Project Report

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Project : Develop a network simulator implementing entire protocol stack.

Integrated Network,Transport and Application layer

1 Resources

1.1 Programminng Language Used

The language used in this project is python which is a high-level, interpreted, general-purpose programming language.The in-built library used is random. Latex used for making the report. **Concept :** Object Oriented Programming

1.2 Resources used

The resources used for building this model include Mod 5 IP addressing, Mod 7 routing, Mod 9 Transport layer and BAF The youtube video `https://www.youtube.com/watch?v=rYodcvhh7b8` was also used for reference

2 Assumptions

We have assumed a linear configuration of routers.

3 Input-Output Format

The program has three types of device:
1. Router
2. Switch
3. End Device
During configuration, User has to choose between these devices and then configure each port with devices, Network ID(if required) and subnet.

```
"F:\computer networks\lab 2\newvenv\Scripts\python.exe" "F:/computer n
******************Configure the network******************
Devices available:
1. Router
2. Switch
3. End device
Press:
1 to add a Router
2 to add a switch
3 to add a End device :
1
Adding a router...................
Enter no of ports: 2
Configuring the ports of router:
Enter the NID for port no : 0 : 20.0.0.0
Enter the subnet value : 28
Enter the NID for port no : 1 : 30.0.0.0
Enter the subnet value : 25
connecting port in current generated router :
In router
Connecting port : 0
Enter the device to add : 2
Adding a switch...................
Enter no of ports: 3
connecting port in current generated switch :
```

```
In switch:
Connecting port : 0
Enter the device to add : 3
Adding the end device..............
Enter NID: 20.0.0.0
Enter the subnet: 28
In switch:
Connecting port : 1
Enter the device to add : 3
Adding the end device..............
Enter NID: 20.0.0.0
Enter the subnet: 28
current switch configured, switching to next
In router
Connecting port : 1
Enter the device to add : 1
Adding a router...................
Enter no of ports: 3
Configuring the ports of router:
Enter the NID for port no : 0 : 30.0.0.0
Enter the subnet value : 25
Enter the NID for port no : 1 : 40.0.0.0
Enter the subnet value : 24
Enter the NID for port no : 2 : 50.0.0.0
Enter the subnet value : 28
connecting port in current generated router :
```

```
In router
Connecting port : 0
Enter the device to add : 2
Adding a switch..................
Enter no of ports: 3
connecting port in current generated switch :
In switch:
Connecting port : 0
Enter the device to add : 3
Adding the end device..............
Enter NID: 40.0.0.0
Enter the subnet: 24
In switch:
Connecting port : 1
Enter the device to add : 3
Adding the end device..............
Enter NID: 40.0.0.0
Enter the subnet: 24
current switch configured, switching to next
In router
Connecting port : 1
Enter the device to add : 1
Adding a router...................
Enter no of ports: 2
Configuring the ports of router:
Enter the NID for port no : 0 : 50.0.0.0
Enter the subnet value : 28
Enter the NID for port no : 1 : 60.0.0.0
```

```
Enter the subnet value : 20
connecting port in current generated router :
In router
Connecting port : 0
Enter the device to add : 2
Adding a switch..................
Enter no of ports: 3
connecting port in current generated switch :
In switch:
Connecting port : 0
Enter the device to add : 3
Adding the end device.............
Enter NID: 60.0.0.0
Enter the subnet: 20
In switch:
Connecting port : 1
Enter the device to add : 3
Adding the end device.............
Enter NID: 60.0.0.0
Enter the subnet: 20
current switch configured, switching to next
current router configured, switching to next
current router configured, switching to next
current router configured, switching to next
```

4   Program walkthrough

Topology
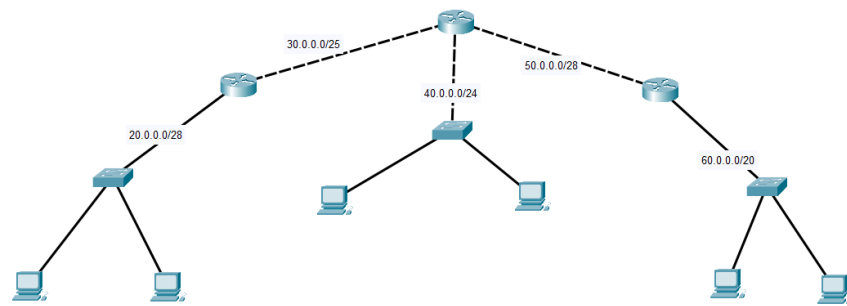
Performing auto Switch Table learning

