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:

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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 Chiraiya Sethiya (1BM23CS08
0) during the 5th Semester August 2025-December 2025.

Signature of the Faculty Incharge:

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Assistant Professor

Department of Computer Science and Engineering

B.M.S. College of Engineering, Bangalore

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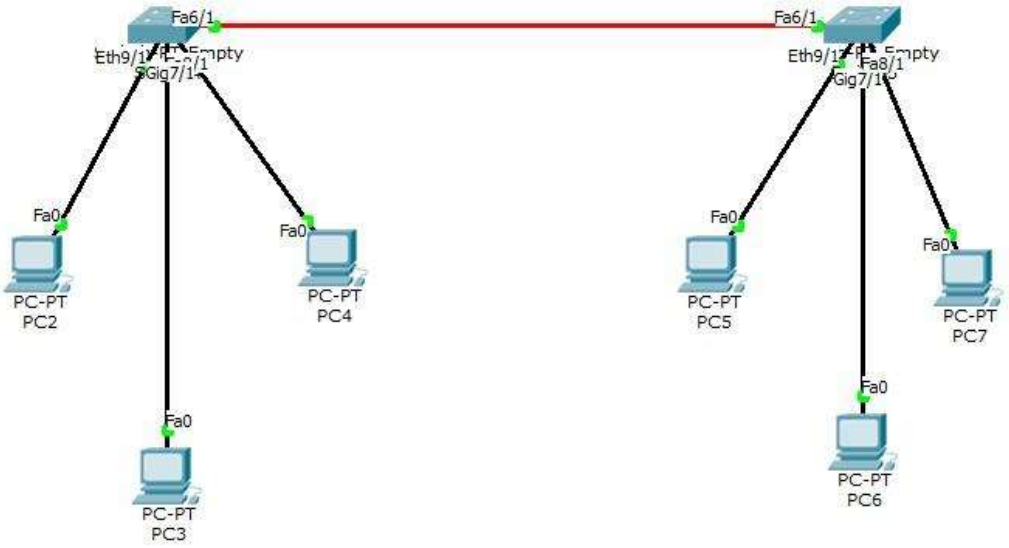
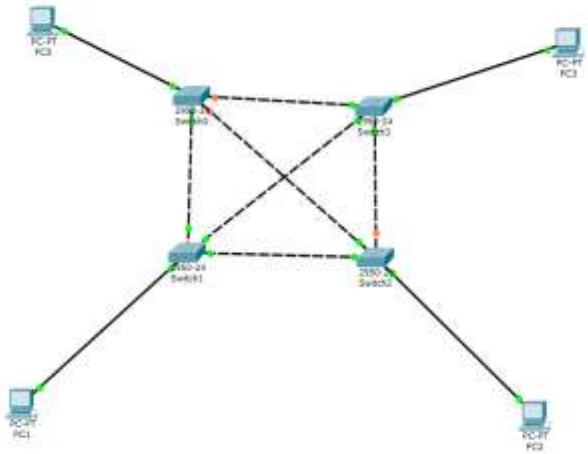
PART - A

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:





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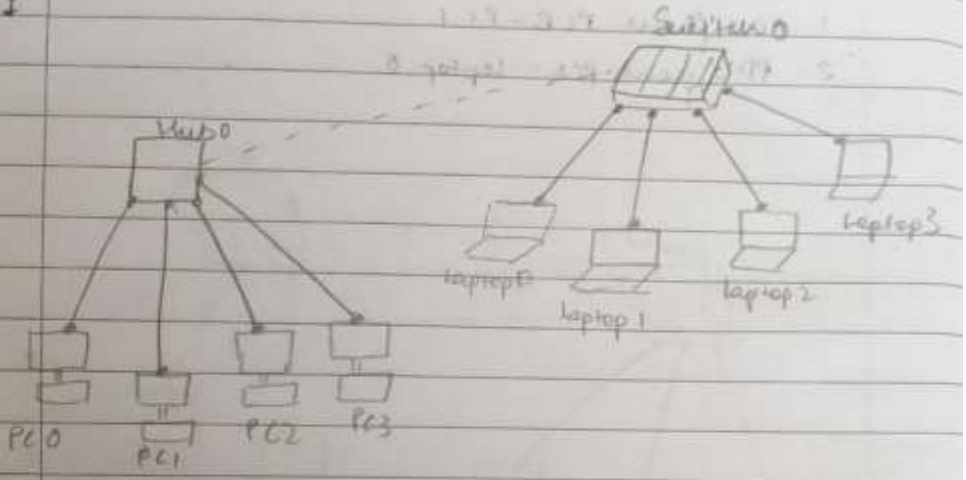
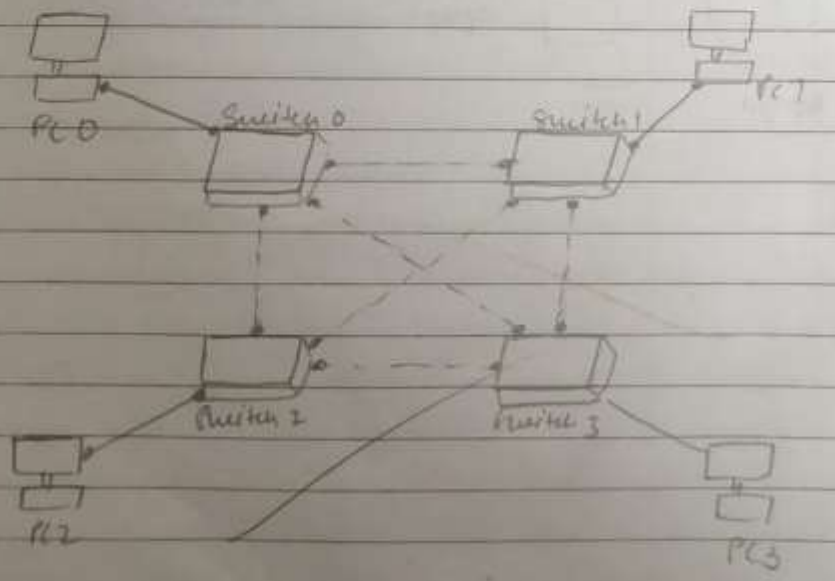
LAB 2

Create new topology & simulate sending a simple video from source to destination using hub and switch as connecting devices & demonstrate a ping message.

