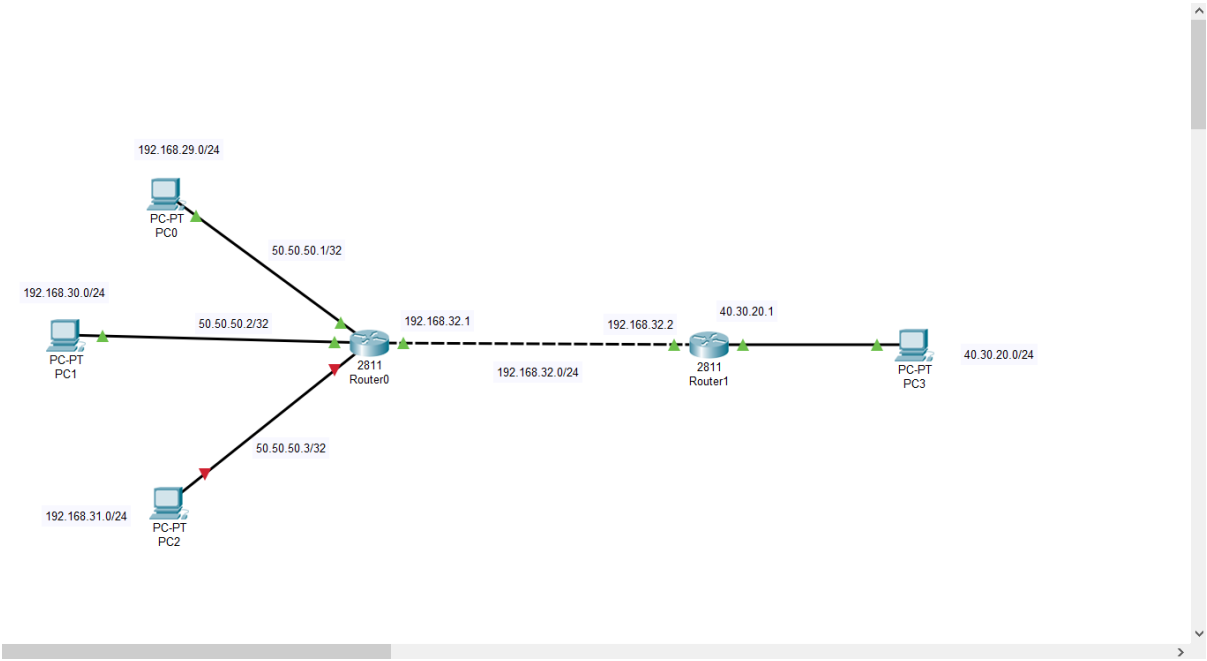
CN_LAB_4_Assignment

CE_055

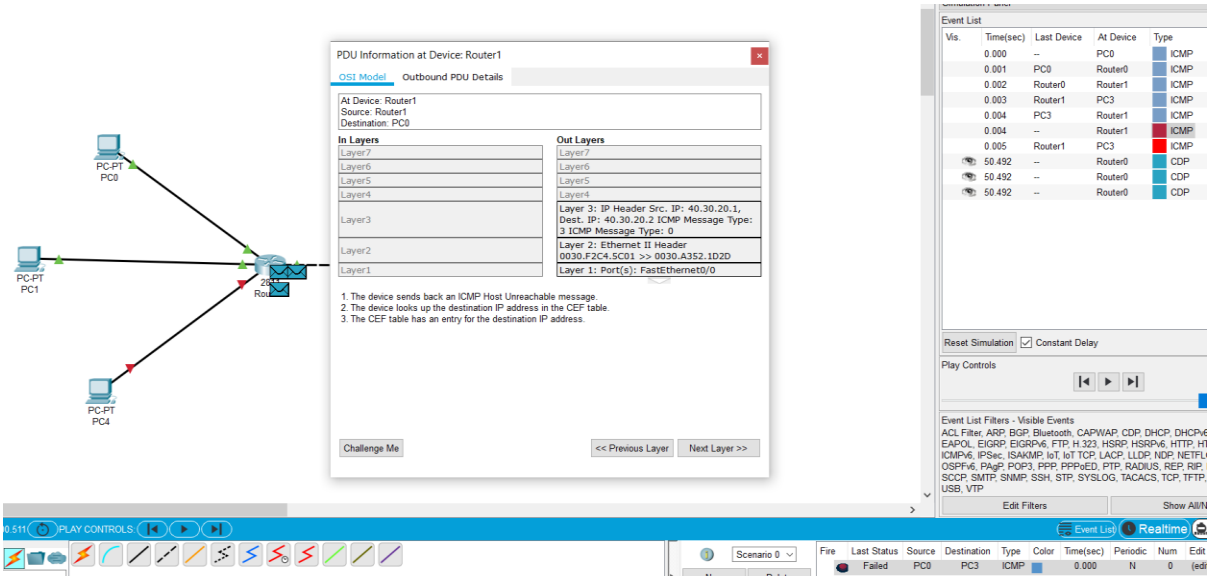
Aim:- Network address translation and implementation of dijkstra algorithm to find shortest path between routers.

1. NAT network1:-

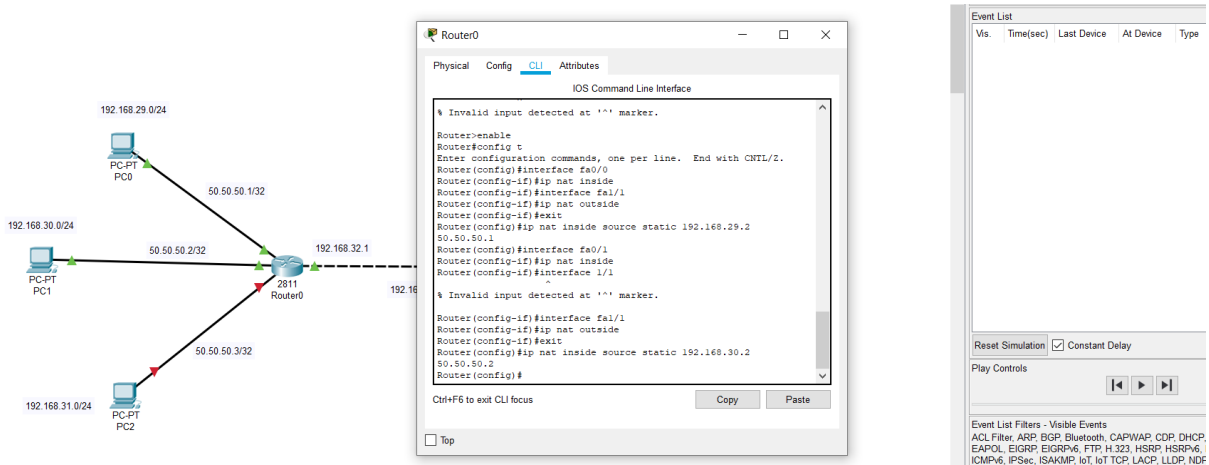
- Network Address Translation (NAT) is a process in which one or more local IP addresses are translated into one or more Global IP addresses and vice versa in order to provide Internet access to the local hosts.
- Generally, the border router is configured for NAT i.e the router which has one interface in local (inside) network and one interface in the global (outside) network. When a packet traverses outside the local (inside) network, then NAT converts that local (private) IP address to a global (public) IP address. When a packet enters the local network, the global (public) IP address is converted to a local (private) IP address.

