(buffer, "r");
    if (fp == NULL) {
        char *msg = "File not found!";
        sendto(sockfd, msg, strlen(msg), 0, (struct sockaddr *)&cliaddr, len);
        printf("File not found, message sent to client.\n");
    } else {
        // Read and send file content
        while (fgets(buffer, MAXLINE, fp) != NULL) {
            sendto(sockfd, buffer, strlen(buffer), 0, (struct sockaddr *)&cliaddr, len);
        }
        fclose(fp);
        printf("File sent successfully.\n");
    }
```

```
    close(sockfd);
    return 0;
}
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <arpa/inet.h>

#define PORT 8080
#define MAXLINE 1024

int main() {
    int sockfd;
    char buffer[MAXLINE];
    struct sockaddr_in servaddr;
    socklen_t len;

    // Create UDP socket
    if ((sockfd = socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
        perror("socket creation failed");
        exit(EXIT_FAILURE);
    }

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

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

    printf("Enter the filename to request: ");
    fgets(buffer, MAXLINE, stdin);
    buffer[strcspn(buffer, "\n")] = '\0';  // remove newline

    // Send filename to server
    sendto(sockfd, buffer, strlen(buffer), 0, (const struct sockaddr *)&servaddr,
sizeof(servaddr));

    printf("Request sent. Waiting for file content...\n\n");

    len = sizeof(servaddr);

    // Receive file contents
    ssize_t n;
    while ((n = recvfrom(sockfd, buffer, MAXLINE, 0, (struct sockaddr
*)&servaddr, &len)) > 0) {
        buffer[n] = '\0';
        printf("%s", buffer);
        if (n < MAXLINE - 1) break;  // assume end of file
    }

    printf("\n\nFile transfer complete.\n");
```

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

Output:

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:\n");
    fgets(gen, sizeof(gen), stdin);
    gen[strcspn(gen, "\n")] = '\0';  // remove newline if present
    printf("Generator polynomial (CRC-CCITT): %s\n", gen);

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

    printf("Enter the message:\n");
    fgets(msj, sizeof(msj), stdin);
    msj[strcspn(msj, "\n")] = '\0';  // remove newline

    n = strlen(msj);

    // Append k zeros to the message
    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);

// Division (XOR)
for (i = 0; i < n; i++)
{
    if (a[i] == '1')
    {
        t = i;
        for (j = 0; j <= k; j++)
        {
            if (a[t] == gen[j])
                a[t] = '0';
            else
                a[t] = '1';
            t++;
        }
    }
}
// Get remainder
for (i = 0; i < k; i++)
    rem[i] = a[n + i];
rem[k] = '\0';
printf("\nChecksum (Remainder):\n");
puts(rem);
// Append checksum to message
printf("\nTransmitted message (with checksum):\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);
// Receiver side
printf("\nEnter the received message:\n");
fgets(s, sizeof(s), stdin);
s[strcspn(s, "\n")] = '\0';  // remove newline
n = strlen(s);
// Division on received message
for (i = 0; i < n - k; i++)
{
    if (s[i] == '1')
    {
        t = i;
        for (j = 0; j <= k; j++, t++)
        {
            if (s[t] == gen[j])
                s[t] = '0';
            else
                s[t] = '1';
        }
    }
}
for (i = 0; i < k; i++)
```

```
        rem[i] = s[n - k + i];
    rem[k] = '\0';
    // Check for error
    flag = 0;
    for (i = 0; i < k; i++)
    {
        if (rem[i] == '1')
            flag = 1;
    }
    if (flag == 0)
        printf("\nReceived message is error-free ✅ \n");
    else
        printf("\nReceived message contains errors ❌ \n");
    return 0;
}
```

Output:

Output

```
Enter the generator polynomial:
101
Generator polynomial (CRC-CCITT): 101
Enter the message:
110101

Message polynomial appended with zeros:
11010100

Checksum (Remainder):
11

Transmitted message (with checksum):
11010111

Enter the received message:
11010111

Received message is error-free ✅


=== Code Execution Successful ===
```

① error detecting code using CRC - CCITT (16 bit)

F = 1101011011

g = 10011 ⟶ 5 zeros − 1 = 4 add in here

$f(x) = x^4 + x^1 + 1$ 10011.

10011

Ex or diff = 1

Same = 0

```
         110000101
10011 ) 11010110110000
        10011
        0 10011      ← exclude.
          10011
          00000 10110
                10011
                00 10100
                   10011
                   00 1110 → Reminder.
```

remainder is 0 otherwise errors.

② F = 100100

$g = x^3 + x^2 + 1$

g = 1101 → 4 − 1 = 3 zeros.

```
        11110
1101 ) 100100000
       1101
       0 1000
         1101
         0 1010
           1101
           0 1110
             1101
             00 1100
                1101
                0001
```

R
2010