1

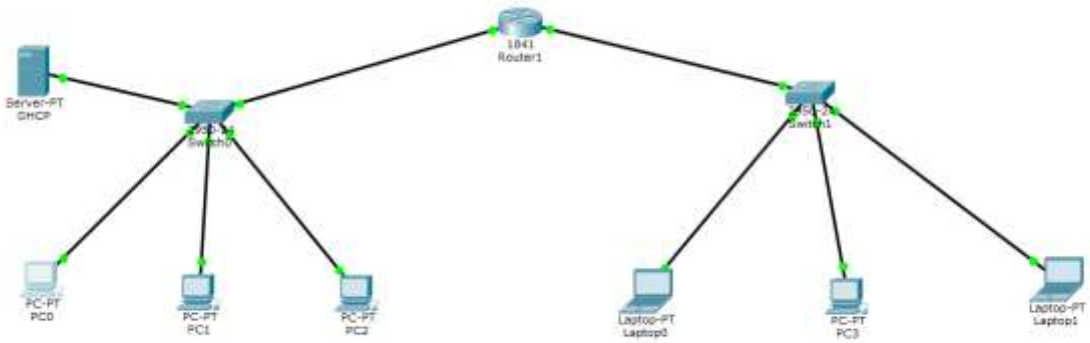


2.



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

Network diagram:



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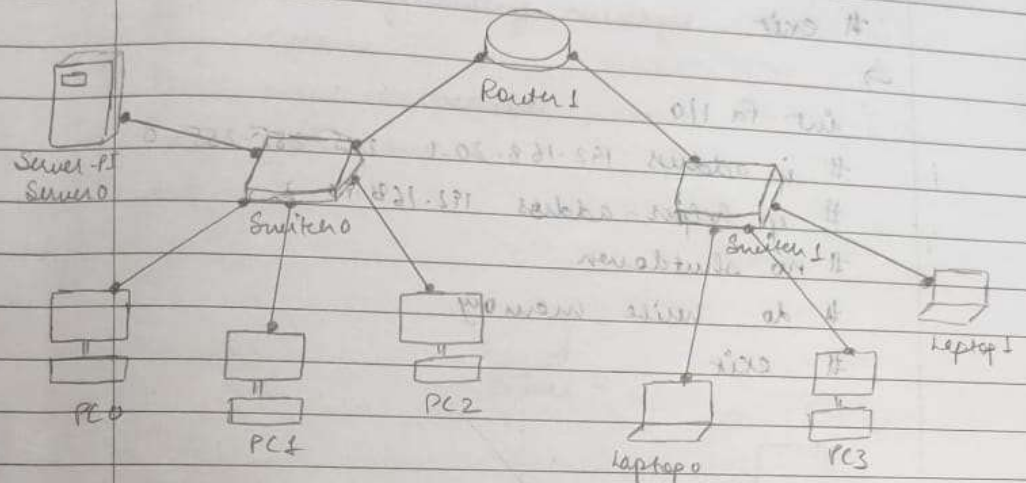
Configure DHCP within a LAN and outside the LAN



Server

① DHCP

↳ Desktop IP config

↳ static

↳ 192.168.10.2

Gateway 192.168.10.1

② Services

↳ DHCP

	ON	ON
↳ Pool Name	SWITCH 1	SWITCH 2
gateway	192.168.10.1	192.168.20.1
Start IP address	192.168.10.3	192.168.20.2
Subnet mask	255.255.255.0	255.255.255.0
max no. of users	20	20
	Add	Add

Router

↳ CLI

↳ no

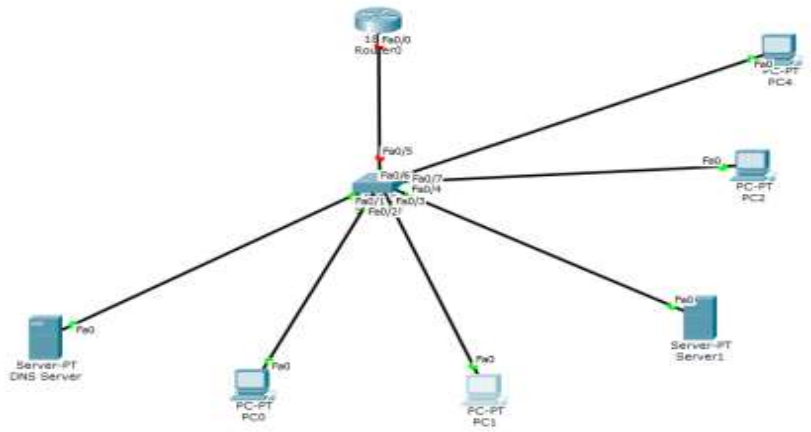
Router> enable

Conf t

int fa 0/0

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

Network diagram:



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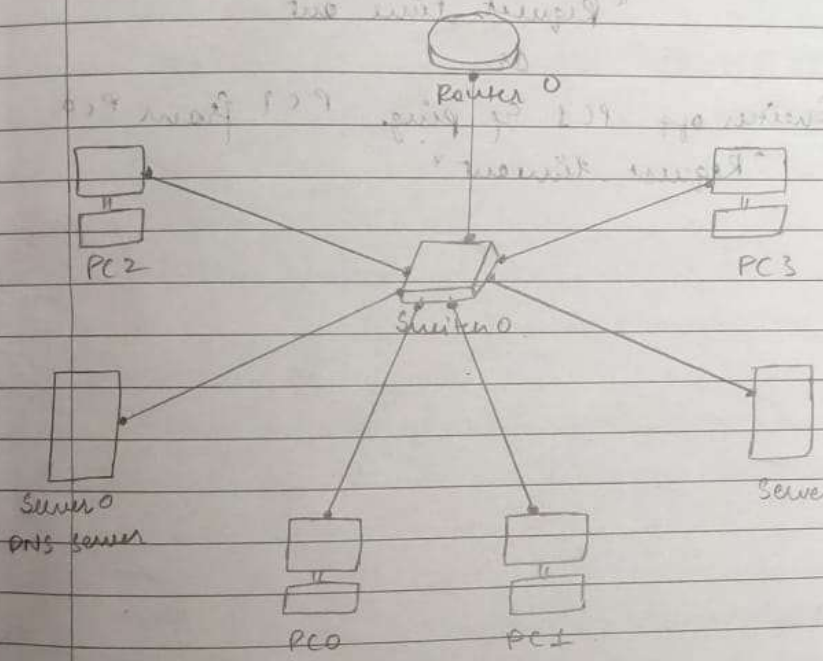
Experiment 3, 2

1) Configure web server, DNS within a land
2) Configure IP addresses to routers in packet tracer. Explore the following messages
   - Ping response
   - Destination unreachable
   - Request time out
   - reply