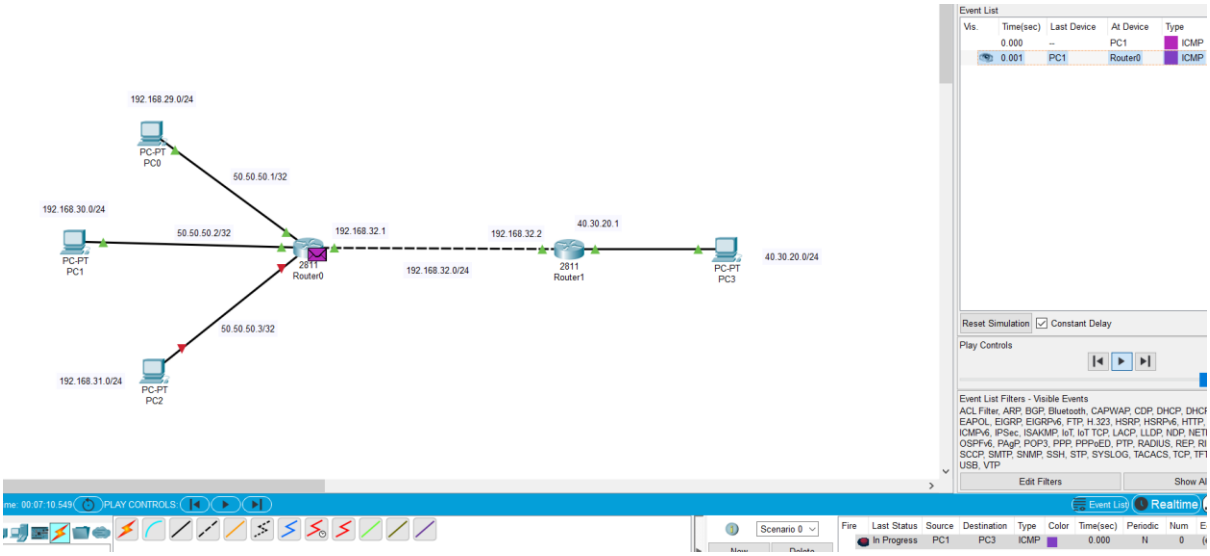


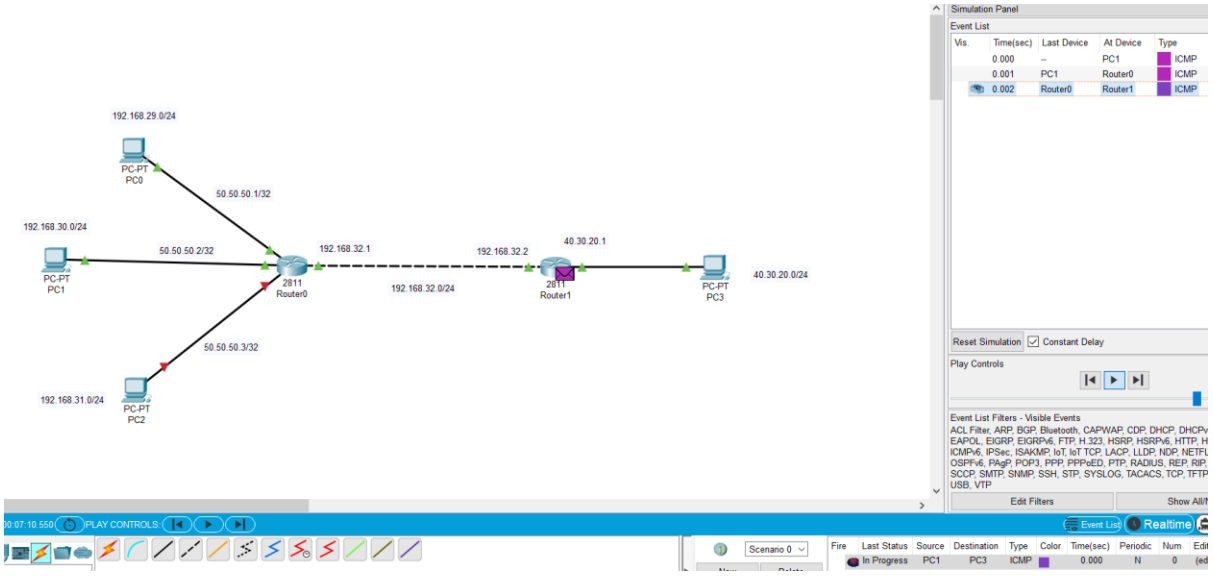
- Error while message transfer.

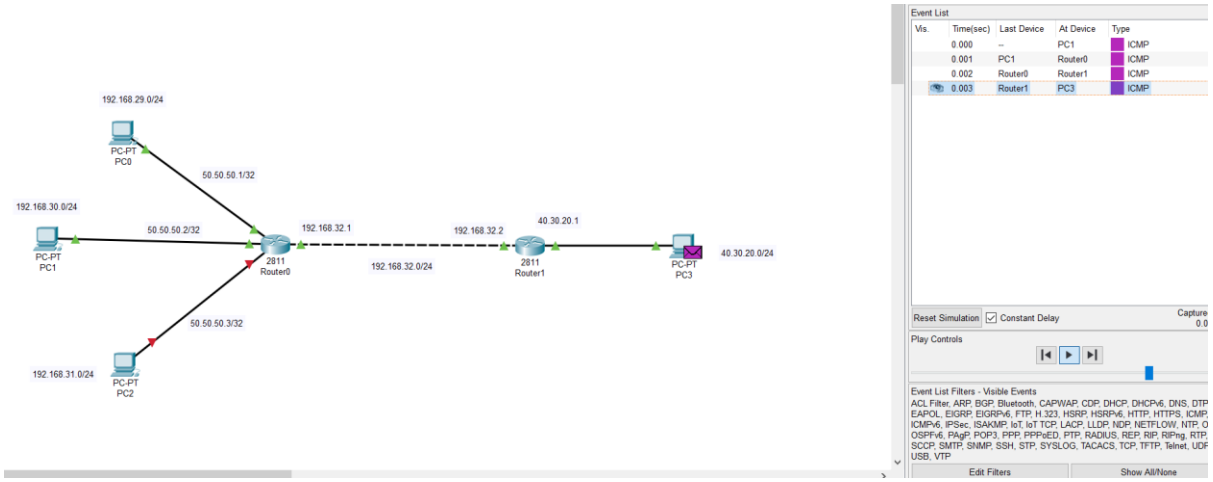


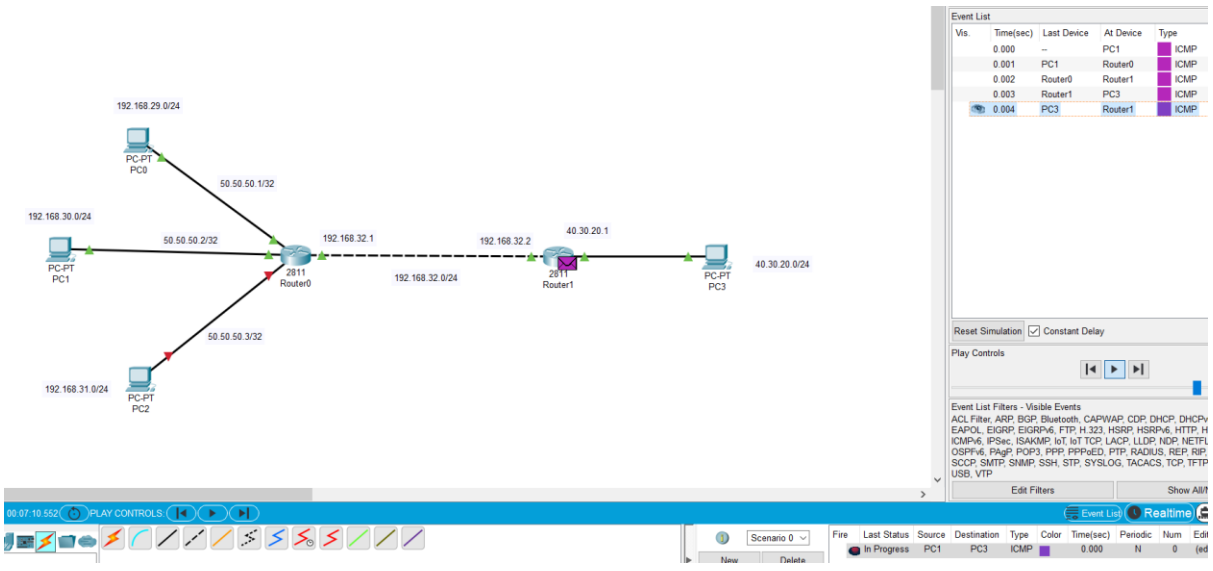
- Unreachable!
- Commands for solution and network translation:-