Figure 1: Switch 1

```
Switch No.2

 __  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __
|                          Switch Table                        |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
|      MAC ADDRESS               :           PORT NO.          |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
|    89:7C:90:3A:91:7E           :               0            |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
|    3A:50:23:1C:50:E4           :               1            |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
|    4F:5A:88:FE:41:FA           :               2            |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
```

Figure 2: Switch 2

```
Switch No.3

 __  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __
|                          Switch Table                        |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
|      MAC ADDRESS               :           PORT NO.          |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
|    82:F5:59:B8:2F:3D           :               0            |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
|    87:53:98:01:C8:C8           :               1            |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
|    56:B1:25:AC:1B:08           :               2            |
|__  __  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
```

Figure 3: Switch 3

Initial routing table configuration

```
Router No.1
      __  __  __  __  __  __  __  __  __  __  __  __  __  __  __
     |                       ROUTING TABLE                     |
     |__  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
     |  Destination  :   subnet   :    Next hop   :    Hops    |
     |__  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
     |   20.0.0.0    :    28      :       DC      :     0      |
     |__  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
     |   30.0.0.0    :    25      :       DC      :     0      |
     |__  __  __  __  __  __  __  __  __  __  __  __  __  __  __|
```

```
Router No.2
          __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
         |                            ROUTING TABLE                    |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |   Destination      :      subnet      :     Next hop      :     Hops     |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     50.0.0.0       :       28         :        DC       :       0        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     30.0.0.0       :       25         :        DC       :       0        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     40.0.0.0       :       24         :        DC       :       0        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
```

```
Router No.3
          __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
         |                            ROUTING TABLE                    |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |   Destination      :      subnet      :     Next hop      :     Hops     |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     50.0.0.0       :       28         :        DC       :       0        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     60.0.0.0       :       20         :        DC       :       0        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
```

Performing dynamic routing using RIP

```
Dynamically updated routing table using RIP
Router No:1
          __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
         |                            ROUTING TABLE                    |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |   Destination      :      subnet      :     Next hop      :     Hops     |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     20.0.0.0       :       28         :        DC       :       0        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     50.0.0.0       :       28         :    30.0.0.77     :       2        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     30.0.0.0       :       25         :        DC       :       0        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     40.0.0.0       :       24         :    30.0.0.77     :       1        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
         |     60.0.0.0       :       20         :    30.0.0.77     :       2        |
         |__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __|
```

8

Router No:2

```
 _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _
|                            ROUTING TABLE                         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    Destination    :    subnet    :    Next hop    :    Hops      |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    50.0.0.0    :    28    :       DC       :    0         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    20.0.0.0    :    28    :    30.0.0.10   :    1         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    30.0.0.0    :    25    :       DC       :    0         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    40.0.0.0    :    24    :       DC       :    0         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    60.0.0.0    :    20    :    50.0.0.7    :    1         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
```

Router No:3

```
 _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _
|                            ROUTING TABLE                         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    Destination    :    subnet    :    Next hop    :    Hops      |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    50.0.0.0    :    28    :       DC       :    0         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    20.0.0.0    :    28    :    50.0.0.9    :    2         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    30.0.0.0    :    25    :    50.0.0.9    :    1         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    40.0.0.0    :    24    :    50.0.0.9    :    1         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
|    60.0.0.0    :    20    :       DC       :    0         |
| _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _  _ _|
```

9

Performing message Transfer

End devies in the topology

```
      **********End devices**********
  Device No.        :       MAC ADDRESS      :        IP ADDRESS
     1              :    CC:F8:C9:03:03:44    :        20.0.0.8
     2              :    1D:12:EF:50:5E:A8    :        20.0.0.2
     3              :    3A:50:23:1C:50:E4    :        40.0.0.175
     4              :    4F:5A:88:FE:41:FA    :        40.0.0.148
     5              :    87:53:98:01:C8:C8    :        60.0.3.27
     6              :    56:B1:25:AC:1B:08    :        60.0.7.245
```