IP address of

DNS server : 192.168.1.5

Web server 1 : 192.168.1.6

PC0 : 192.168.1.100

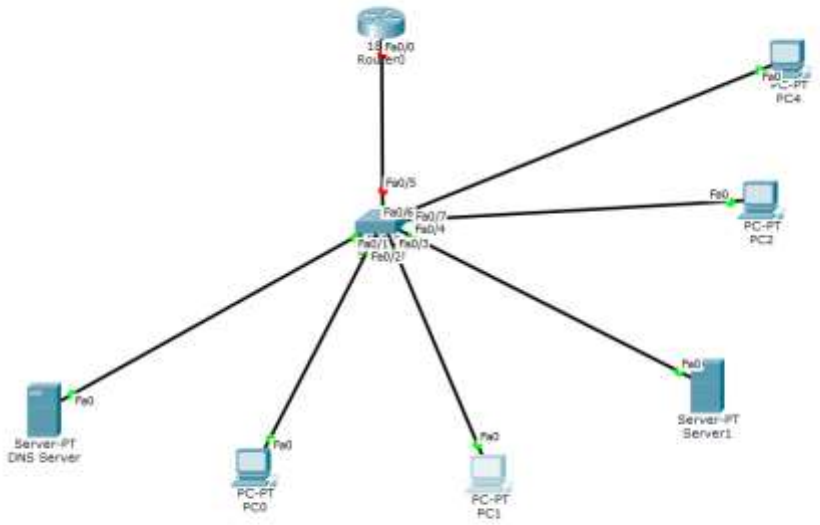
PC1 : 192.168.1.101

PC2 : 192.168.1.102

PC3 : 192.168.1.103

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

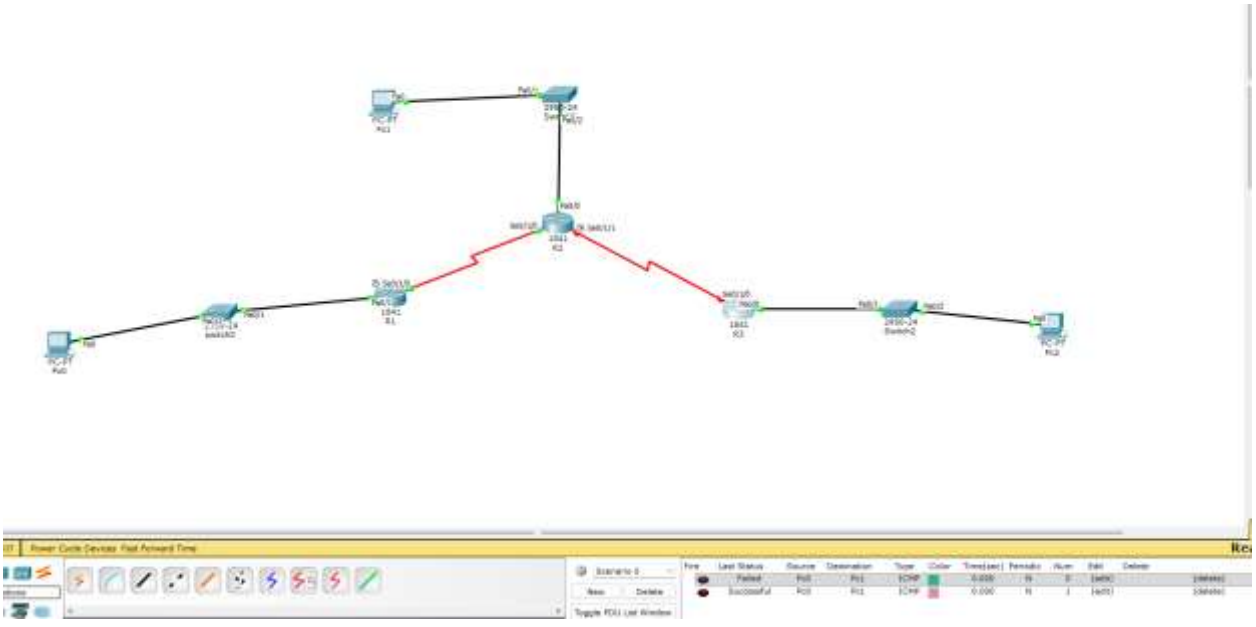
Network diagram:



Configuration:

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

Network diagram:



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Router 2 CLI

- enable
- conf t
- ip route 192.168.10.0 255.255.255.0 172.16.1.1
- ip route 192.168.30.0 255.255.255.0 172.16.2.2
- exit
- write memory
- show ip route

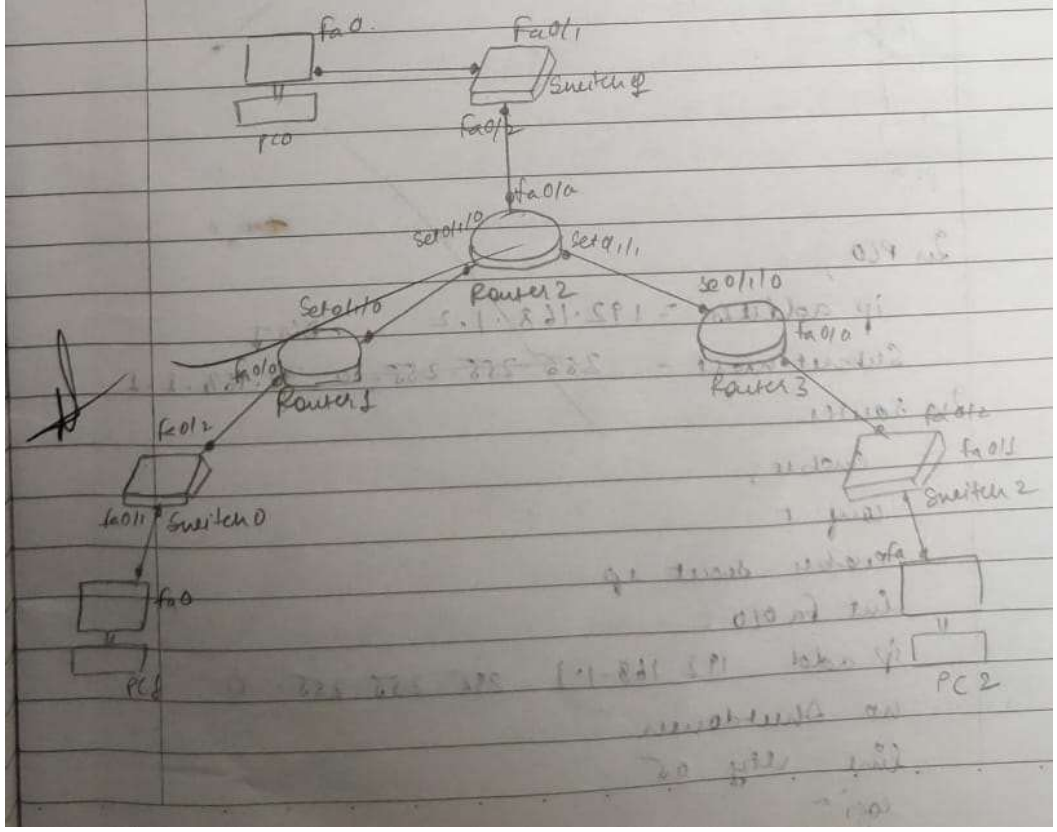
Router 3 CLI

- enable
- conf t
- ip route 0.0.0.0 0.0.0.0 Se0/1/0
- exit
- write memory
- show ip route