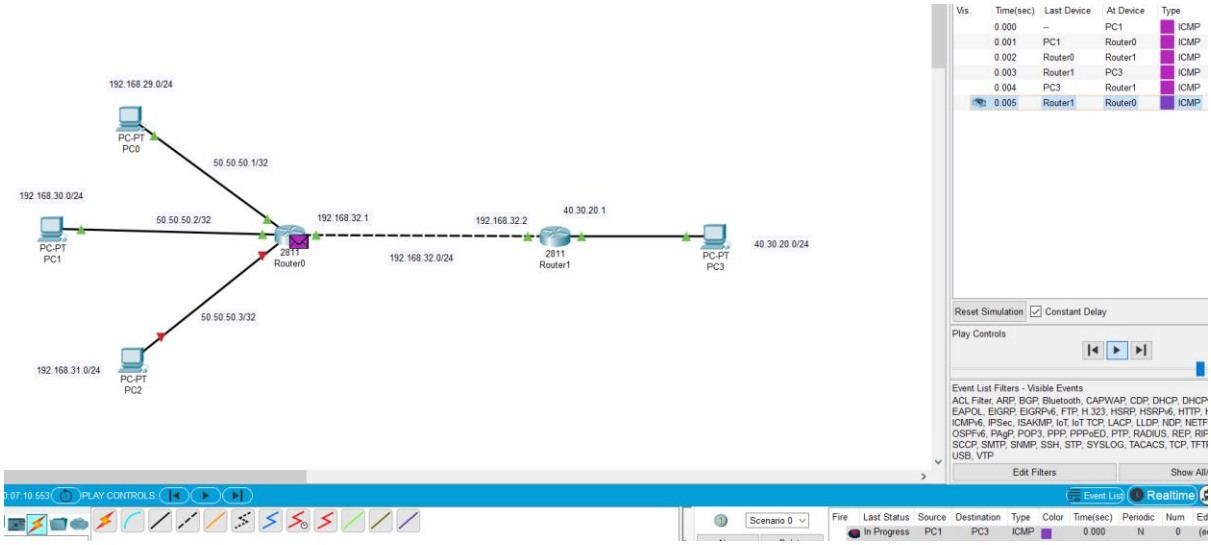


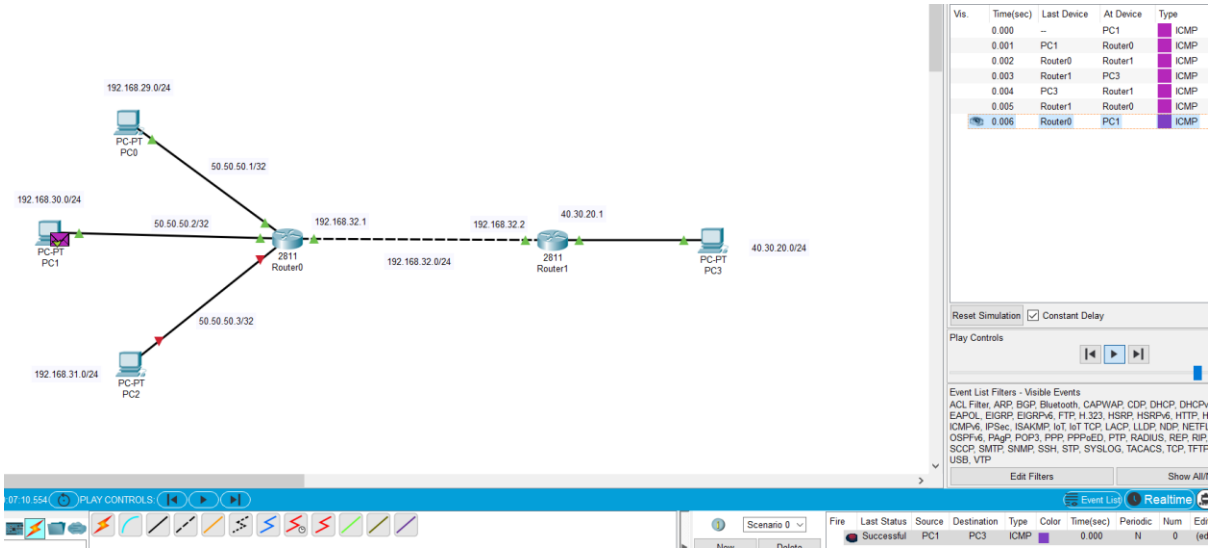



192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
PC-PT
PC1
192.168.32.1
2811
Router0
192.168.32.2
40.30.20.1
2811
Router1
PC-PT
PC3
40.30.20.0/24
192.168.32.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Simulation Panel
Event List
Vis. Time(sec) Last Device At Device Type
0.000 -- PC1 ICMP
0.001 PC1 Router0 ICMP
0.002 Router0 Router1 ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
ACL Filter, ARP, BGP, Bluetooth, CAPWAP, CDP, DHCP, DHCPv
EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP, H
ICMPv6, IPSec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NETFL
OSPFv6, PAgP, POP3, PPP, PPPoED, PTP, RADIUS, REP, RIP,
SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFTP
USB, VTP
Edit Filters
Show All/
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire Last Status Source Destination Type Color Time(sec) Periodic Num Edit
In Progress PC1 PC3 ICMP 0.000 N 0 (ed

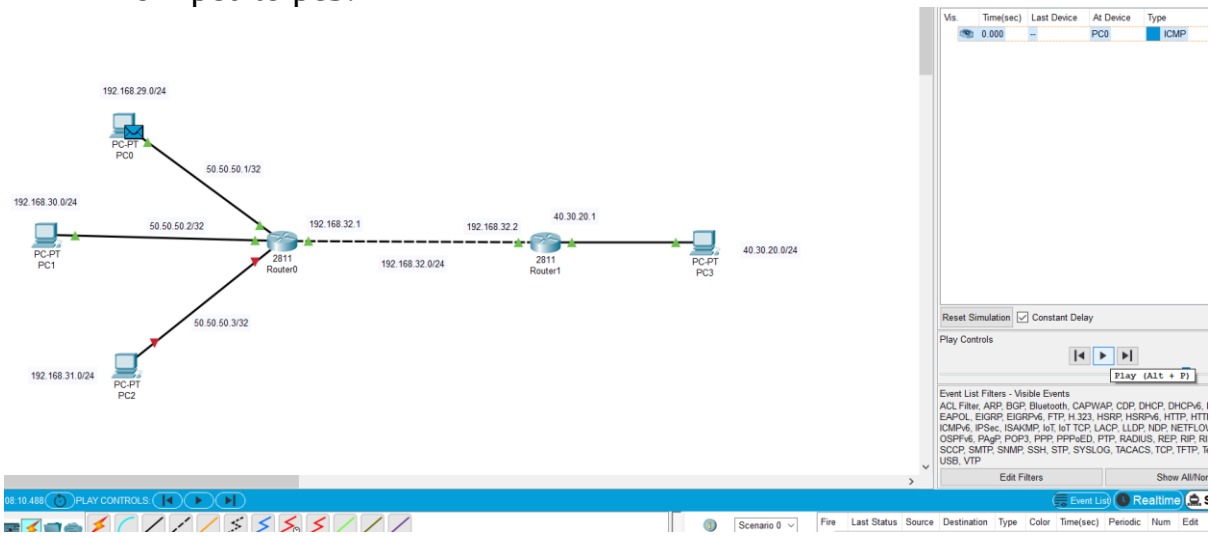

192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
PC-PT
PC1
192.168.32.1
2811
Router0
192.168.32.2
40.30.20.1
2811
Router1
PC-PT
PC3
40.30.20.0/24
192.168.32.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Event List
Vis. Time(sec) Last Device At Device Type
0.000 -- PC1 ICMP
0.001 PC1 Router0 ICMP
0.002 Router0 Router1 ICMP
0.003 Router1 PC3 ICMP
Reset Simulation
Constant Delay
Capture
Play Controls
Event List Filters - Visible Events
ACL Filter, ARP, BGP, Bluetooth, CAPWAP, CDP, DHCP, DHCPv6, DNS, DTP
EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP, HTTPS, ICMP
ICMPv6, IPSec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NETFLOW, NTP, O
OSPFv6, PAgP, POP3, PPP, PPPoED, PTP, RADIUS, REP, RIP, RIPng, RTP,
SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFTP, Telnet, UDP
USB, VTP
Edit Filters
Show All/None

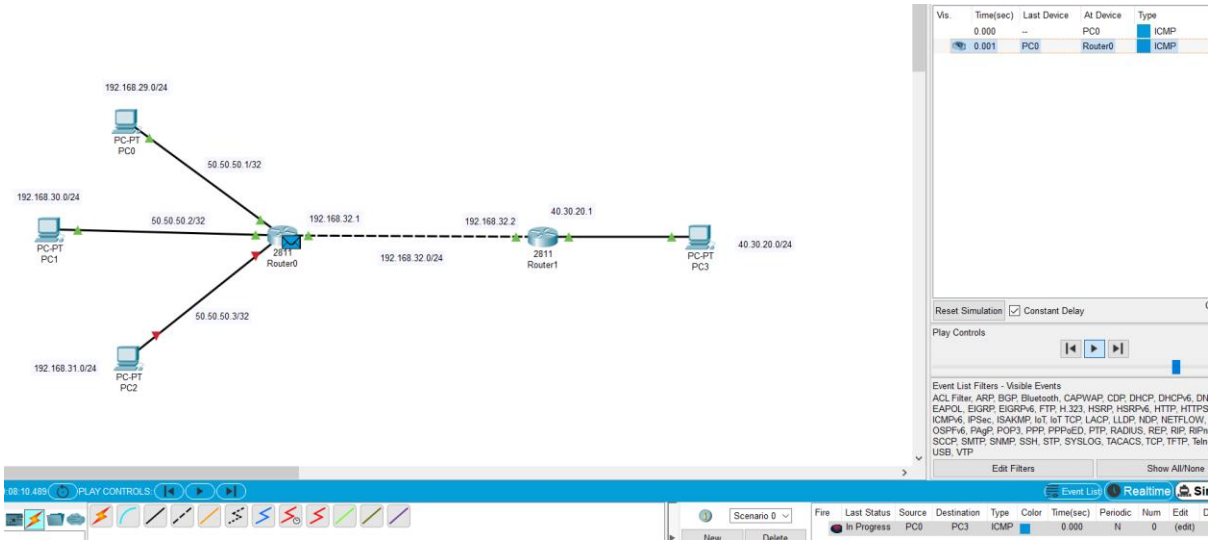

192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
PC-PT
PC1
192.168.32.1
2811
Router0
192.168.32.2
40.30.20.1
2811
Router1
PC-PT
PC3
40.30.20.0/24
192.168.32.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Event List
Vis. Time(sec) Last Device At Device Type
0.000 -- PC1 ICMP
0.001 PC1 Router0 ICMP
0.002 Router0 Router1 ICMP
0.003 Router1 PC3 ICMP
0.004 PC3 Router1 ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
ACL Filter, ARP, BGP, Bluetooth, CAPWAP, CDP, DHCP, DHCPv
EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP, H
ICMPv6, IPSec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NETFL
OSPFv6, PAgP, POP3, PPP, PPPoED, PTP, RADIUS, REP, RIP,
SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFTP
USB, VTP
Edit Filters
Show All/
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire Last Status Source Destination Type Color Time(sec) Periodic Num Edit
In Progress PC1 PC3 ICMP 0.000 N 0 (ed