Input
It requires source and destination device sequence number. It is using well defined port numbers Gmail and Instagram, and ephimeral port number newPRC. It requires application for port to port delivery and data.

```
Enter the source device no:1
6
Enter the destination device no:Process available:
instagram
gmail
newprc
Enter the process name:instagram
Enter the data to send:110001110
```

Working

When source and destination are in different network

1. It first check source and destination NID if they are different it means they are in different network

2. Then it sends the data to its gateway which is within the network. So, it requires mac address. To get mac address it performs ARP.

3. This process fills the arp table of end device and when the ack is received it fill the arp table of router.

```
Sending data from device having ip :20.0.0.8
to the device having ip :60.0.7.245
Source and destination are in different network:
Entry not in arp table...
performing ARP:
sending arp request to:<class 'router.router'>.......
ARP request successful.......
Sender device arp table:

            _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
           |                      ARP  TABLE                     |
           | _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
           |        IP ADDRESS       :        MAC ADRESS         |
           | _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
           |        20.0.0.13        :      45:0F:7F:5D:26:19     |
           | _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|


Router arp table:

            _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
           |                      ARP  TABLE                     |
           | _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
           |        IP ADDRESS       :        MAC ADRESS         |
           | _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
           |        20.0.0.8         :      CC:F8:C9:03:03:44     |
           | _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
```

4. Then it adds layer 2 header to the data and sends it to the router.

5. Router strips the layer 2 header and sends the data to the next router.

6. when it reaches to the destination router network. Since the destination device is present in this network so it requires mac addresses for within the network delivery. So, it performs ARP which populates arp table of the router and the destination device.

7. Now, it again adds layer 2 header and sends to the destination device.

8. End device strips layer 2 and layer 3 header and compares the port for port to port delivery. And then it strips layer 4 header.

```
sending arp request to:<class 'end_devices.end_device'>.......
IP match not found
Adding layer2 header:
Router received data successfully:
Striping layer2 header
Sending msg to next router......
Sending msg to next router......
Entry not in arp table...
 performing ARP:
sending arp request to:<class 'end_devices.end_device'>.......
IP match not found
sending arp request to:<class 'end_devices.end_device'>.......
ARP request successful.......
Router ARP table:

        _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
       |                      ARP  TABLE                |
       |_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
       |          IP ADDRESS       :        MAC ADRESS  |
       |_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
       |            60.0.7.245      :     56:B1:25:AC:1B:08  |
       |_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
```

```
Destination device arp table:

        _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
       |                      ARP  TABLE                |
       |_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
       |          IP ADDRESS       :        MAC ADRESS  |
       |_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|
       |            60.0.1.29       :     82:F5:59:B8:2F:3D  |
       |_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|

Adding layer2 header......
Message received successfully.....
Message recieved at instagram
```

When they are in same network

```
Want to send more data(y/n):y
Enter the source device no:1
Enter the destination device no:2
Process available:
instagram
gmail
newprc
Enter the process name:gmail
Enter the data to send:11100011
adding layer4 header
Encapsulated data : 111110000111100011
adding layer3 header
Encapsulated data : 000101000000000000000000000001000000101000000000000000000000000010111110000111100011
```

```
Sending data from device having ip :20.0.0.8
to the device having ip :20.0.0.2
Source and destination are in same network:
message received successfully
Message recieved at gmail
Want to send stream(y/n):n




Want to send more data(y/n):n


Process finished with exit code 0
```

Performing Go Back N in the transport layer network

It uses window of size 3 and frame of size 4

```
Want to send stream(y/n):y




Enter stream(size>4):1110000011111111111111001010101010101010100111
    frame   :   status
    1110    :   Ack received
    0000    :   Ack received
sliding the window:
    1111    :   Ack received
    1111    :   Ack received
    1111    :   Ack received
sliding the window:
    1001    :   Ack received
    0101    :   Ack received
    0101    :   Ack received
sliding the window:
    0101    :   Ack received
    0101    :   Ack received
    0011    :   Ack received
sliding the window:
|
```