IP address

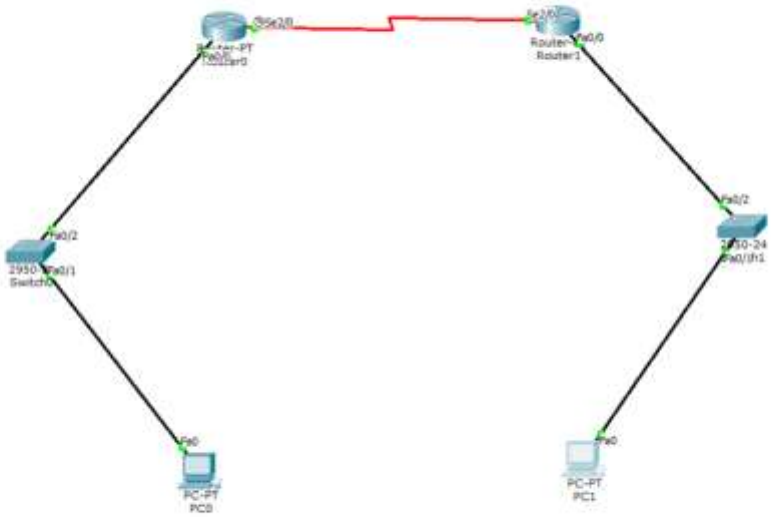
PC0: 192.168.20.10

PC1: 192.168.10.10



Program 6: Configure RIP routing Protocol in Routers.

Network diagram:



Configuration:

Routing information protocol

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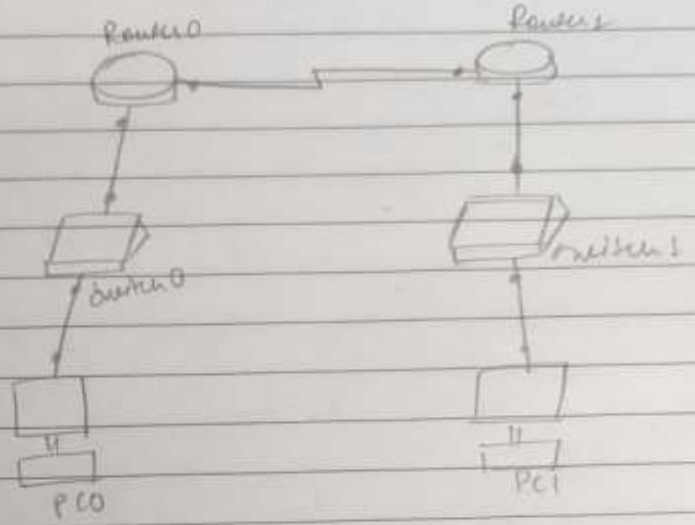
Configure RIP routing protocol in routers to transfer packet from node A to node B.



PC0

IP addrss 192.168.1.2

gateway 192.168.1.1

PC1

IP addrss 192.168.2.2

gateway 192.168.2.1

Router0

IP address 192.168.1.1 (fa0/0)

Serial2/0 10.10.0.2

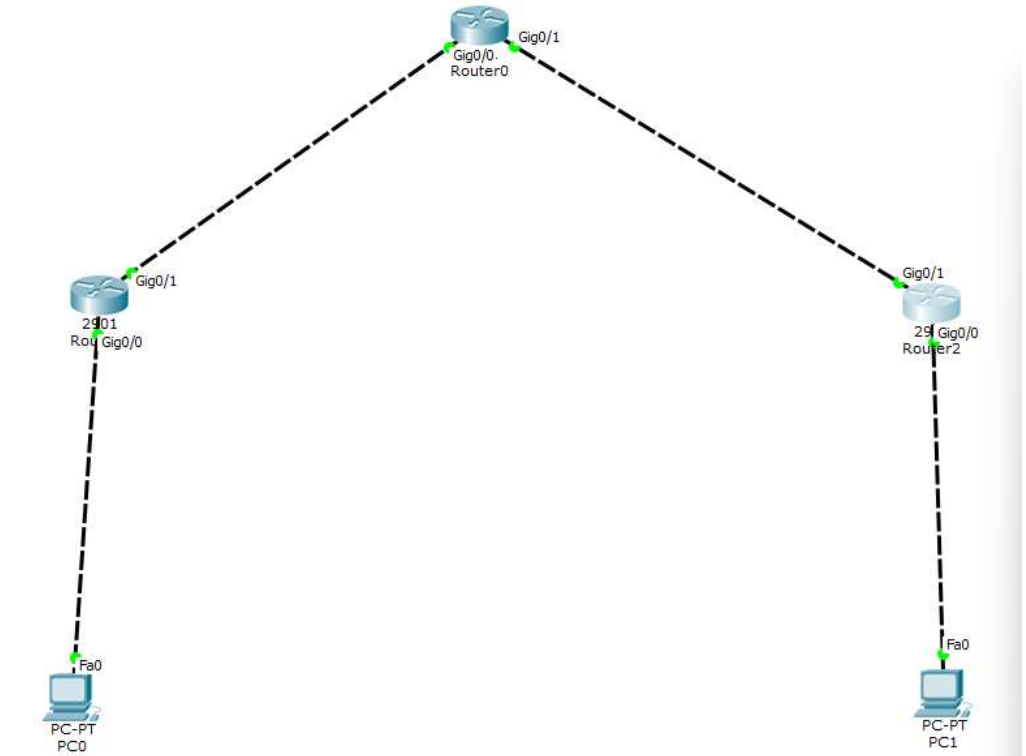
Router1

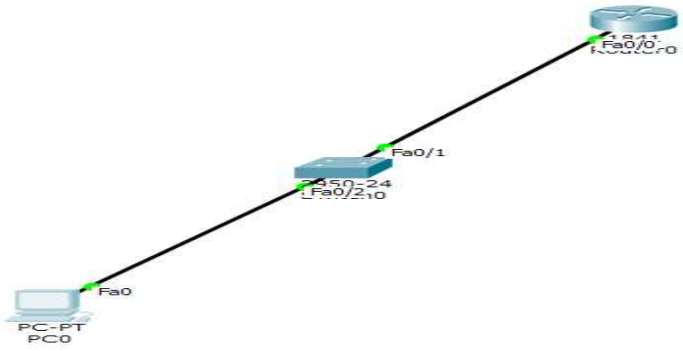
IP address 192.168.2.1 (fa0/0)