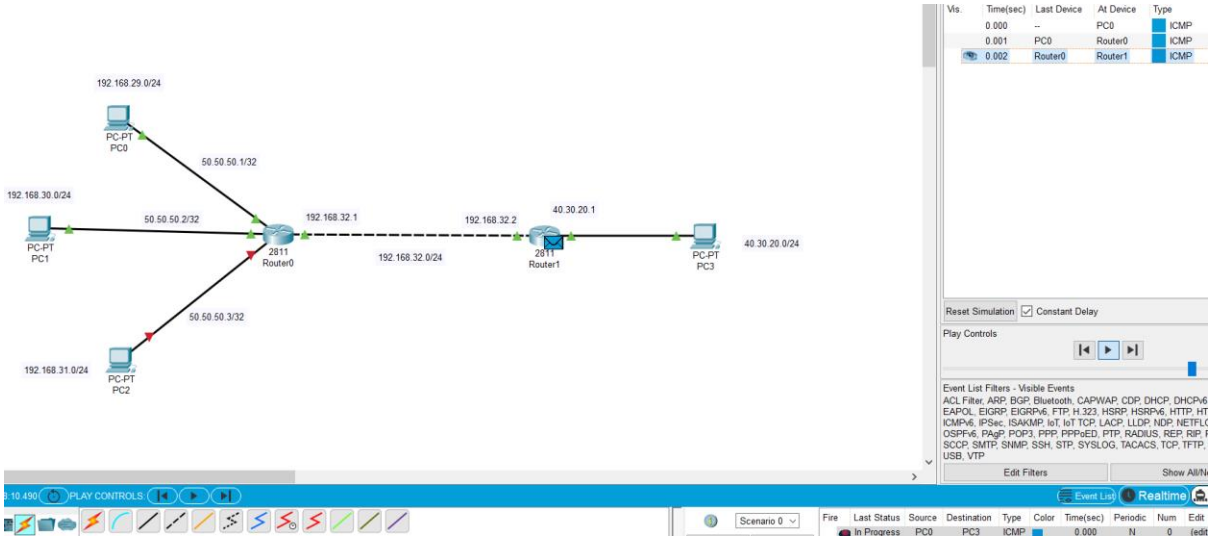


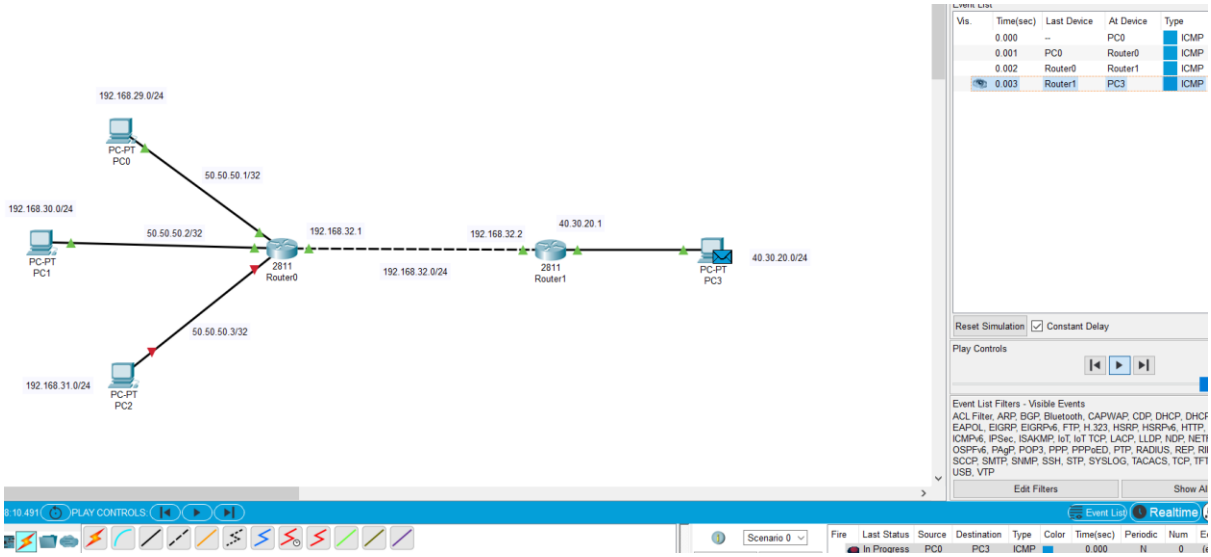


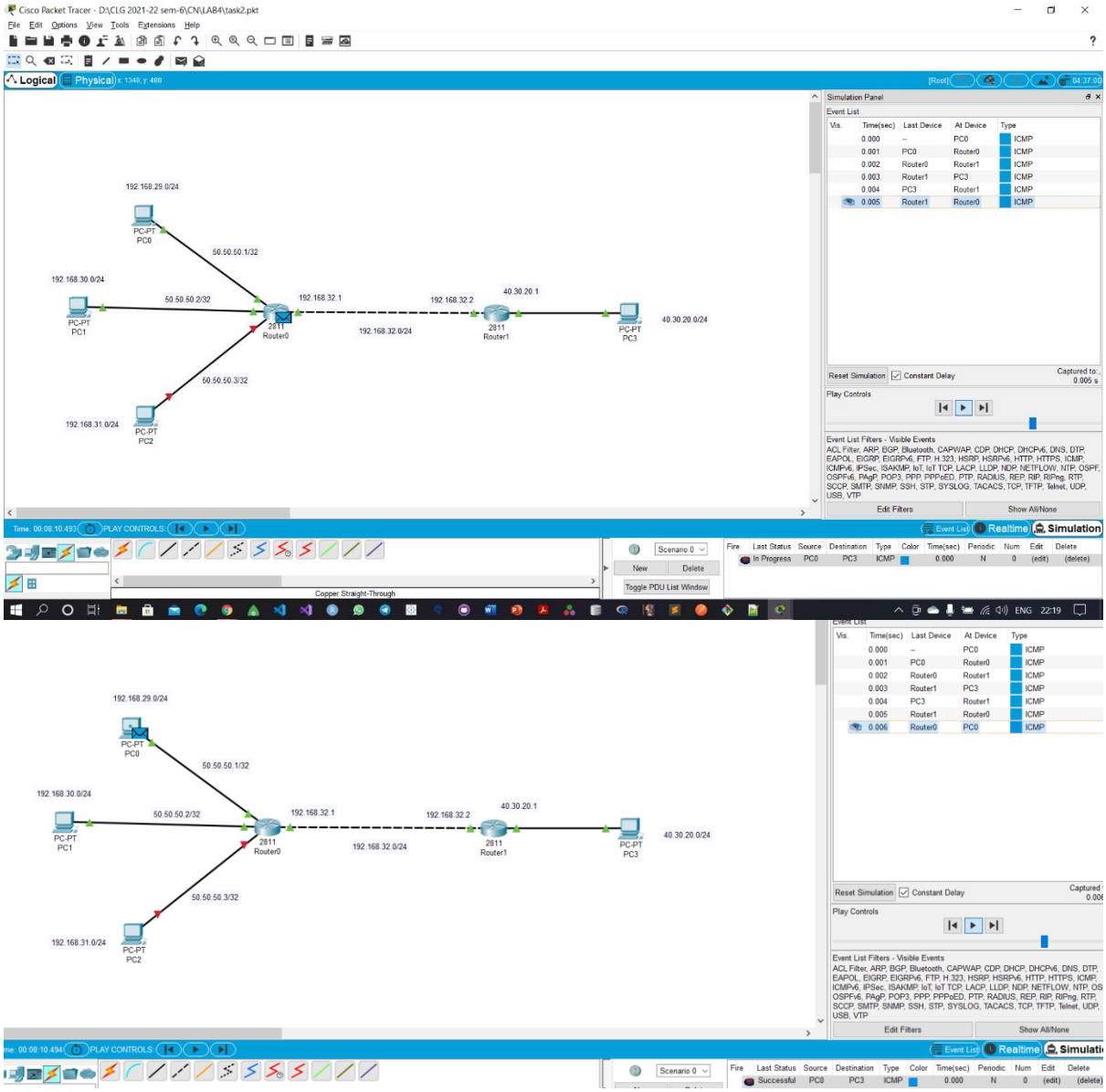
- From pc0 to pc3:-



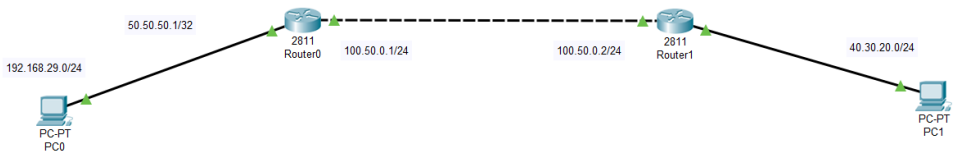

192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
192.168.32.1
192.168.32.2
40.30.20.1
PC-PT
PC1
2811
Router0
192.168.32.0/24
2811
Router1
PC-PT
PC3
40.30.20.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Vis. Time(sec) Last Device At Device Type
0.000 -- PC0 ICMP
0.001 PC0 Router0 ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
ACL Filter, ARP, BGP, Bluetooth, CAPWAP, CDP, DHCP, DHCPv6, DN
EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP, HTTPS
ICMPv6, IPSec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NETFLOW,
OSPFv6, PAgP, POP3, PPP, PPPoED, PTP, RADIUS, REP, RIP, RIPn
SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFTP, Teln
USB, VTP
Edit Filters
Show All/None
PLAY CONTROLS:
Event List
Realtime
Scenario 0
New
Delete
Fire Last Status Source Destination Type Color Time(sec) Periodic Num Edit
In Progress PC0 PC3 ICMP 0.000 N 0 (edit)

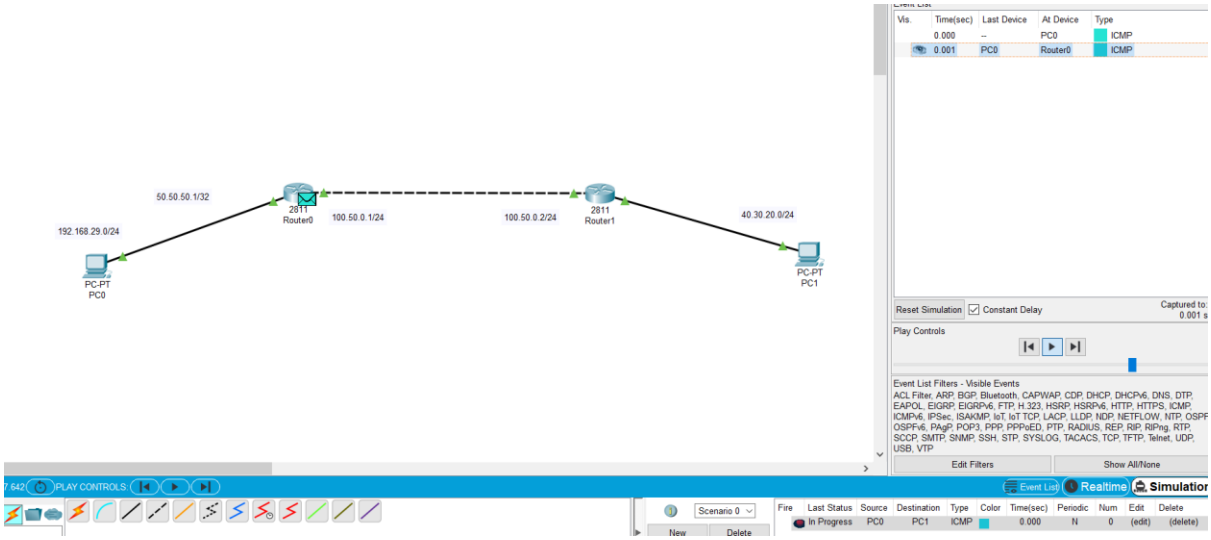

192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
192.168.32.1
192.168.32.2
40.30.20.1
PC-PT
PC1
2811
Router0
192.168.32.0/24
2811
Router1
PC-PT
PC3
40.30.20.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Vis. Time(sec) Last Device At Device Type
0.000 -- PC0 ICMP
0.001 PC0 Router0 ICMP
0.002 Router0 Router1 ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
ACL Filter, ARP, BGP, Bluetooth, CAPWAP, CDP, DHCP, DHCPv6
EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP, HT
ICMPv6, IPSec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NETFL
OSPFv6, PAgP, POP3, PPP, PPPoED, PTP, RADIUS, REP, RIP,
SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFTP,
USB, VTP
Edit Filters
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire Last Status Source Destination Type Color Time(sec) Periodic Num Edit
In Progress PC0 PC3 ICMP 0.000 N 0

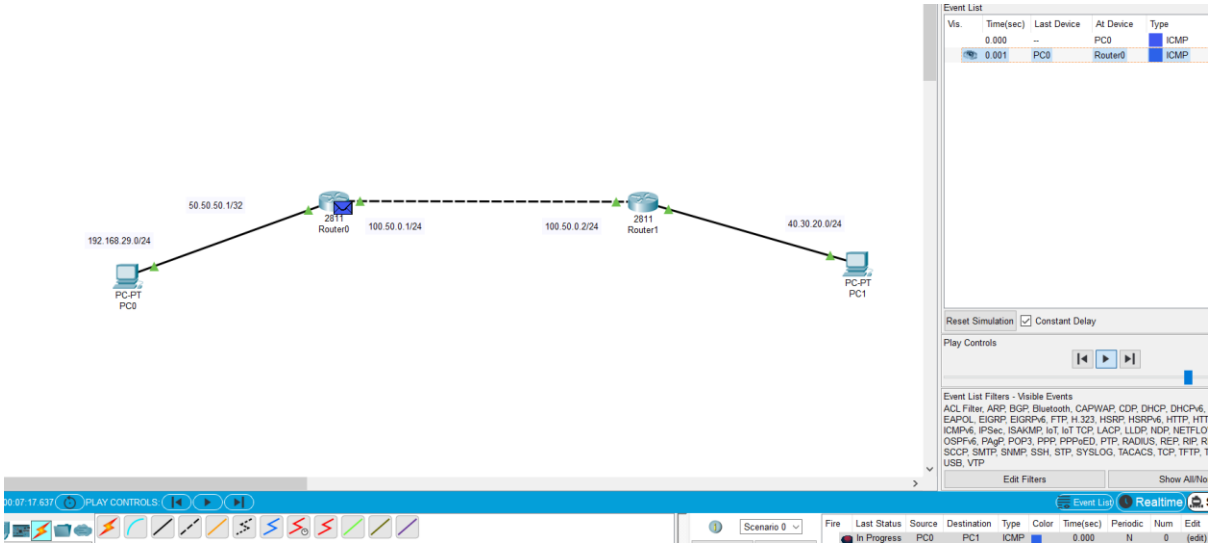

192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
192.168.32.1
192.168.32.2
40.30.20.1
PC-PT
PC1
2811
Router0
192.168.32.0/24
2811
Router1
PC-PT
PC3
40.30.20.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Vis. Time(sec) Last Device At Device Type
0.000 -- PC0 ICMP
0.001 PC0 Router0 ICMP
0.002 Router0 Router1 ICMP
0.003 Router1 PC3 ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
ACL Filter, ARP, BGP, Bluetooth, CAPWAP, CDP, DHCP, DHCP
EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP,
ICMPv6, IPSec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NET
OSPFv6, PAgP, POP3, PPP, PPPoED, PTP, RADIUS, REP, RI
SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFT
USB, VTP
Edit Filters
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire Last Status Source Destination Type Color Time(sec) Periodic Num
In Progress PC0 PC3 ICMP 0.000 N 0