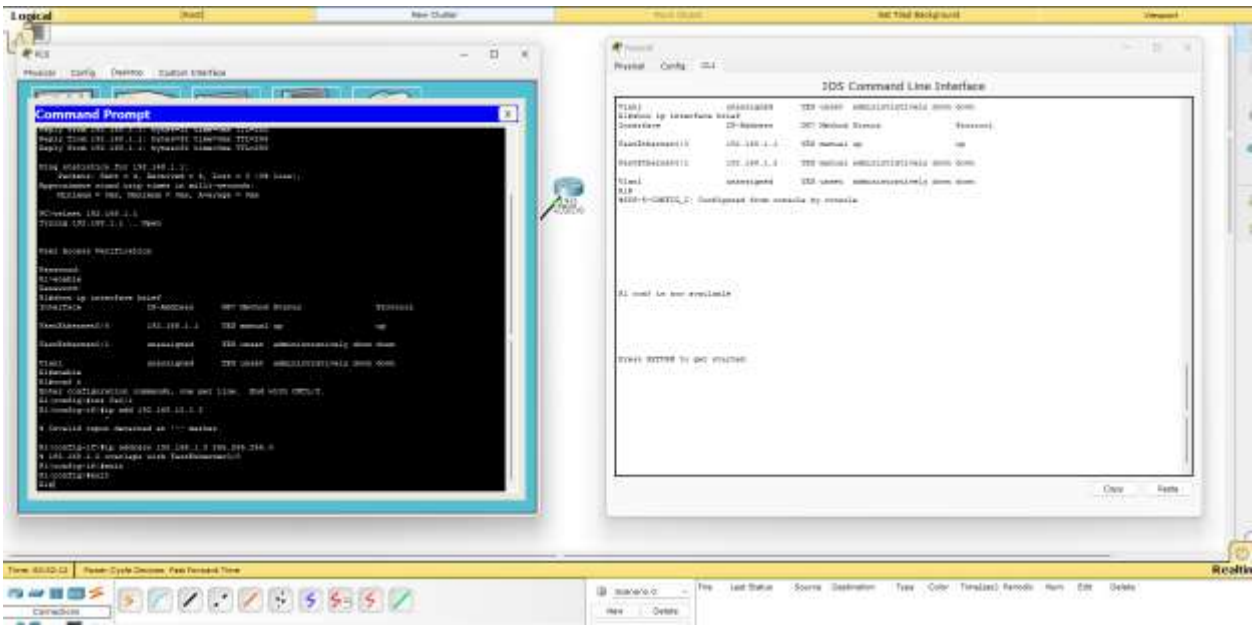
Serial2/0 10.10.0.3

Program 7: Configure OSPF routing protocol.

Network diagram:







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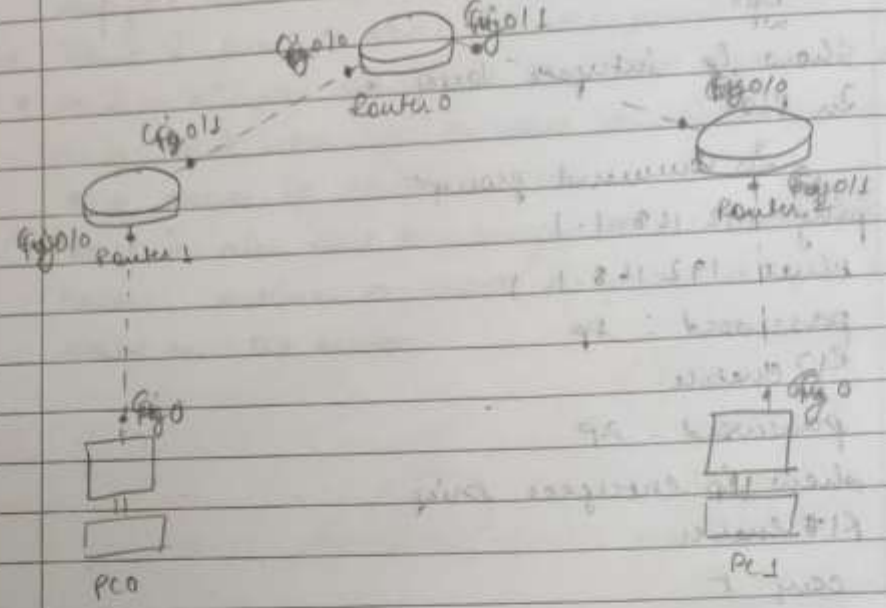
Experiment - 6

Conf. OSPF protocol.



In Router 0

Config:

GigabitEthernet 0/0

ip address 192.168.55.1 On it

GigabitEthernet 0/1

ip address 176.16.10.1 On it

Router 1

config

0/0 ip address 192.168.44.1

0/1 ip address 192.168.55.2

Router 2

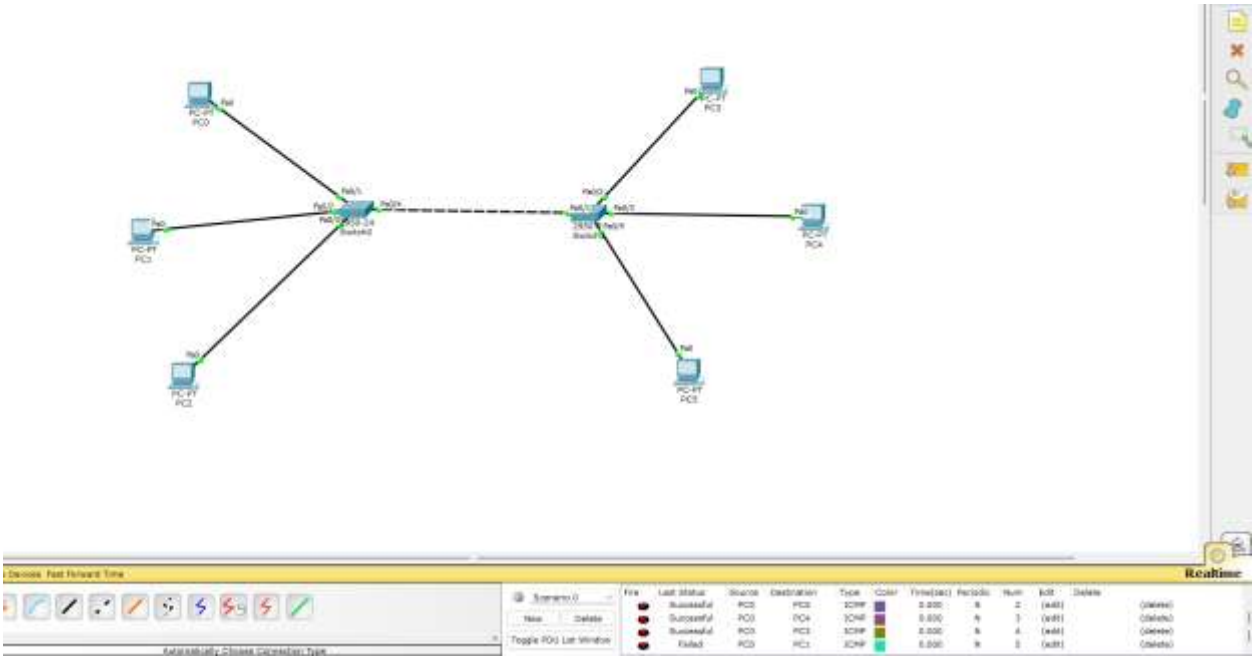
config

0/0 ip address 176.16.10.2

0/1 ip address 10.10.22.1

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

Network diagram:



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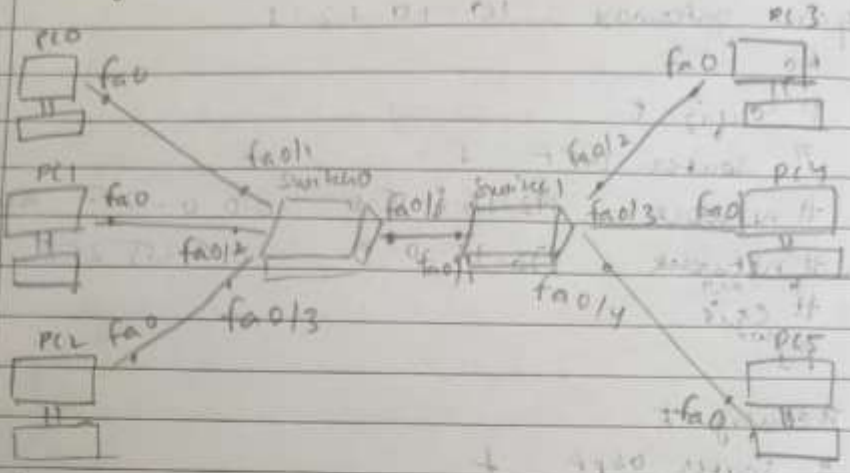
Experiment - 7

To construct a VLAN & make the PC's communicate among VLAN



Ip address of

PC0 - 192.168.1.2
PC1 - 192.168.1.3
PC2 - 192.168.1.4
PC3 - 192.168.1.5
PC4 - 192.168.1.6
PC5 - 192.168.1.7

VLAN 10
fa0/1 PC0
fa0/2 PC3

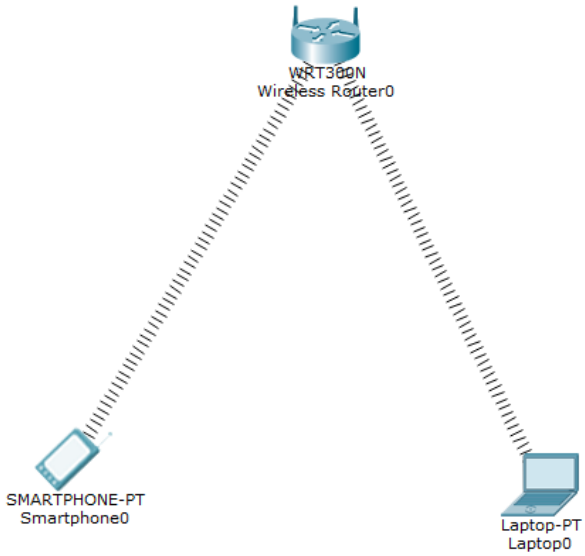
VLAN 20
fa0/2 PC1
fa0/4 PC4

VLAN 30
fa0/3 PC2
fa0/4 PC5

Switch 0
> enable
conf t
int fa0/1
Switchport access vlan 10
int fa0/2
Switchport access vlan 20
int fa0/3
Switchport access vlan 30
int fa0/4
Switchport access mode trunk
exit

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

Network diagram:



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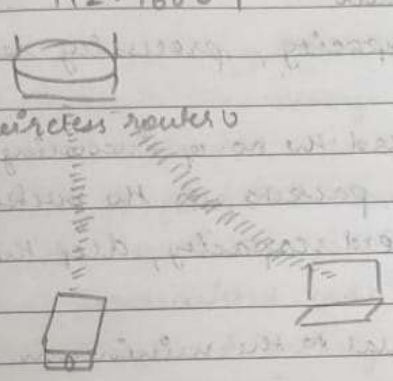
Experiment - 9

construct a network & make the nodes communicate wirelessly



for laptop,

turn it off, take out the port & drop it again drag & drop wireless port

Wireless Router

↳ config → wireless,

SSID - BMSCE

authentication - WPA2 - PSK PSK2

password - bmsce1234

in smartphone

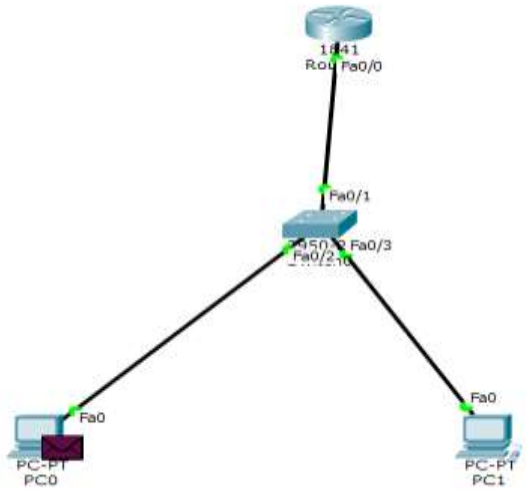
↳ config - wireless

↳ SSID - BMSCE

↳ authentication - bmsce1284

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

Network diagram:



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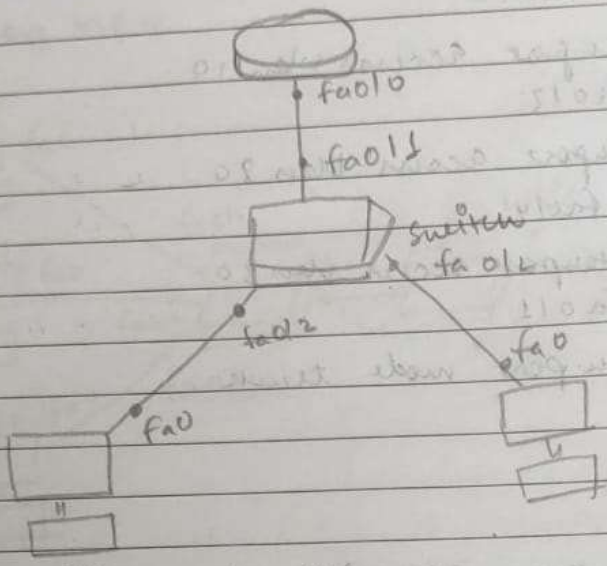
Experiment 8