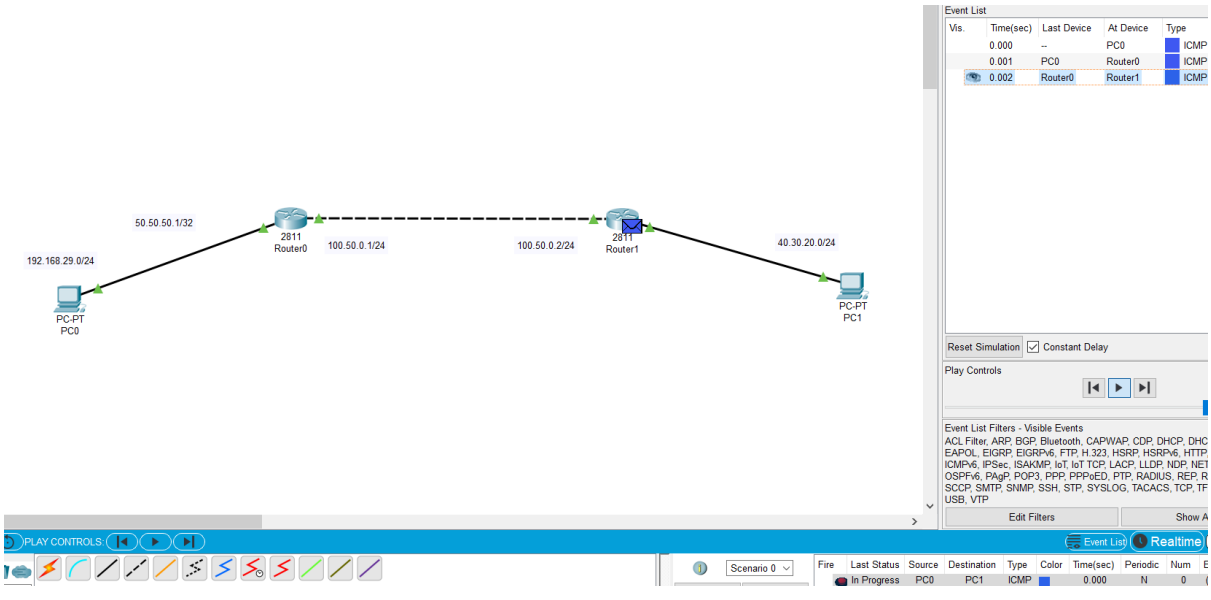

Cisco Packet Tracer - D:\CLG 2021-22 sem-6\CN\LAB4\task2.pkt
File Edit Options View Tools Extensions Help
Logical Physical
192.168.29.0/24
PC-PT PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
192.168.32.1
192.168.32.2
40.30.20.1
PC-PT PC1
2811 Router0
192.168.32.0/24
2811 Router1
PC-PT PC3
40.30.20.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT PC2
Simulation Panel
Event List
Vis. Time(sec) Last Device At Device Type
0.000 -- PC0 ICMP
0.001 PC0 Router0 ICMP
0.002 Router0 Router1 ICMP
0.003 Router1 PC3 ICMP
0.004 PC3 Router1 ICMP
0.005 Router1 Router0 ICMP
Reset Simulation Constant Delay
Play Controls
Event List Filters - Visible Events
ACL Filter, ARP, BGP, Bluetooth, CAPWAP, CDP, DHCP, DHCPv6, DNS, DTP, EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP, HTTPS, ICMP, ICMPv6, IPSec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NETFLOW, NTP, OSPF, OSPFv6, PAgP, POP3, PPP, PPPoED, PTP, RADIUS, REP, RIP, RIPng, RTP, SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFTP, Telnet, UDP, USB, VTP
Edit Filters Show All/None
Time: 00:08:10.493 PLAY CONTROLS:
Event List Realtime Simulation
Copper Straight-Through
Scenario 0 New Delete Toggle PDU List Window
Fire Last Status Source Destination Type Color Time(sec) Periodic Num Edit Delete
In Progress PC0 PC3 ICMP 0.000 N 0 (edit) (delete)
ENG 22:19
192.168.29.0/24
PC-PT PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
192.168.32.1
192.168.32.2
40.30.20.1
PC-PT PC1
2811 Router0
192.168.32.0/24
2811 Router1
PC-PT PC3
40.30.20.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT PC2
0.006 Router0 PC0 ICMP
Reset Simulation Constant Delay
Play Controls
Event List Filters - Visible Events
Edit Filters Show All/None
Time: 00:08:10.494 PLAY CONTROLS:
Scenario 0
Fire Last Status Source Destination Type Color Time(sec) Periodic Num Edit Delete
Successful PC0 PC3 ICMP 0.000 N 0 (edit) (delete)

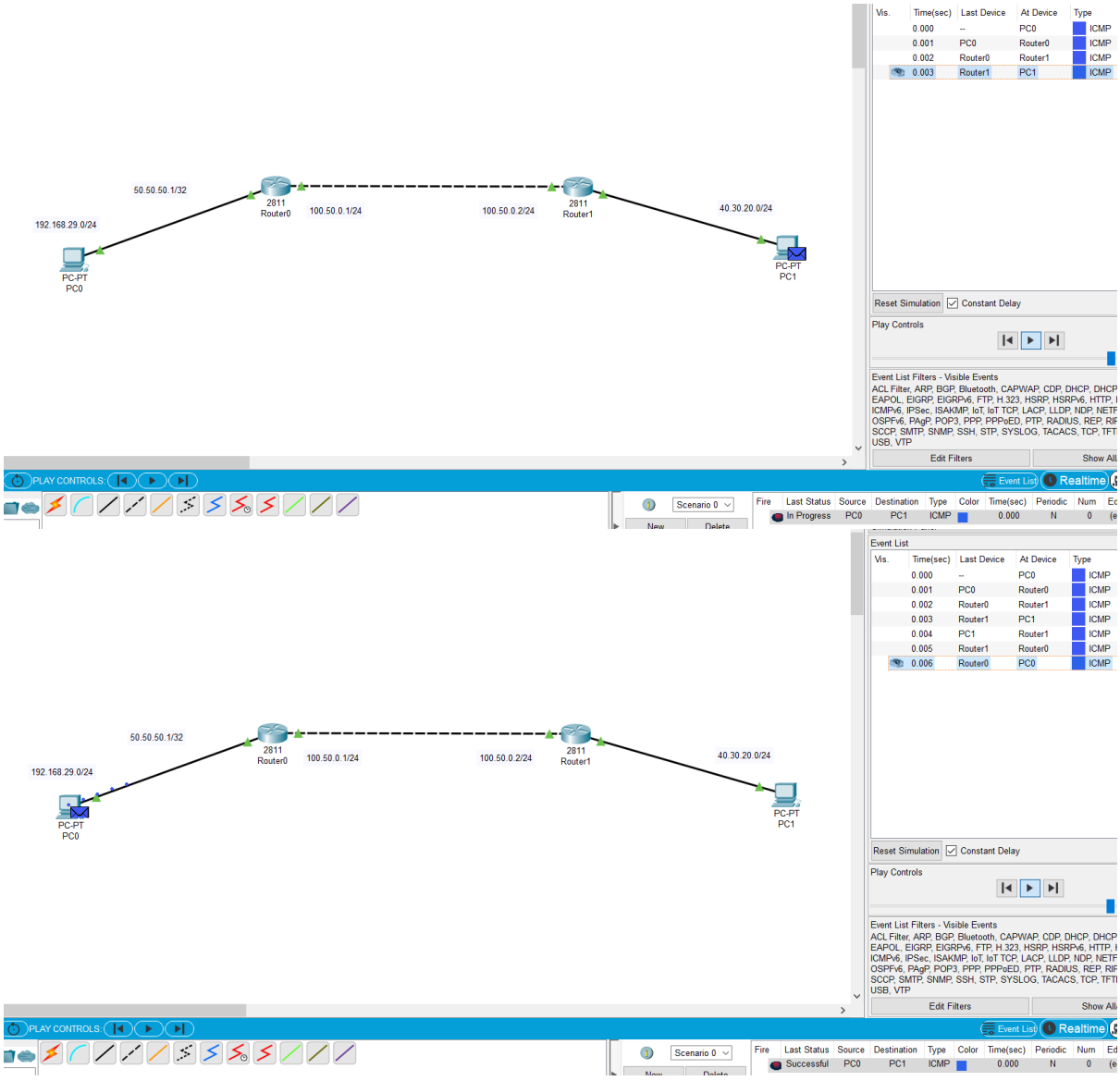
2. Network2:-


50.50.50.1/32
2811 Router0
100.50.0.1/24
100.50.0.2/24
2811 Router1
40.30.20.0/24
192.168.29.0/24
PC-PT PC0
PC-PT PC1

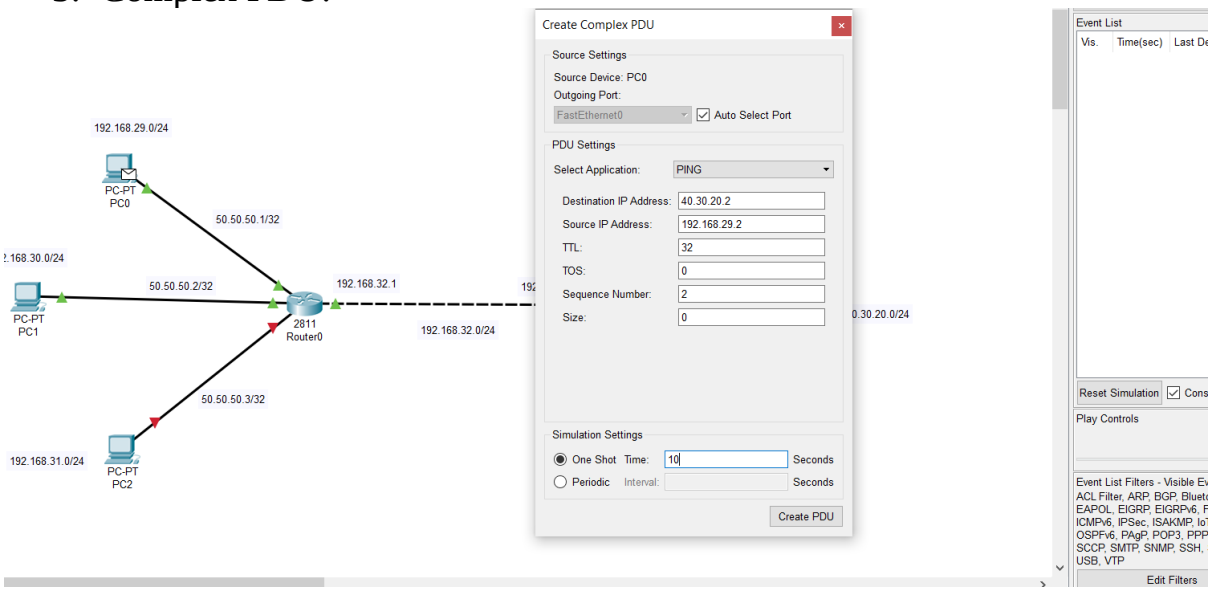

50.50.50.1/32
2811
Router0
100.50.0.1/24
100.50.0.2/24
2811
Router1
40.30.20.0/24
192.168.29.0/24
PC-PT
PC0
PC-PT
PC1
Vis.
Time(sec)
Last Device
At Device
Type
0.000
--
PC0
ICMP
0.001
PC0
Router0
ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
Edit Filters
Show All/None
PLAY CONTROLS:
Event List
Realtime
Simulation
Scenario 0
New
Delete
Fire
Last Status
Source
Destination
Type
Color
Time(sec)
Periodic
Num
Edit
Delete
In Progress
PC0
PC1
ICMP
0.000
N
0
(edit)
(delete)