Demonstrate the TTL life of a packet



IP address of

PC0 - 192.168.1.2

PC1 - 192.168.1.3

Router - 192.168.1.1

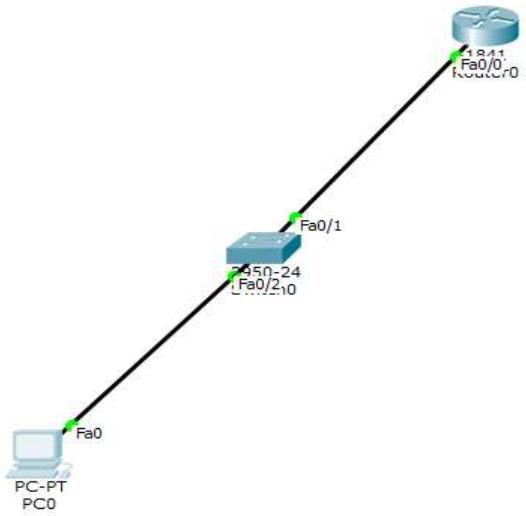
Default gateaway for PC0 & PC1 } 192.168.1.1

Message from PC0 - PC1 - successful

TTL 255, 128

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:

Experiment - 5

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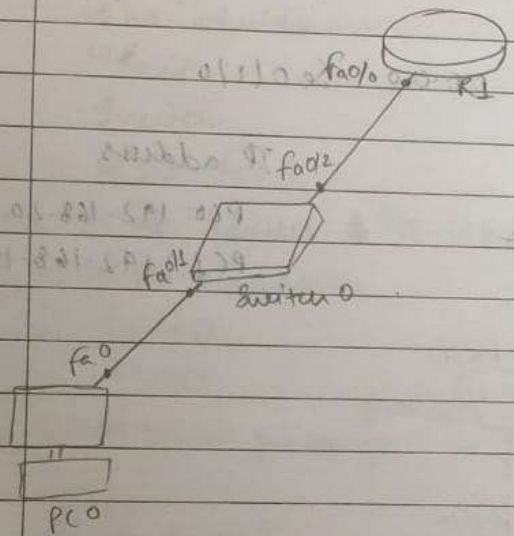
Configure telnet to access router remotely

→ Telnet is used to access remote server.

→ It is a simple command line tool that runs on comp & it allows you to send commands remotely to a server & administrator

→ Telnet is also used to manage other devices like router, switches to check if ports are open or closed on the server.



In PC0,

ip address = 192.168.1.2 DG→

Subnet mask - ~~255.255.255.0~~ 192.168.1.1

In router

enable,

conf t

enable secret cp

int fa 0/0.

ip add 192.168.1.1 255.255.255.0.

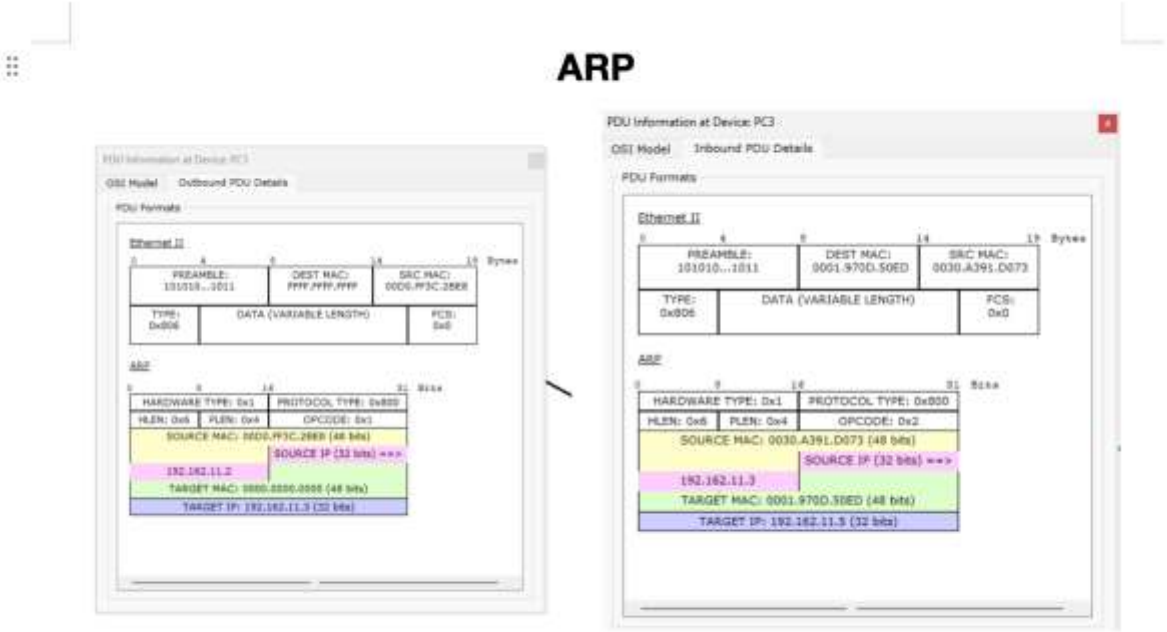
no shutdown

line vty 0 5

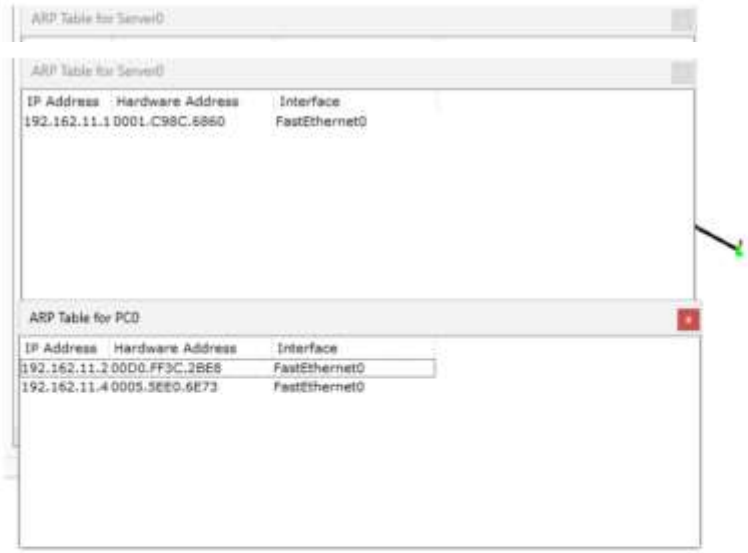
login

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

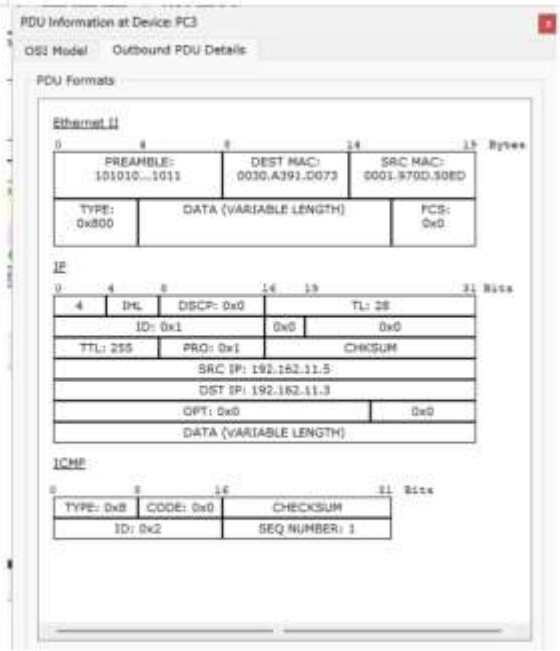
Network diagram:



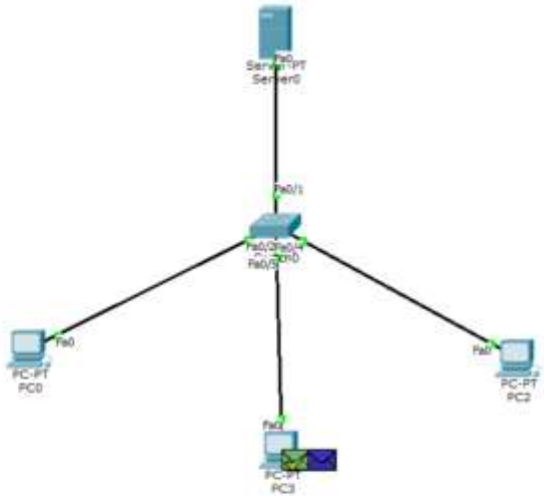
THE MAC ADDRESS before and after encrypting and sending



ARP table of pc0 and server after sending a simple PDU



The address of sent one



topology

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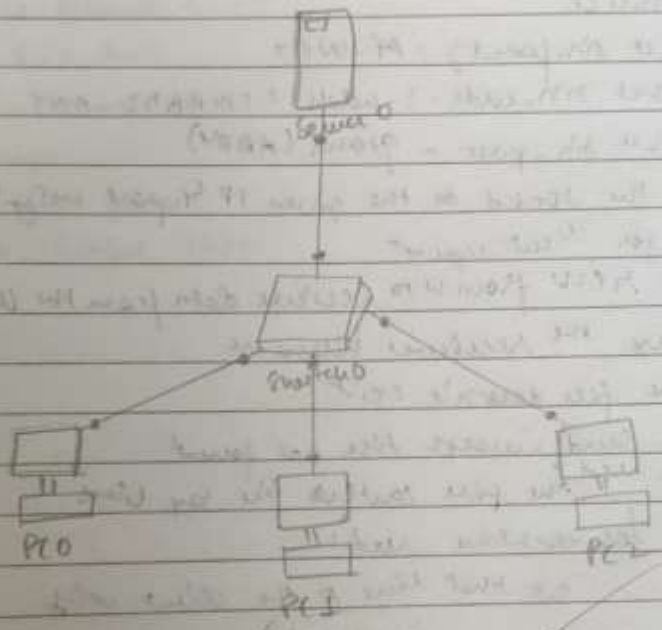
Address Resolution Protocol

- ARP is used to map the IP address to the MAC address
- ARP is used to get data link layer address, MAC address with the help of IP address



PC 0 :

IP address : 192.168.11.1

DNS server : 192.168.11.4

PC 1

IP address : 192.168.11.2

DNS server : 192.168.11.4

PC 2

IP address : 192.168.11.3

DNS server : 192.168.11.4

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:

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PART-B

Leaky Bucket Simulation

1. Start the program
2. Read bucket capacity, processing rate, & no. of secs.
3. For each sec, read the no. of incoming packets
4. Add incoming packets to the bucket
5. If packets exceed capacity, drop the extra packets
6. Send packets equal to the minimum of packets in bucket, processing rate
7. Update the no. of packets left in the bucket
8. Repeat for all secs.
9. After all inputs, continue sending remaining packets until the bucket is empty
10. Stop the program

Output

Enter bucket size : 5
Enter processing rate : 2
Enter no. of secs you want to simulate : 3
Enter the size of packet entering at 1 sec : 5
2 sec : 4
3 sec : 3

Second	Packet Received	Packets 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

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:

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Part B client server communication

Algorithm (client side)

1) sfd = create a socket with the socket (...) system call
2) connect the socket to the address of the server using the connect (sfd, ...) system call. The IP address of the server machine & port no. of the server need to be provided
3) read file name from standard input by n = read (stdio, buffer, size of (buffer))
4) write file name to the socket using write (sfd, buffer, n)
5) Read file contents from the socket by m = read (sfd, buffer, size of (buffer))
6) Display file contents to standard output by write (stdio, buffer, n)
7) Go to step 5 if m > 0
8) close socket by close (sfd)

Algorithm (Server side)

1) sfd = create a socket with the socket (...) system call
2) Bind the socket to an address using the bind (sfd, ...) system call. If not one of machine IP address, assign the structure member s_addr to INADDR_ANY. Assign a port no. b/w 3000 & 5000 to the port
3) listen for connections with the listen (sfd, ...) system call)
4) sfd = Accept a connection with the accept (sfd, ...) system call. This call typically blocks until a client connects with the server
5) Read the filename from the socket by n = read (sfd, buffer, size of (buffer))
6) Open the file by fd = open (buffer)

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;
}
```

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4) Client server communication using UDP socket

Algorithm (server side)

1) Start
2) use socket (AF_INET, SOCK_DGRAM, 0) to create datagram (UDP) socket
3) Initialize
   - Set sin_family = AF_INET
   - Set sin_addr.s_addr = INADDR_ANY
   - Set sin_port = ground (4000)
4) Bind the socket to the given IP & port using bind()
5) wait for client request
   - use recvfrom() to receive data from the client
6) Display the received filename
7) If the file doesn't exist
   - Send message file not found
   else read the file contents like by line
   for receiving read:
   So that line to the client using
   send()
8) Close the file after sending all the contents
9) Close the socket using close()
10) End

output (server client side)

UDP Server is running on port 8080...
Client request file: example.txt
File sent successfully

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 ===
```

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CRC Error Detection

1. Start the program
2. Enter the generator polynomial & the message
3. Append zeros to the message (generator length - 1)
4. Divide the appended message by the generator using XOR to find the remainder
5. Append the remainder to the original message to form the transmitted code
6. Enter the received message
7. Divide the received message by the generator again
8. If the remainder is all zeros → message is error-free, else → error detected
9. Stop the program

Output

Enter the generator polynomial : 101
Generator polynomial (CRC-CCITT) : 101
Enter the message : 110101
Message polynomial appended with zeros : 11010100
Checksum (remainder) : 11
Message with checksum appended : 11010111
Enter the received message : 11010111
Received message is error-free.