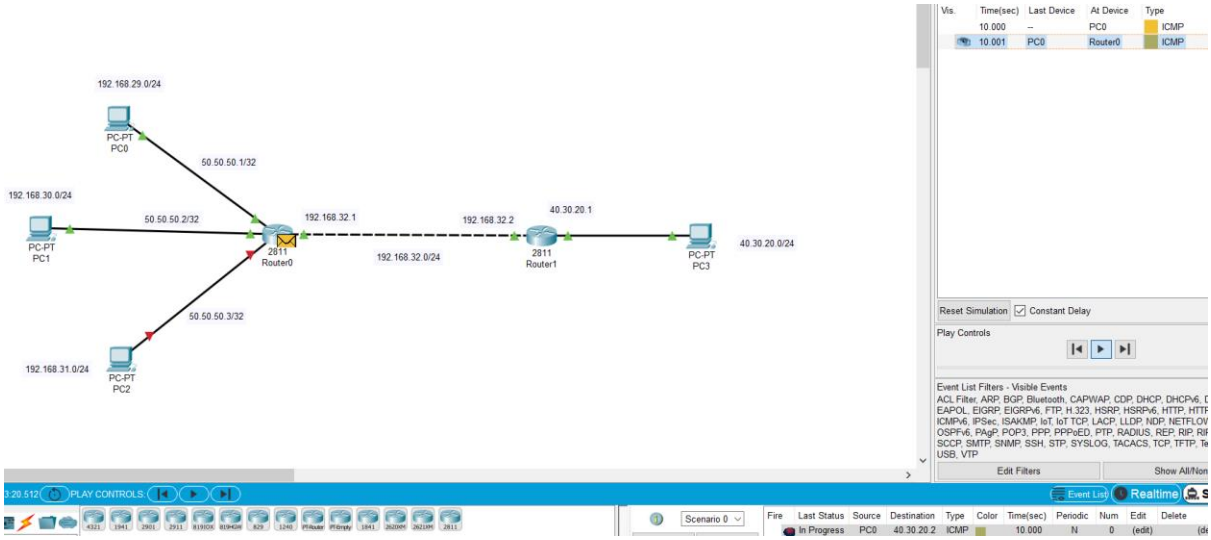

50.50.50.1/32
2811
Router0
100.50.0.1/24
100.50.0.2/24
2811
Router1
40.30.20.0/24
192.168.29.0/24
PC-PT
PC0
PC-PT
PC1
Event List
Vis.
Time(sec)
Last Device
At Device
Type
0.000
--
PC0
ICMP
0.001
PC0
Router0
ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
Edit Filters
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire
Last Status
Source
Destination
Type
Color
Time(sec)
Periodic
Num
Edit
In Progress
PC0
PC1
ICMP
0.000
N
0
(edit)

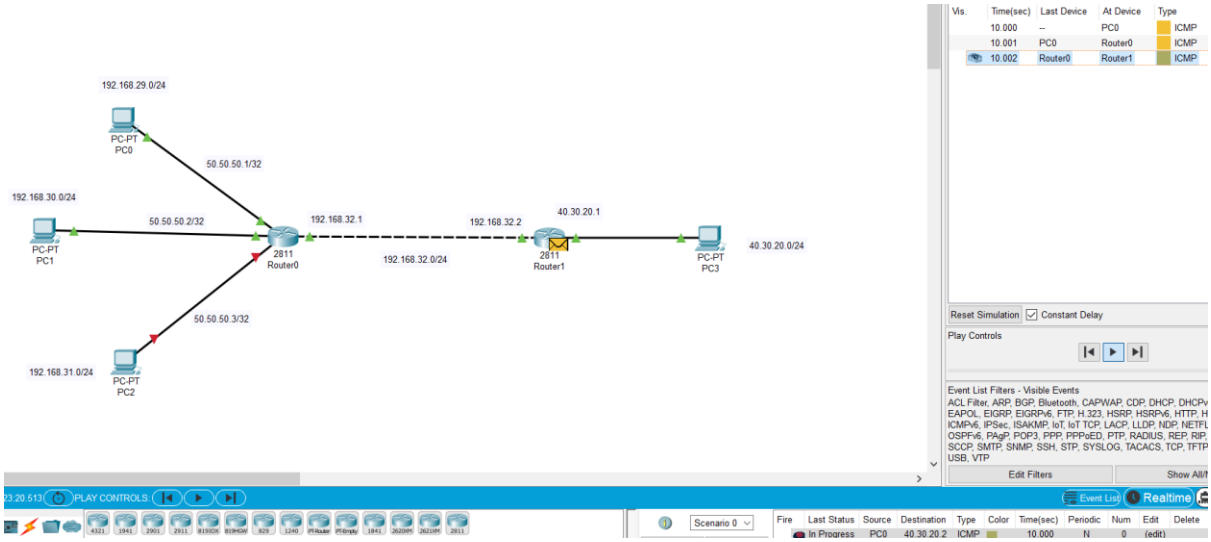

50.50.50.1/32
2811
Router0
100.50.0.1/24
100.50.0.2/24
2811
Router1
40.30.20.0/24
192.168.29.0/24
PC-PT
PC0
PC-PT
PC1
Event List
Vis.
Time(sec)
Last Device
At Device
Type
0.000
--
PC0
ICMP
0.001
PC0
Router0
ICMP
0.002
Router0
Router1
ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
Edit Filters
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire
Last Status
Source
Destination
Type
Color
Time(sec)
Periodic
Num
In Progress
PC0
PC1
ICMP
0.000
N
0

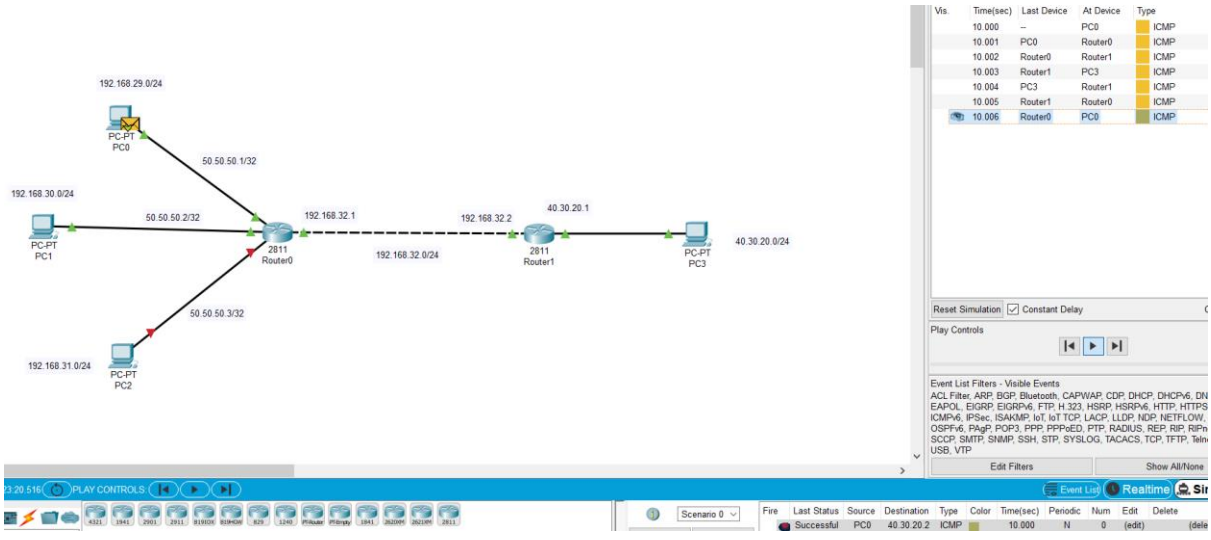


3. Complex PDU:-




192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
192.168.32.1
192.168.32.2
40.30.20.1
PC-PT
PC1
2811
Router0
192.168.32.0/24
2811
Router1
PC-PT
PC3
40.30.20.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Vis.
Time(sec)
Last Device
At Device
Type
10.000
--
PC0
ICMP
10.001
PC0
Router0
ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
Edit Filters
Show All/Non
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire
Last Status
Source
Destination
Type
Color
Time(sec)
Periodic
Num
Edit
Delete
In Progress
PC0
40.30.20.2
ICMP
10.000
N
0
(edit)


192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
192.168.32.1
192.168.32.2
40.30.20.1
PC-PT
PC1
2811
Router0
192.168.32.0/24
2811
Router1
PC-PT
PC3
40.30.20.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Vis.
Time(sec)
Last Device
At Device
Type
10.000
--
PC0
ICMP
10.001
PC0
Router0
ICMP
10.002
Router0
Router1
ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
Edit Filters
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire
Last Status
Source
Destination
Type
Color
Time(sec)
Periodic
Num
Edit
Delete
In Progress
PC0
40.30.20.2
ICMP
10.000
N
0
(edit)


192.168.29.0/24
PC-PT
PC0
50.50.50.1/32
192.168.30.0/24
50.50.50.2/32
192.168.32.1
192.168.32.2
40.30.20.1
PC-PT
PC1
2811
Router0
192.168.32.0/24
2811
Router1
PC-PT
PC3
40.30.20.0/24
50.50.50.3/32
192.168.31.0/24
PC-PT
PC2
Vis.
Time(sec)
Last Device
At Device
Type
10.000
--
PC0
ICMP
10.001
PC0
Router0
ICMP
10.002
Router0
Router1
ICMP
10.003
Router1
PC3
ICMP
10.004
PC3
Router1
ICMP
10.005
Router1
Router0
ICMP
10.006
Router0
PC0
ICMP
Reset Simulation
Constant Delay
Play Controls
Event List Filters - Visible Events
Edit Filters
Show All/None
PLAY CONTROLS:
Event List
Realtime
Scenario 0
Fire
Last Status
Source
Destination
Type
Color
Time(sec)
Periodic
Num
Edit
Delete
Successful
PC0
40.30.20.2
ICMP
10.000
N
0
(edit)

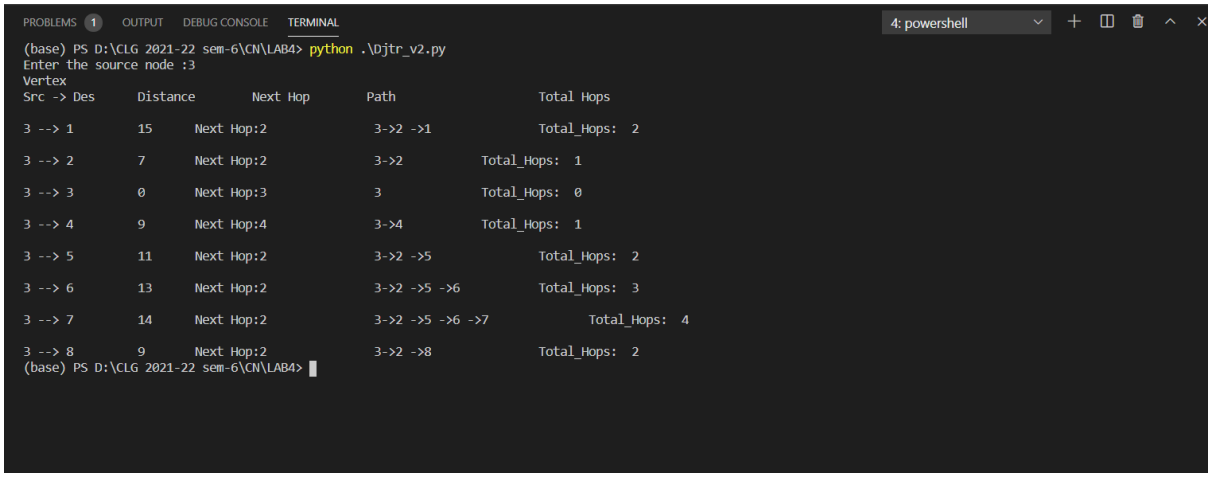
4. Dijkstra Algorithm:-

Code:-

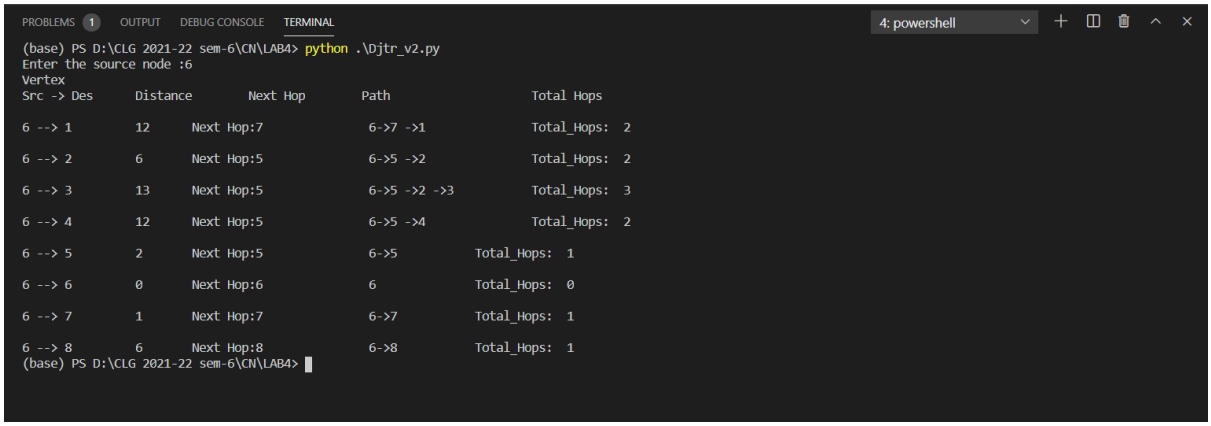
```
'''
Author : Dhruv B kakadiya

'''
class Graph:
    def min_distance(self, dist, queue):
        minimum = float("Inf")
        min_index = -1
        for i in range(len(dist)):
            if ((dist[i] < minimum) and (i in queue)):
                minimum = dist[i]
                min_index = i
        return min_index

    # print path from source to all node reccursively
    def printPath(self, parent, j):
        if (parent[j] == -1):
            print(j)
            return
        self.printPath(parent, parent[j])
        print(j)

    # for printing solution for shortest path
    def printSolution(self, dist, parent):
        src = self.src
        print("Vertex \t\t\nSrc -
> Des\tDistance\tNext Hop\tPath\t\t\tTotal Hops")
        for i in range(1, len(dist)):
            print("\n%d --> %d \t%d\t" % (src, i, dist[i]), end = "")
            if(dist[i] != float('inf')):
                temp_path = []
                temp_path_string = ""
                currentNode = i
                hop_count = 0
                while(currentNode != src and currentNode >= 0 ):
                    hop_count += 1
                    temp_path.insert(0, currentNode)
                    temp_path_string = str(currentNode) + " -
>" +  temp_path_string
                    currentNode = parent[currentNode]
                if(i == src):
                    temp_path.insert(0, src)
                temp_path_string = str(src) + "->" + temp_path_string
                temp_path_string = temp_path_string[ : -2]
```

```
                print(f"Next Hop:{temp_path[0]}\t\t", temp_path_string, "\t\tT
otal_Hops: ", hop_count)

    def dijkstra(self, graph, src):
        self.src = src
        row = len(graph)
        col = len(graph[0])
        dist = [float("Inf")] * row
        parent = [-1] * row
        dist[src] = 0
        queue = []
        for i in range(row):
            queue.append(i)
        while (queue):
            u = self.min_distance(dist,queue)
            queue.remove(u)
            for i in range(col):
                if ((graph[u][i]) and (i in queue)):
                    if (dist[u] + graph[u][i] < dist[i]):
                        dist[i] = dist[u] + graph[u][i]
                        parent[i] = u
        self.printSolution(dist,parent)

g= Graph()

graph = [[0, 4, 0, 0, 0, 0, 0, 8, 0],
        [4, 0, 8, 0, 0, 0, 0, 11, 0],
        [0, 8, 0, 7, 0, 4, 0, 0, 2],
        [0, 0, 7, 0, 9, 14, 0, 0, 0],
        [0, 0, 0, 9, 0, 10, 0, 0, 0],
        [0, 0, 4, 14, 10, 0, 2, 0, 0],
        [0, 0, 0, 0, 0, 2, 0, 1, 6],
        [8, 11, 0, 0, 0, 0, 1, 0, 7],
        [0, 0, 2, 0, 0, 0, 6, 7, 0]
        ]

# Print the solution
src = int(input("Enter the source node :"))
g.dijkstra(graph,src)
```

- Output:-



```
PROBLEMS 1  OUTPUT  DEBUG CONSOLE  TERMINAL                                  4: powershell
(base) PS D:\CLG 2021-22 sem-6\CN\LAB4> python .\Djtr_v2.py
Enter the source node :3
Vertex
Src -> Des      Distance        Next Hop        Path                    Total Hops

3 --> 1         15      Next Hop:2              3->2 ->1                Total_Hops:  2

3 --> 2         7       Next Hop:2              3->2            Total_Hops:  1

3 --> 3         0       Next Hop:3              3               Total_Hops:  0

3 --> 4         9       Next Hop:4              3->4            Total_Hops:  1

3 --> 5         11      Next Hop:2              3->2 ->5                Total_Hops:  2

3 --> 6         13      Next Hop:2              3->2 ->5 ->6            Total_Hops:  3

3 --> 7         14      Next Hop:2              3->2 ->5 ->6 ->7                Total_Hops:  4

3 --> 8         9       Next Hop:2              3->2 ->8                Total_Hops:  2
(base) PS D:\CLG 2021-22 sem-6\CN\LAB4>
```



```
PROBLEMS 1  OUTPUT  DEBUG CONSOLE  TERMINAL                                  4: powershell
(base) PS D:\CLG 2021-22 sem-6\CN\LAB4> python .\Djtr_v2.py
Enter the source node :6
Vertex
Src -> Des      Distance        Next Hop        Path                    Total Hops

6 --> 1         12      Next Hop:7              6->7 ->1                Total_Hops:  2

6 --> 2         6       Next Hop:5              6->5 ->2                Total_Hops:  2

6 --> 3         13      Next Hop:5              6->5 ->2 ->3            Total_Hops:  3

6 --> 4         12      Next Hop:5              6->5 ->4                Total_Hops:  2

6 --> 5         2       Next Hop:5              6->5            Total_Hops:  1

6 --> 6         0       Next Hop:6              6               Total_Hops:  0

6 --> 7         1       Next Hop:7              6->7            Total_Hops:  1

6 --> 8         6       Next Hop:8              6->8            Total_Hops:  1
(base) PS D:\CLG 2021-22 sem-6\CN\LAB4>
```